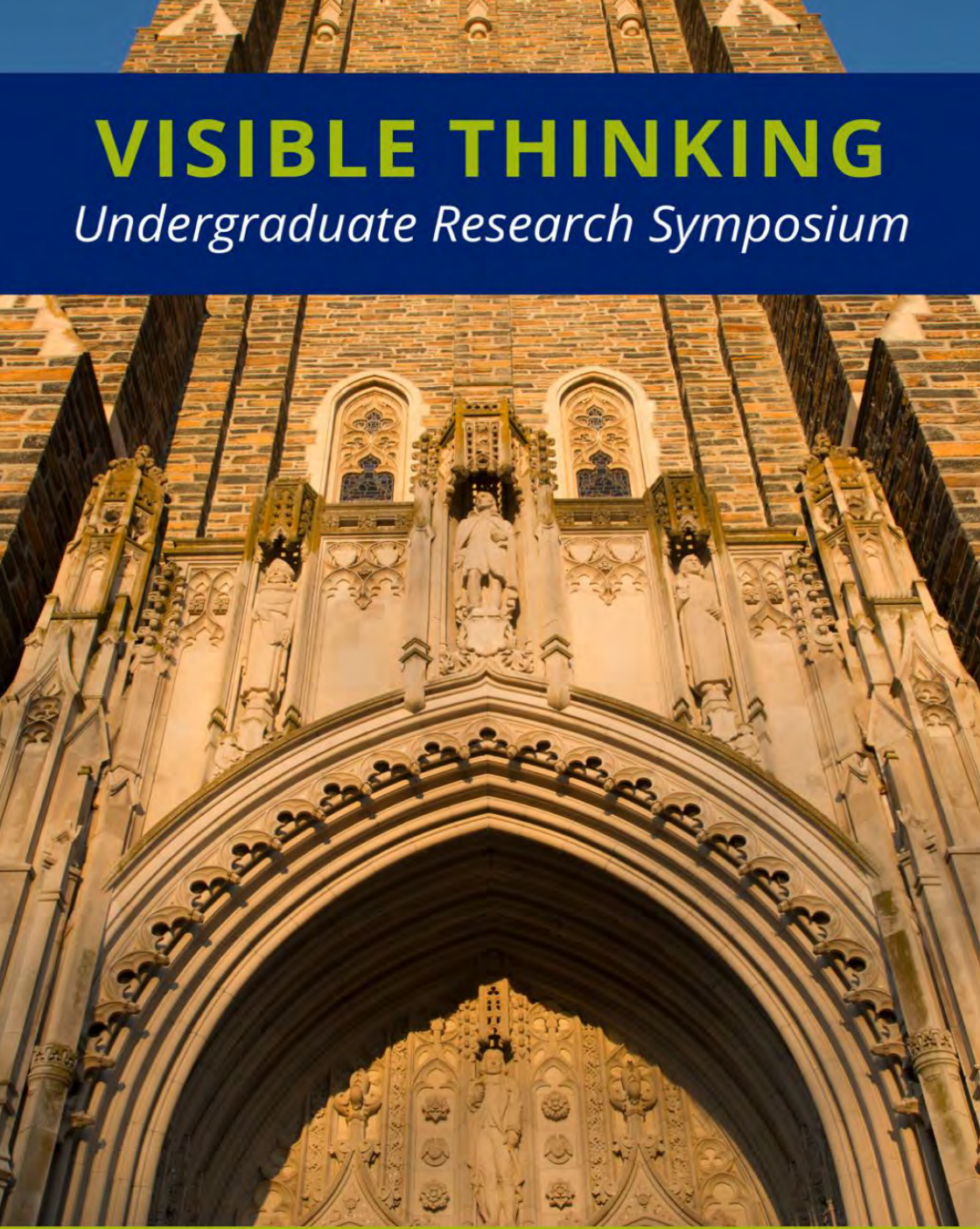
VISIBLE THINKING

Undergraduate Research Symposium



Duke UNIVERSITY | UNDERGRADUATE RESEARCH SUPPORT OFFICE

VISIBLE THINKING

Visible Thinking is a program of:
The Undergraduate Research Support Office
Trinity College of Arts & Sciences at Duke University

Dr. Sarah Russell, Director
McCall Calloway, Program Coordinator
Olivia Morales, Student Support

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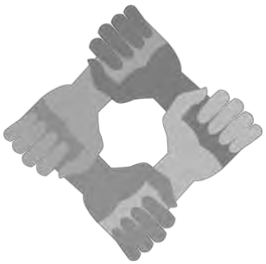
COMMUNITY- ENGAGED RESEARCH

Throughout this book, you will see abstracts with the symbol below. This identifies projects as Community-engaged Research.



Community-engaged Research (CER) projects have met some combination of the following 4 criteria:

- There were conversations with the community on the purposes of the CER.
- There was collaboration in the design of the project with a community partner.
- There was collaboration in the implementation of the project with a community partner.
- There will be public dissemination of the results of the CER.

Investigating Sexual Assault Related Tonic Immobility and PTSD Development

Carolyn Bell
Faculty Mentor: David Rubin
Behavioral Sciences/Psychology

Freezing in response to threat is a biological reality. It is an automatic, primitive response, which occurs across species and affects the nervous system through well-studied, understood neurobiological mechanisms. It occurs when an animal is in danger and has no means of escaping or overpowering a predator. This response occurs in humans when they are confronted with interpersonal danger or threat, with no clear route to escape or overpower their attacker. Sexual assault is a specific type of interpersonal threat that includes all of the factors necessary to induce a state of tonic immobility; personal contact or restraint, eye contact, extreme proximity of threat, and fear. When tonic immobility is induced under attack, the individual is unable to move or speak, while maintaining fully alert consciousness. The individual is helpless to protect themselves, while preserving the ability to vividly encode a memory of the attack and their response. This behavioral response leads to enhanced self-blame and elevated PTSD symptom severity in individuals who engage tonic immobility during a sexual assault. Without understanding what, how, or why they froze, survivors with tonic immobility experience are difficult to treat with classical post trauma treatment methods, which are still being adapted as new PTSD development and treatment models become available. General expectations and personal experiences regarding traumatic event responses and post trauma outcomes were assessed in a general population of 400 individuals using a multiple scale questionnaire and multivariate analysis. The findings indicate that the degree of peritraumatic tonic immobility is positively correlated with the severity of each included post trauma outcome measure. Further exploration is necessary to determine if sexual assault survivors with tonic immobility experience attribute a consistent pattern of post trauma symptoms (e.g. self-blame) to the their tonic immobility reaction, as compared to the assault itself.

Investigating the Neural Mechanisms by which Mind-Wandering Impacts Prospective Memory

Shreya Bhatia
Faculty Mentor: Marty Woldorff
Behavioral Sciences/Psychology

Prospective memory (PM) is an important and widely employed form of memory that entails remembering to perform a future task. Failure of any of the neurocognitive processes underlying prospective memory can lead to a PM error, which can have varying degrees of severity, depending on the task. This thesis study investigates the impact of perceived value on PM. Subjects performed a computer-based, vigilance task while EEG measures of their brain activity were being recorded. In particular, to simulate a real-life scenario, participants acted as cafeteria staff members serving lunches to students, after they had learned which students required which type of lunch. In the main vigilance task, subjects were presented with the student faces and pressed a button to serve a standard lunch to the majority of students, but a subset of students required either a dairy-free or peanut-free lunch. Participants pressed a different button to deliver the specialized lunches to those students, with the consequence of an error being either a stomachache (moderate consequence, dairy problem) or an allergic reaction (severe consequence, peanut problem). The high temporal resolution of EEG allowed us to analyze the cascade of neural activity that is associated with PM. The results of this study will advance our understanding of the mechanisms underlying perceived value differences and how they impact our ability to successfully perform PM tasks in everyday life. We found significant differences between the response times and response accuracies between the standard conditions and the conditions with assigned consequences. EEG analysis showed a positive-polarity deflection (200-400 ms) after the onset of a PM cue, which was interpreted as a neural indicator of detecting a previously learned cue. A later positive deflection, termed the parietal positivity, showed distinct differences between the value conditions, indicating the highest allocation of cognitive resources for the severe consequence condition.

Digital Neurointerventions: Self efficacy, Subclinical Depression, and Motivating Physical Activity

Melanie Camejo Coffigny
Faculty Mentors: Gregory Samanez-Larkin and Jaime Castrellon
Behavioral Sciences/Psychology

Most people understand the positive effects of frequent physical activity, as well as the negative consequences of leading a sedentary life. However, even when aiming for the former, they continue to struggle with being motivated to be physically active. Previous research suggests that both motivation for health rewards and perceived self-efficacy differ between individuals with symptoms of subclinical depression compared to healthier populations. This study uses neuromarketing to optimize mobile digital health messages aimed at increasing physical activity by examining whether individual differences in depressive symptoms moderated the associations between self-efficacy and physical activity. Thirty-two participants (varying from none to many symptoms of subclinical depression according to Beck Depression Inventory, BDI) answered daily surveys on their mood and self-efficacy, defined as their confidence in increasing their daily physical activity, over a course of three months. Wrist-mounted activity trackers were used to collect data on daily steps and activity intensity. Two weeks into the study, participants viewed and made motivation ratings on 80 statements about physical activity while undergoing fMRI. These messages were then delivered one per day for the next 80 days while participants wore the activity trackers. To examine initial individual differences related to depression and self-efficacy, we used the activity tracking and daily survey data in a series of linear mixed models. We used random intercepts for participants and analyzed the interaction between self-efficacy and BDI score on physical activity. Higher self-efficacy (“How confident are you in your ability to increase your daily physical activity?”) was positively correlated with step count, $t = 9.89$, $p < .001$. Individuals with higher self-efficacy had a higher step count. The relationship between daily self- efficacy and steps was dependent on BDI score, $t = –4.89$, $p < .001$. Individuals with low BDI scores showed the strongest benefits of self-efficacy on physical activity. The benefits of self- efficacy on daily physical activity were weaker in those with higher levels of depressive symptoms. Thus, although BDI scores were not significantly associated with physical activity (steps), $t= -1.88$, $p = 0.071$, higher levels of perceived self-efficacy were associated with higher levels of physical activity.

50 Shades of Talk: Investigating Racial and Cultural Differences in College Students' Verbal and Nonverbal Communication Styles

Alexandra Chan
Faculty Mentors: Makeba Wilbourn, Stephen Gibson and Sascha Enders
Behavioral Sciences/Psychology

In our lifetime, on average, we can interact with and communicate with anywhere between 1,000 to 80,000 people. Despite where you fall in that range, you communicate with others almost every day of your life. The United States is exponentially increasing in racial and cultural diversity, making interracial communication an unavoidable aspect of life (Chappell, 2017). Now, more than ever, it is salient to understand how people within and outside of our own racial group communicate; we can foster both connections with others, as well as a less prejudiced and a more equitable society. The current study is a three-way cross-cultural investigation of Asian-American, Black, and White identifying college students' verbal communication—operationalized as story themes—and nonverbal communication styles—operationalized as gestures. Participants were asked to tell an emotionally salient experience that had occurred while in college. Their stories were video-recorded, transcribed, and later coded for 26 different story themes, which include identity related, experiences, and relationships/emotions and 5 gesture styles, which include metaphoric, affectual, and beats. I predict I will find significant communication differences on the basis of race. These findings will help to inform future generations of diverse college students and the ways in which they communicate and connect with each other.

Gender Euphoria in Transgender Adults

Kyra Citron
Faculty Mentors: Nancy Zucker, Samuel Marsan and Janie Long
Behavioral Sciences/Psychology

"We shouldn't call ourselves gender dysphoric—that's negative—be gender euphoric—happy, with euphoria" (Rupard, 1987). Virginia Prince, a transgender author and organizer, coined the term gender euphoria in opposition to medicine's emphasis on the negative experience of gender and the later psychiatric diagnosis of gender dysphoria. While gender dysphoria has a clear definition and criteria, what is gender euphoria? Through an online survey of transgender adults, this study aims to discern an understanding an experience of gender euphoria through the qualitative responses of participants; propose a definition of gender euphoria and assess individuals relative agreement and refinement of this definition to better inform this experience, and examination associations of the experience of gender euphoria with individual choices regarding the management of gender dysphoria. An interdisciplinary literature review of gender euphoria informed a preliminary definition and proposed constituents of gender euphoria—positive affect, gender belonging, and authentic self— that were assessed for individual agreement. Looking to clarify debates on this term, we hypothesize that gender euphoria a) is not significantly correlated with gender dysphoria supporting the independence of these dimensions and (b) is not associated with desire to receive trans-affirming medical care. Finally, we hypothesize that gender euphoria will be associated with positive trans identity. With approximately 400 participants, of various transgender identity and ages ranging from 18 to 70 (skewing younger), this is the first psychological research study on gender euphoria.

An Experimental Study of the Impact of Smartphones on Classroom Enjoyment, Attention, and Learning // The Effects of Joint Attention to Auditory Stimuli on Affiliation

Kayley Dotson
Faculty Mentor: Bridgette Hard
Behavioral Sciences/Psychology

How does being constantly connected to the internet through smartphones shape students' experiences in the classroom? We randomly assign students to view a lecture with or without their smartphones. We use a high-powered design to test whether, and to what degree, access to smartphones in the classroom affects attention, enjoyment, and learning. This project examines a basic claim that is supported by several theoretical perspectives and abundant empirical laboratory research: Exogenous distractions (e.g., a buzz or sudden light flash in the environment) undermine attention and subsequent memory. We explore the implications of this basic effect in a naturalistic setting by asking how the presence of phones in the classroom affects students' attention and learning during a lecture. Smartphones can be distracting, and in social settings, they have been shown to undermine how much we enjoy our social experiences. For example, people who had smartphones out and on during a shared meal (compared to those whose phones were away and silenced), reported more distraction and less enjoyment of the social experience. If these effects extend to a lecture setting, students' learning may be undermined by the presence of their smartphones. Our study tests whether past research would replicate and extend from face-to-face interaction to a classroom environment. Crucially, our study will be preregistered, yielding insights regardless of whether there is or there is not an effect of smartphones on student outcomes.

Children have been found to be more more likely to affiliate when jointly attending to a stimulus. However, in previous research, children were actively engaging with visual stimuli, thus not exploring the effect of auditory stimuli. The present study seeks to discover if listening to music increases a child's likelihood to affiliate with an unknown other. In a 2x2 design, participants experience a condition with or without music and with or without an adult experimenter in the room for the first part of the study. An adult experimenter either then enters to play with toys or moves to the other side of the room to play with toys. Participants are observed through an affiliation measure. We expect that children will be more likely to affiliate in the condition with both music and the experimenter.

Investigating Weight Stigma in Hollywood

Holly Holder
Faculty Mentor: Nancy Zucker
Behavioral Sciences/Psychology

Throughout decades, the stars we admire on the big screen have also been the models we use to measure what is seen as beautiful, attractive, and good. From Marilyn Monroe's curves in the 1950s to emaciated Sports Illustrated models in the 1990s, who we see in film and photos have given us our current beauty standards, and in Hollywood "thin" has always been "in." Previous research has shown that most people view the thin body as ideal and also tend to equate attractiveness with being good and likable. Therefore, plus-sized actors have often been shunned from work. When they do get cast in a movie or TV show, their character is more often than not written specifically to be overweight. The argument from casting directors is "why take a chance" on someone who may not garner a fan cult around their image. However, there is a substantial lack of research in whether audience members would actually enjoy a movie or character less if the character was portrayed by an actor who doesn't perfectly fit Hollywood's thin beauty ideal. If countless studies show that the thin ideal has large impacts on body dissatisfaction and negative affect, then the inclusion of more diverse and relatable body types is worth our attention. This study includes a sample size of n=77 university students who took an anonymous online survey in which they were provided a movie plot summery and accompanying pictures of the leading actors. There were four randomized trials: the pictures of the male and female actors as is, the pictures photo-shopped to appear plus-sized, and two mixed conditions. Participants were asked questions about the movie's plot and interest as well as questions from the Body Dissatisfaction Subscale (BDS) of the Eating Disorder Inventory (EDI) and the Depression Anxiety Stress Scale (DASS-21). I predicted that there will be no significant difference in how participants answer movie-related questions, but if a difference is detected, higher body dissatisfaction may lead to a preference for thin actors

Empathy Across Demographics: Children's Perceptions of In-group and Out-group Members

Jiwon Julie Hwang
Faculty Mentor: Rita Svetlova
Behavioral Sciences/Psychology

This study aims to explore whether presenting groups in particular ways and helping children connect to characters on a personal level through learning about likes/dislikes could influence children's group preferences. Preschool children between the age range of 5 to 6 years are introduced to paper characters, some of whom belonged to the same arbitrary group as the child (in-group) and some who belonged to a different group (out-group). The study employs a two-by-two factorial design. In one between-subjects manipulation, children either receive neutral information about characters' preferences (Baseline condition), or are told that some characters across groups shared their characteristics and preferences (Similarity condition). In another between-subjects manipulation, the two groups are presented either in a competitive context (Competition condition) or in a neutral context (No-competition condition). Assessing children's attitudes toward both in-group and out-group characters will help discern differential effects of similarity and competition.

Freshmen Attitudes Towards Mental Health Treatment: The Effects of Psychoeducational Dialogues

Bruny Kenou
Faculty Mentors: Nancy Zucker and Savannah Erwin
Behavioral Sciences/Psychology

There is extensive research on the barriers that prevent people from seeking help when they are faced with mental illness issues. Fear of stigma from others, misinformation about the nature and positive treatment responses of individuals diagnosed with a psychiatric disorder, and inability to identify symptoms in oneself are some of the most prevalent factors that prevent people from seeking treatment that may be beneficial. The first year in college is a difficult developmental transition for young adults and can contribute to increased feelings of anxiety, stress, and mental health deterioration. Given the existing gap between prevalence of mental illnesses and utilization of mental health services, it is important to find ways to decrease negative attitudes towards help seeking. This study will be looking at whether reading psychoeducational dialogues between a mental health professional and patient changes attitudes towards seeking mental health help amongst freshman college students. Participants will be randomized into receiving one of three types of dialogues: one that focuses on the biological basis of mental disorders, one that focuses on destigmatizing mental illness by providing facts that contradict common myths, and one that combines the first two conditions. Changes in attitudes as well as individual factors (e.g., sex, race) that may moderate these attitudes will also be explored.

A Short Time to Play: Infant Language Development Across Activities, Gender and Race

Rebekah Lester
Faculty Mentor: Makeba Wilbourn
Behavioral Sciences/Psychology

On average, mothers spend about 10 minutes reading and hours 45 minutes playing with their children each day. During these brief yet significant activities, how might activity type, infant gender, and caregiver race affect the infants' language development? This study extends upon a prior study's research on a book task by examining whether gender and race influenced mothers' language in play. In video-recordings of Black and White mothers (N = 50) playing with their infants (ages 10, 14, 18, and 22 months), mothers' total words, unique words, nouns, proper nouns/pronouns, adjectives, verbs, and emotion words were calculated alongside the infants' receptive and productive vocabularies. Results showed that gender and race did not impact the total or unique words that infants heard; however, like the book task, black boys heard the least amount of total words and unique words, though these results were marginally significant. Gender and race did not influence the different parts of speech the infants heard during the play task. All white mothers' parts of speech correlated with each other, while all but the relationships between nouns with proper nouns/pronouns as well as nouns with verbs were significantly associated for black mothers. Finally, infants' receptive and productive vocabularies were not significantly related to the mothers' speech, even across races. Overall, gender and race did not significantly influence the total words, total unique words, or parts of speech that the infants heard in play; however, black boys tended to hear less total words and unique words. Therefore, in play and book activities, mothers' speech may not be universally the same, implying that research on caregiver-child interactions could provide better support for these short activities if it keeps these intersectionalities in mind.

Awe, Group Cohesion, and Religious Self-Sacrifice

Maria Naclerio
Faculty Mentors: Patty van Cappellen and Sarah Gaither
Behavioral Sciences/Psychology

Awe is an emotion that is frequently experienced in religious rituals. Research has documented the effects of awe on the small self, spirituality, and sense of connectedness. In two studies we aimed to extend this literature by investigating the functions of awe for religious group cohesion (indexed as identity fusion with the group and inclusion of the group in the self), which can ultimately lead to self-sacrifice for the group (indexed by a self-report scale and decision to self-sacrifice for the group in a Trolley paradigm). Study 1 investigated these relationships at the dispositional level and revealed that participants (N = 731) who experience more frequent awe also experience greater group cohesion and are more willing to self-sacrifice. The relationship between awe and self-sacrifice was mediated by vastness (a component feature of small self) and group cohesion. In Study 2, community participants (N = 197) were randomly assigned to either an awe or neutral video and then completed the same measures as in Study 1. We failed to find significant differences between conditions on group cohesion and self-sacrifice, however there was a significant effect of vastness. Taken together, this research highlights the emotional sources of religious group cohesion, with implications for the role of awe in religious extremism.

Assessing Substance-Free Residential Communities at Postsecondary Institutions

Sarabesh Natarajan
Faculty Mentor: Rick Hoyle
Behavioral Sciences/Psychology

The present study examines whether differences in an undergraduate's residential environment—primarily comparing substance-free environments to residential communities not designated as "substance-free"—translate to significant differences in academic success, psychological well-being, personal patterns of substance use, perceptions of substance use, and the frequency of experiencing secondhand effects of substance use. Moreover, the study attempts to unearth predictors of an undergraduate's decision to select (or not select) a substance-free living environment—such as basic demographics, personality, religiosity, a personal capacity for self-control, perceptions of substance use, and the substance use of influential others. Based on conclusions drawn from previous research, the benefits of living in a substance-environment is suggested to be multifold: in addition to consuming substances—such as marijuana, tobacco, and alcohol—significantly less than residents of non-substance-free communities, undergraduate students living in substance-free residencies are predicted to experience secondhand effects of substance use significantly less and have a significantly higher degree of academic success. The most significant predictors of a student's decision to select (or not select) a substance-free living environment are hypothesized to be the substance use of influential others and personal perceptions of substance use. Undergraduate students were recruited from various sources, including Amazon Mechanical Turk, the Duke University Department of Psychology and Neuroscience Sona subject pool, and online forums (e.g. Reddit, GroupMe, etc.) to take an online survey. The survey asked personal questions, such as those relating to demographics, psychological well-being, and personality—as well as inquiries into personal substance use and the substance use of others. Data collection is currently ongoing. Should the predictions of the present study be supported by the results of the study, the research team hopes to propose an optimal design for substance-free communities and advertise to residential colleges and universities a means by which contemporary substance crises may be mitigated for the college student population.

Sarah Kwiatek and Fernanda Chardulo Dias De Andrade are data analysts for the project. Special thanks to Sarah Kwiatek for her enormous help with the research study, and a special thanks to the Hoyle Lab for providing guidance and encouragement during the entire process.

The Role of Colorism and Manhood Threat in White People's Shooter Bias

Nneka Nwabueze
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Behavioral Sciences/Psychology

Research has shown that unarmed Black men (UBM) are more likely to be shot than unarmed white men, and dark-skinned UBM are more likely to be shot than light-skinned UBM (Johnson et al., 2019; Crutchfield et. al, 2017). Meanwhile, people also generally associate black people with negative masculine qualities (e.g., anger, violence) regardless of their gender (Freeman et al., 2016). Our study aims to use a combination of shooter- and sequential-priming tasks (SPTs), in which we test how white participants' (targeted N = 400) stereotypical notions of race, skin color, and gender interact to predict the shooting of UBM. First, we use a shooter-bias task to experimentally test a prior correlational finding that dark-skinned UBM are more likely to get shot than light-skinned UBM (Crutchfield et. al, 2017). Next, using a SPT, we test whether the extent to which darker skin shooter bias of black men is due to the associations people hold between dark skin and dangerousness. Using a final SPT, we test if people's association between dark skin and dangerousness is moderated by the extent to which people relate dark skin and masculine stereotypes. In sum, we hope to pinpoint multiple mechanisms that may explain shooter bias.

Are You Watching? The Impact of Joint Attention on Attitudes Towards Shared Experiences in Young Children

Julia Thielhelm
Faculty Mentors: Michael Tomasello and Wouter Wolf
Behavioral Sciences/Psychology

Children will go to great lengths to engage in shared experiences with others. Since previous research has shown that minimally shared experiences, like jointly attending a video, facilitate social closeness between children and adults, children's motivation to engage in such experiences might, at least in part, be due to the social nature of these experiences. This raises the question whether children find engaging in a shared experience more rewarding than engaging in a similar experience by themselves. In the current study, 47 participants aged 4.25 – 4.75 watched a video sitting next to an experimenter, who either watched the video with them in the joint attention condition or pretended to read a book in the disjoint attention condition. During the video, distractor toys were displayed, and we expected children in the joint attention condition to watch the video longer and have larger latency times to take leave than those in the disjoint attention condition. Despite finding trends in the hypothesized direction, we found that there was no significant difference between conditions in participants' total time watching the video or latency time to leave. Further study is needed to minimize participants' individual differences, increase the number of participants, and elucidate how young children perceive minimally shared experiences.

Examining the Impact of Parent and Child Intentional Self-Regulation Strategies on Adolescents with Chronic Illness

Kira Wang
Faculty Mentor: Melanie Bonner
Behavioral Sciences/Psychology

Childhood onset chronic conditions such as diabetes, cancer, and cystic fibrosis negatively impact the well-being of parents and adolescents. Individuals can adaptively cope to disease-related stressors using intentional self-regulation (ISR), which describes how one modifies thoughts, emotions, and behaviors to achieve goals. Prior studies have found that the coping and adjustment of parents and adolescents with chronic illness are closely intertwined, but ISR's role in this transactional relationship is not well understood. The aim of this retrospective study is to investigate the role of parent and child ISR in adolescent quality of life. ISR was measured via self-report on a 9-item ISR scale and adolescent quality of life was assessed by the 23-item PedsQL measure. Relationships between these variables were explored in a sample of 131 adolescents with chronic illness and their parents. Multiple regressions revealed that adolescent and parent ISR predicted adolescent quality of life, even after controlling for race/ethnicity, socioeconomic status, and sex. A significant positive correlation was found between adolescent and parent ISR. The mediation model tested by the Hayes PROCESS macro for SPSS revealed that ISR did not mediate the relationship between adolescent ISR and quality of life. These findings suggest that parent-child use of ISR may be central towards improving the lives of adolescents with chronic illness. Future work may benefit from exploring ISR-based interventions for this patient population.

Metaphorically Speaking, Metaphorically Thinking: Implications of Metaphorical Lay Theory in Education for Student Attitudes and Behaviors

Michelle Wong
Faculty Mentor: Bridgette Hard
Behavioral Sciences/Psychology

One common way for people to communicate lay theories about how the world works are metaphors, which both reflect and shape how people think about complex issues and experiences. Our research aims to understand metaphors for teaching and learning and how they shape educational attitudes, emotions, and behaviors. Previously, our work has focused on 1) using participant ratings from an online sample to identify the four most common metaphors (gardener, coach, sculptor, and tour guide) 2) mapping the entailments of teaching metaphors to describe the college teacher-student relationship for students and teachers 3) measured the explanatory power of each metaphor, to see how well they predict actual educational behaviors and attitudes in current or recent college student. In the present research, we aim to explore if students' preferred metaphors can truly predict different academic attitudes and behaviors. Using findings of teacher and student intuitions in our previous research to inform building a study on Qualtrics and launched through Amazon Mechanical Turk, we ask students to select their preferred metaphor for the teacher-student relationship that best describes their actual experience, and their ideal one. We ask them to rate themselves on a wide range of academic attitudes and behaviors, such as help-seeking, study strategies, reliance on classmates, etc, in addition to academic mindsets and personalities (e.g. growth mindset, Big Five). We seek to establish a relationship between the participant ratings to identify potential predictive relationships between their preferred metaphors and their self-reported behaviors.

Known, New, and New-ish Words: How Infants Learn Novel Words Familiar in Sound or Meaning

Sarah Yang
Faculty Mentors: Elika Bergelson, Charlotte Moore and Shannon Dailey
Behavioral Sciences/Psychology

Infants may find some novel words easier to learn than others, based on how similar those words are to words that infants already know. In the present study, we investigated novel word learning success in 10-, 14-, and 18-month-olds. For two weeks, families read to infants a picture book that introduced three novel words. Two of these novel words closely resembled words that infants may have known already: *"banoona"* sounded like *"banana"*, and *"shang"* referred to an object that looked like an apple. The third novel word, *"dax"*, was completely novel in both sound and meaning. After the two weeks of reading, in an eyetracking experiment, we measured word comprehension by assessing whether infants looked longer at the named picture in a two-picture display. We found that only 18-month-olds learned the novel words, and only in some contexts. The number or length of picture book reading sessions did not predict infants' novel word learning success. We discuss how infants at age 18 months may find it easier to learn novel words that sound familiar, compared to completely novel words and to novel words familiar in meaning. Better understanding of the types of words that children find easier or more difficult to learn may lead to future improvements in the design of educational programs and of interventions for children with language deficits. Other findings related to adult control participants are reviewed.
Keywords: word learning, lexical structure, sound, meaning

Promoting Post-Traumatic Growth in Survivors of Sexual Violence Through Creative Expression

Jin Myung Yoon
Faculty Mentors: Moria Smoski, Noga Zerubavel and Ernestine Briggs-King
Behavioral Sciences/Psychology

Exposure to trauma may have long-lasting, damaging effects on survivors of sexual violence. However, extensive research show that survivors still manage to persevere despite the adverse consequences, suggesting that recovery from trauma is possible. Specifically, many engage in a process called post-traumatic growth (PTG), where individuals exhibit positive personal transformation. Rather than concentrating on the traumatic event and its negative aftermath, those who engage in PTG consciously reevaluate the events, focus on their strength and agency, and in turn have a positive outlook into the future. It follows, then, the approach to trauma intervention ought to be transformed so that it targets both negative symptoms and encourage opportunities for growth. Accordingly, this research proposal presents a novel intervention model that incorporates concepts of PTG. Specifically, it seeks to explore the ways in which PTG could be induced through the analysis of common post-traumatic symptoms, theories and process of PTG, and empirical data on growth-inducing interventions

Neural Evidence for Control State Reinstatement: an fMRI Study

Ziwei Zhang
Faculty Mentors: Tobias Egner and Christina Bejjani
Behavioral Sciences/Psychology

Can we remember and learn strategically when to pay attention in a certain situation to help decision making? In this project, we wanted to investigate whether attentional control states (low vs. high focus of attention) could be associated in memory with particular stimuli, such that when the stimuli are shown again, the attentional states would be reinstated. When we compare high > low control states, we would expect to see increased activation in regions known to be involved in cognitive control, namely, dorsal anterior cingulate cortex (dACC), dorsolateral prefrontal cortex (dlPFC), and inferior frontal gyrus (IFG). To see whether we can find this neural signature of control reinstatement, we utilized a visual-auditory Stroop paradigm. In a three-phase study, people first
categorized trial-unique images as man-made or natural while ignoring auditory input from the headphone (a voice saying “natural” or “man-made”) that could be congruent or incongruent with the correct response. Two lists were hard (75% incongruent trials), and two were easy (25% incongruent trials). In fact, we found increased activation in regions mentioned in our hypothesis during the memory task if the images came from a hard vs. easy block, which supported the hypothesis of reinstatement of attentional control states.

Study designed and ran by: Dr. Yu-chin Chiu

Role of O-GlcNAcylation in SEC24C function

Caitlin Lamb
Faculty Mentors: Michael Boyce and Brittany Bisnett
Biological Sciences

Coat protein complex II (COPII) mediates forward protein and lipid cargo trafficking from the endoplasmic reticulum via five protein components required for in vitro vesicle formation: SAR1, SEC13, SEC23, SEC24, and SEC31. While the structure and function of COPII proteins are well understood, we do not fully understand how COPII is regulated in response to environmental and cellular stimuli. We and others have found that O-linked-beta-N-acetylglucosamine (O-GlcNAc), a dynamic single-sugar modification added to serines and threonines of intracellular proteins, decorates many human COPII components, including all four SEC24 paralogs. Additionally, others have shown that COPII, and specifically SEC24, may play a role in the formation of the autophagosome for autophagy, a process in which the cell degrades its own components. However, the regulation of SEC24's canonical and autophagic functions remains unclear. To determine the function of SEC24 O-GlcNAcylation, we mapped O-GlcNAc sites on SEC24C using mass spectrometry and created unglycosylatable serine or threonine to alanine mutations at each O-GlcNAc site. We then used CRISPR-Cas9 to create SEC24C-/- HEK 293T and HeLa cells, and reintroduced unglycosylatable SEC24C mutants. By comparing SEC24C-/- to control HeLa cells, we discovered a baseline difference between levels of autophagy. Furthermore, SEC24C-/- 293T cells may be more sensitive to ER stress than control cells are. With these differences between SEC24C -/- and control cells, we will next determine whether the differences persist when comparing the unglycosylatable mutants to wild type SEC24C, using Western blots and immunoprecipitation. This study will enhance our understanding of the role of O-GlcNAcylation on SEC24C function and the interplay between canonical COPII function and autophagy.

Endogenous Expression and Regulation of Basement Membrane Tissue Integrity, Maintenance, and Regeneration in Long-lived C. Elegans

David Chen
Faculty Mentors: David Sherwood and Eric Hastie
Biological Sciences

Basement membranes (BMs) are supramolecular matrices built on laminin and type IV collagen networks and their health reflects the body's ability to heal wounds and repair tissues across all organs. Defective BM regeneration after injury leads to the development of scar tissue (fibrosis). In humans, fibrotic diseases can be systemic or organ-specific. Caenorhabditis elegans is a useful model system for studying basement membranes and fibrosis because of its genetic and morphological similarity to humans, optically clear body, and fast-generation times. The Sherwood laboratory has endogenously labelled 29 major BM matrix components and receptors with fluorescent markers in C. elegans to investigate BM regulation in vivo. We're interested in a role for type IV collagen and laminin BM networks in tissue maintenance and regeneration. We have observed fibrotic tissue in the worm gonads and older worms have an increased fibrotic phenotype. Using a mutant worm that has a lifespan that is 5 times longer than wild time worms, we will use high resolution microscopy to study the effects of aging on type IV collagen, laminin, nidogen, and perlecan network organization. In addition, we are interested in conducting RNAi screens, conditional knockdown, and misexpression experiments to understand the genetic and cellular mechanisms for BM and fibrotic development over time in wild-type and long-lived worm.

Studying the Biologic Function of GRK3 In Bone Homeostasis and Disease

Arindam Ghosh
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Biological Sciences

When aging wild type and Grk3-/- mice (1.5-2 years old) for a separate project, a collaborator with the Tarrant Lab serendipitously noticed abnormal growth within the bone of an old Grk3-/- mouse. We examined more bones from these mice and found several more growths that were not present in the wild type mice. The lesions contain a mix of osteoblasts, osteoclasts, bone, and new vasculature. Our current hypothesis is that these lesions are similar to Paget's Disease of Bone in humans due to the age of onset and appearance of the lesions. Paget's Disease is a poorly understood disorder in older people in which osteoclasts are abnormally activated and eat away at the bone. Osteoblasts then try to repair the bone, resulting in an area of weak disorganized bone. We look at microCT scans of femurs, tibias, spines, and skulls of aged WT and Grk3-/- mice to determine the prevalence of these lesions. Suspected lesions are then sectioned and stained for further examination. Previous work in the lab determined that Grk3 is not highly expressed in osteoblasts, so we are trying to learn more about Grk3's role in osteoclasts. We are working on using RNAseq to determine which signaling pathways in pre-osteoclasts and mature osteoclasts Grk3 may be modulating.

Making scents: The relationship between microbial communities, reproductive hormones, and chemical compounds in lemur labial secretions

Lucy Greenwald
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Biological Sciences

Animals, including humans, use olfactory cues in social communication to guide their interactions. Volatile organic compounds (VOCs), the chemicals present within olfactory signals, can encode important information about an individuals' traits or current state. Reproductive hormones and commensal microbial communities are known to influence an animal's chemosignals, which can lead to behavioral consequences. While we know that olfactory communication is important in mate selection in non-human primates (e.g. lemurs), we know little about how changes in an animal's physiology or its microbiomes are linked to changes in scent signatures. Here, we examine the tri-part relationship between reproductive hormones, glandular microbiomes, and olfactory signals. We examined both the chemical and microbial composition of labial secretions in individual females of two lemur species, Coquerel's sifakas (*Propithecus coquereli*) and ring-tailed lemurs (*Lemur catta*), that were experiencing either natural endocrine cycles or contraception with synthetic steroids. We analyzed the covariation between chemical and microbial composition across species and hormonal conditions. The contraceptive, depo-provera, significantly diminished reproductive hormone concentrations in Coquerel's sifakas. In ring-tailed lemurs, the differences in absolute concentrations were not significant; however, we still found that the contraceptive eliminated much of the variation in hormone levels. Our results did not reach statistical significance, but we did identify some modest patterns that suggest contraception reduces the diversity of microbial and chemical compositions. While we completed the analyses for the Coquerel's sifakas, their chemosignals contained few unique compounds, which may have masked significant effects. Further analyses are needed to process the chemical data for ring-tailed lemurs, whose richer chemical signals may provide more clear insight into how chemosignals are affected by host physiology. Further studies are needed to look at more individuals and additional species in order to get a better picture of these processes.

Testing for Interactive Effects of Salinity and Plant-root proximity on Soil Microbial Communities in Coastal Freshwater Wetlands of North Carolina

Lingrong Jin
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Biological Sciences

Salinization of freshwater wetlands impacts soil microorganisms which regulate soil carbon pools and nutrient cycling. Salinity is a well-documented stressor for microbial communities, affecting both community structure and function. Soil microbial communities are also structured by proximity to plants, with distinctive bacterial communities within and on the root surface versus in the more distal root-associated soil (rhizosphere). While there is substantial effort in understanding the impact of saltwater intrusion on coastal wetland ecosystems, less is known about the interactive effect of salt stress and plant-root proximity on soil microbial community structure. To understand how the microbial communities associated with plant roots shift along salinity gradients, I examined soil microbial communities associated with a common salt marsh plant, Sporobolus pumilus, along a natural salinity gradient in the coastal freshwater wetlands of North Carolina. I hypothesized that microbial communities more closely associated with the root would be more resilient to environmental stress due to beneficial plant-microbe interactions, whereas those in the more distal rhizosphere would experience larger community shift. Results show that salinity as well as other soil physicochemical characteristics had significant impacts on microbial diversity and species turnover in both root compartments across the gradient. However, except for some phyla, the patterns of changes in microbial community structure were very similar between the two root compartments. This study illustrates that soil microbial communities are structured by complex environmental gradients as well as potential plant influence which requires further investigation.

Predictors of juvenile male rank acquisition among wild baboons

Aren Kalash
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Biological Sciences

This project will investigate one aspect of dominance hierarchies among baboons, particularly the pattern of agonistic interactions between adult females and juvenile males prior to male sexual maturation. The ability of juvenile males to assert dominance over adult females is partially reflective of juvenile male rank ascension during this period. I hypothesize juvenile males with social and physical advantages will ascend rank more quickly and at earlier ages. Additionally, I hypothesize males will have greater difficulty superseding alpha females in rank due to a certain "alpha particularity" whereby alpha females possess advantageous qualities over non-alpha females, deeming them more formidable competitors. Combes & Altmann (2001) offer support for this phenomenon, highlighting an apparent "invulnerability" of top-ranking females to losing rank to other female family members.

From observations of Amboseli baboons in Kenya between 1980-2010, I will leverage data consisting of 382,562 recorded agonisms between juvenile males (n=203) and adult females to extract, for each male, predictive information including age of maturation, age at first agonism, age at first win over an adult female competitor, and maternal rank. For each adult female competitor, group identity, dominance rank, and rapidity of outranking by juvenile male will also be assessed. Results will offer a unique insight on the challenges of social development in baboons and the influences of various individual and demographic traits.

Investigating the role of Pak1 in the molecular mechanism of EMT during sea urchin embryonic development

Tzu-Chieh Michael Wen
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Biological Sciences

An epithelial-mesenchymal transition (EMT) is the process where polarized epithelial cells develop the cell surface properties of mesenchymal cells, become motile, breach the basement membrane and enter the blastocoel. The EMT is important in understanding embryogenesis, tissue regeneration, and cancer metastasis. In sea urchin embryos both the primary mesenchyme cells (PMCs) and many non-skeletogenic mesoderm (NSM) cells go through an EMT and the process can be studied directly in vivo. We used results from a transcriptome analysis that show effector genes expressed in various cell types during late blastula and gastrula stages of Lytechinus variegatus to uncover Pak1 as a potential gene involved in EMT. This study attempts to understand the role Pak1 plays in the molecular mechanism of EMT. We have successfully cloned Pak1, synthesized an RNA probe, and performed in situ hybridization experiments to see where the gene is expressed throughout development. We then knocked down Pak1 using an inhibitory drug and a morpholino to determine what role the gene plays during EMT. We show that Pak1, a kinase involved in cell motility and morphology, is expressed in both the PMCs and a subpopulation of NSM before and after they go through an EMT and that it may be involved in cell deadhesion.

Size doesn't matter: double-mated Drosophila simulans females display no preference for male sex comb size

Frederick Xu
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In many species of Drosophila, males possess forelimb appendages known as sex combs, which are utilized in courtship and copulation. The importance of these traits for mating has led to their association with sexual selection via female preferences. However, the exact nature of this selection remains unclear as studies over the last 25 years have found conflicting results. Recent work demonstrated that virgin male D. simulans do not differ in their mating success based on sex comb tooth number. However, most flies in the wild have previously mated. This project explores the relationships of courtship and copulation events with sex comb tooth numbers between female D. simulans and male partners. Virgin male and female flies were timed for duration from first courtship event to copulation as well as copulation duration: this constituted first pairings. Any successfully-mated first-pairing females were then paired with a second virgin male one week later and again timed for courtship and copulation durations, constituting second pairings. Timings from the first and second pairings were compared to the two males' respective sex comb tooth numbers. Data analysis did not find signals of directional selection driven by female preferences for male sex comb tooth number between successful first-pairing and second-pairing males. However, several other intriguing relationships were identified. Copulation duration was significantly longer for second-pairing males compared to first-pairing males. And while found to be just beyond significance, slight correlations were found between courtship duration and average comb size of second-pairing males as well as courtship duration and comb size difference values between first-pairing and second-pairing males. These results indicate that there could be deeper relationships between multiple matings and female preferences: it could take more than two copulations for female choice in D. simulans to crystalize. There are exciting paths for future investigation. Studies utilizing choice tests (where females are presented with multiple males in one instance) may better simulate wild conditions. In this way, the underlying dynamics of sexual selection can be better understood while also integrating sex combs as a model trait for this evolutionary process.

Characterizing the Role of Type IV Collagen in Basement Membrane Mechanical Properties

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Basement membranes (BMs) are a form of extracellular matrix that provide animal tissues with structural support among other important functions. Type IV collagen is a major constituent protein of BMs known to be important for mechanical stability, stiffness, and load-bearing. Though basement membranes are often considered to be static structures, they must stretch to accommodate rapid shape changes in dynamic animal tissues. BMs' role in structural support is known, but how individual basement membrane constituent proteins contribute to the macromolecular assembly's mechanical properties – including deformability and/or elasticity – is poorly understood. In order to investigate which BM constituents facilitate these properties, I will focus on the C. elegans spermatheca, the region of the C. elegans gonad where oocytes are ovulated and fertilized by sperm. The spermathecal basement membrane flexes to accommodate a fourfold increase in the volume of the spermathecal lumen as the oocyte passes through it during ovulation; it is thus an excellent model for investigating the BM of a dynamic tissue. Through fluorescence confocal microscopy, fluorescence recovery after photobleaching (FRAP), RNAi knockdown, and atomic force microscopy experiments, I will elucidate how type IV collagen contributes to the deformability/elasticity of the spermathecal basement membrane during ovulation.

Vessel Based Databases for Photoacoustic Machine Learning

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Introduction: The ability of photoacoustic tomography to convert optical energy into acoustic energy provides a unique advantage in constructing detailed vessel images. More precisely, since PAT can translate optical contrast into acoustic waveforms, such as the contrast between oxy- and deoxy- hemoglobin in the blood, the images produced by this modality are high in resolution and specific in vascular imagery (Xia et al., 2014). By using the biological contrast of hemoglobin, PAT provides a non- invasive label-free way to image blood vessels clearly (Xia et al., 2014). Since vessels are of extreme importance in medical intervention, there has been great interest in developing high-resolution imaging technologies for vasculature. One way to improve the image quality is by the coupling of imaging modalities with machine learning. Prior applications of machine learning in photoacoustics include image reconstruction and artifact removal (Kirchner, Gröhl, & Maier-Hein, 2018, Wang, Ye, Mueller, & Fessler, 2018, Allman, Reiter, & Bell, 2017). The innovation in machine learning has led to high quality imaging and more accurate reconstruction especially in the realm of photoacoustics. Considering the importance of training data in machine learning applications in photoacoustic imaging, this project explores several existing, open-source image databases that have the potential to benefit deep learning approaches to photoacoustic tomography.

Materials and Methods: Since this project is a compilation of image databases and training information, this section includes a comprehensive review of 8 vessel-based databases. Each is assessed based on the type of training data offered, ease of accessibility, application to PAT machine learning, and type of machine learning approach with which each is compatible. The databases analyzed here are as follows: MedPix data images, STARE, DRIVE, Isfahan Misp, MICE Imaging, Rotterdam Coronary Artery project, NITRC, and the ELCAP Public Lung Image database.

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Automation of the Quantification of Vasoactivity in Tissue Engineered Blood Vessels

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Current treatments for cardiovascular disease(CVD) focus on risk factors and symptoms that are difficult to address with early intervention or preventative measures within the vasculature.
Tissue engineered blood vessels (TEBVs) allow for the in-depth investigation of how various unexplored risk factors affect the advancement of CVD. TEBVs are evaluated at the cellular, structural, and functional level to determine if they have a similar response to known disease risk factors as in vivo vessels. Functional testing is measured by quantifying vasoactivity, or constriction and dilation in response to vasoconstrictor and vasodilator small drug molecules. These responses are quantified by perfusing the TEBVs while they are video recorded. Images are then isolated from the recordings and the diameter of the vessel is measured to quantify the vasoactivity. The images are uploaded to MATLAB, sharpened, and filtered for noise. The edges of the vessels are detected by converting the image to greyscale and using a threshold of contrast. The optimal threshold was determined by assaying vasoactivity using thresholds between 20 percent and 70 percent of the maximum brightness. The MATLAB code does tend to follow the trends of the manually measured data, showing that the code can accurately detect changes in the vessel diameter. An important distinction is the difference in the standard deviation, with a decrease of 78.4 percent from the manually measured data to the data collected from MATLAB. This suggests that the code is able to target changes in the TEBVs more precisely, which could be due to a greater number of diameter measurements taken, with a 40-fold increase in measurements, in a much shorter time. The MATLAB program was able to effectively and precisely measure vasoactivity of the TEBVs under various conditions. By automating the detection system, more samples can be taken at a much faster rate than manually measured data, which will expedite the process of using TEBVs in the future in addition to normalizing the process across the lab.

Anti-Saccade and Sub-concussive Loading: Changes in Initial and End Gain Task Metrics Following Head Impact Exposure in a High School Football Season

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An accurate and objective diagnostic tool for mild traumatic brain injury (mTBI) resulting from sub-concussive loading – described as the cumulative effects of sustained low-magnitude head impact exposure (HIE) – in pediatric populations that participate in a contact sport does not yet exist. The objective of this pilot study was to examine the relationship between HIE and eye-tracking performance using two accuracy (gain - % of target; deg/deg) based anti-saccade task metrics in varsity high school football athletes across a season to understand potential neurological deficits resulting from sub-concussive loading. Participating varsity football athletes during the 2017-2018 season (n = 31) were grouped into 10th (low) and 90th (high) HIE percentiles based on weekly HIE frequency scores self-reported through athletic activity/contact exposure questionnaires (AACEQ). Eye-tracking assessments were conducted at the beginning-of-season (BOS), middle-of-season (MOS) and end-of-season (EOS) for each player. Mixed-design ANOVAs were performed for anti-saccade initial and end gain. Task performance was analyzed at BOS, MOS, and EOS (repeated measures) between low (n = 4) and high (n = 4) HIE groups (between subjects factor). The mixed-design ANOVA indicated a significant interaction between time of season and HIE group on end gain, $F(2,134) = 3.857$, $p = 0.024$. A repeated measures ANOVA indicated a significant effect of time of season on end gain, $F(1.536,52.232) = 3.834$, $p = 0.038$, in the low HIE group (Greenhouse-Geisser correction). Bonferroni-corrected post-hoc tests revealed that there was not a significant difference between pairwise comparisons at different time points throughout the season. There was not a significant effect of time of season on end gain in high HIE group, $F(2,66) = 1.073$, $p = 0.348$. At EOS, end gain was significantly lower in the low HIE group (89.8 ± 29.8, $p = 0.003$) compared to the high HIE group (124.4 ± 58.8). The mixed-design ANOVA omnibus test for initial gain indicated no significant interaction or main effects. These pilot results suggest that anti-saccade end gain may exhibit differences across seasonal time points and between HIE groups of varsity football athletes. However, some limitations that may have skewed true measures of low and high HIE groups include three assumptions: the AACEQ accurately stratifies HIE, the small samples are representative of true low and high HIE, and there was no learning effect.

Bass Connections Project

Recombinant Synthesis of Micelle-Forming Diblock Polypeptides for Cancer Immunotherapy

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Biological Sciences

Checkpoint blockades and adoptive T cell therapy have highlighted recent breakthroughs in cancer immunotherapy, but clinically effective cancer vaccines have yet to be achieved. By leveraging biomaterials for the delivery of antigen and adjuvant it is possible to fine-tune an anticancer immune response. Nanoparticles have demonstrated tremendous potential for the enhancement of immunotherapies by promoting increased antigen uptake, programming accumulation in the lymph nodes, and decreasing clearance. Here we describe the use of a diblock consisting of reslin-like polypetides (RLPs), hydrophobic repetitive proteins, and elastin-like polypeptides (ELPs), hydrophilic repetitive protein biopolymers, for a cancer vaccine consisting of antigen and negatively charged adjuvants, such as CpG. RLP-ELP diblocks, a novel class of amphiphilic diblock polypeptides, are a strong choice for such as they provide a robust platform for creating micelles of a given size and morphology. We were successfully able to express and purify Ova-RLP40 -ELP80 -K12. We have shown the protein's surprising formation of a zipper structure and its binding to CpG. We have also shown that this complex structure increase may enhance protein activity. Additional investigation of different RLP-ELP variants will be used to further characterize micelle and/or zipper formation, and to determine which fusion is the ideal candidate for a vaccine platform.

Excluding Nuclear Copies in Mitochondrial Whole-Genomes of Tigers (Panthera tigris)

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Due to their captivating beauty and intrigue, more tigers (Panthera tigris) reside in the United States than in the wild. While some tigers reside in Association of Zoos and Aquariums (AZA) zoos, others find themselves in private zoos, faux sanctuaries, or kept as pets. With declining wild populations, captive tigers in accredited venues can be potential resources for genetic rescue; however, little is known about the diversity and ancestry of tigers outside the AZA and their potential use in aiding conservation. Mitochondrial DNA (mtDNA) is traditionally used as a way to identify species and populations, but mtDNA studies run the risk of sequencing nuclear copies of mtDNA (known as numts). Numts are genomic DNA regions homologous to mtDNA, making them susceptible to co-amplification by primers designed for mitochondrial gene regions. Numts are known to be widely present in felids and thus create difficulties when using mitochondrial DNA for genetic studies. We tested three alternative methods (PCR amplification, PCR amplification of diluted DNA, and PCR of exonuclease digested DNA) to isolate mitochondrial DNA from captive US tiger populations. We uncovered that while dilutions fail to prevent numt contamination, enzymes can be used to degrade linear DNA and leave solely mtDNA to be sequenced. We demonstrate techniques to verify clean reads and found that many previously published NCBI sequences of tiger mtgenomes contain numts. We show that the presence of numts can inappropriately cluster tigers together using phylogenetic methods and were able to verify the maternal ancestry of several captive, non-AZA tigers.

Alveolar type II cell to alveolar type I cell differentiation in organoid culture

Robin Yeh
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Biological Sciences

Lung organoids are an in vitro three-dimensional (3D) culture that are generated from a single stem cell and comprised of organ-specific epithelial cells. The alveoli consist of alveolar type II cells (AEC2s), and type I cells (AEC1s). AEC2s are stem cells in the alveoli, proved to differentiate into AEC1s after injury in mice. Our preliminary date shows that when AEC2s are co-cultured with lung stromal cells in MTEC medium in 3D, the AEC2s are able to proliferate and differentiate to AEC1s. Current culture condition is not well-defined because it contains stromal cells and supplements such as bovine pituitary extract or fetal bovine serum, making it unable to use clinically. We are developing a medium that is serum-free and promotes differentiation of AEC2s to AEC1s without stromal cell support. We hypothesize that controlling the inhibitions and activations of Wnts, bone morphogenic proteins (BMP), and transforming growth factor beta (TGF-b) would allow for this. To test this, I will first culture AEC2s organoids in our serum-free medium containing Wnts activator and TBF-b inhibitor, which promotes AEC2s proliferation. Next, I will develop a differentiation medium, testing out different levels of cytokines/supplements and analyze growth of AEC2s and AEC1s by immunofluorescence assay. I want to answer: what factors promotes AEC2 to AEC1 differentiation.

Investigation of ARF proteins for T. gondii infection

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Biological Sciences

Toxoplasma gondii is an intracellular parasite that causes toxoplasmosis, and it relies on host cell interactions for its survival and infection. Therefore, to better understand T. gondii infection, host factors important to infection development need to be investigated. This study investigates if and how human ADP-ribosylation factor (ARF) proteins are implicated in the infection process. Using real-time polymerase chain reaction, the expression levels of three classes of ARF proteins are investigated at multiple time points post-infection. Based on current data, these classes of ARF proteins do not appear to be upregulated throughout infection. Further experimentation and microscopy analysis will be done to supplement these results.

Clemastine is a dual-stage inhibitor of the Plasmodium falciparum parasite

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Biological Sciences

Plasmodium falciparum, the parasite responsible for the deadliest form of malaria, affects millions of people each year. P. falciparum adopts a complicated life cycle where the parasite infects mosquito midgut epithelium, human liver cells and blood cells. Antimalarial drugs that target multiple life stages can block parasite development and transmission in a more effective manner and may help prevent the development of drug resistance. We previously identified that clemastine, an FDA-approved antihistamine, effectively inhibits the blood and liver stage with an unknown mechanism of action. As observed in our blood stage cultures, parasites treated with clemastine have delayed growth compared with a DMSO control and a human TRiC inhibitor HSF1A. At later time points, clemastine-treated parasites have a lowered ratio of late- stage schizonts, indicating that treatment leads to delayed development. Our proteomics assays suggest that clemastine targets the P.falciparum TCP-1 (TRiC/CCT) ring complex, which is required for the folding of actin and tubulin. Our findings show that clemastine destabilization of TRiC results in disorientation of microtubule filaments during Plasmodium asexual reproduction and an overall reduction in tubulin levels. Clemastine-induced disruption of tubulin formation is not seen in human host cells, indicating selectivity for targeting parasites. Overall, our study highlights selective targeting of Plasmodium TRiC protein-folding as a strategy controlling Plasmodium development. Further studies of pre-approved, dual-stage inhibitors like clemastine can reveal novel targets within Plasmodium in order to combat malaria

Elucidating the role of host Aquaporin-3 during apicomplexan infection

Michael Tran
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Biological Sciences

Parasitic protozoans of the genus Plasmodium cause malaria. The liver stage of the Plasmodium life cycle is asymptomatic, obligatory, and dependent on host hepatocytes. This dependency provides an opportunity to examine host factors essential to the Plasmodium life cycle that could be druggable targets. Another intracellular parasite, Toxoplasma, which is from the same phylum (Apicomplexa) as Plasmodium, has a close evolutionary background, similar development patterns, and a higher infection rate; thus, it may be a fruitful model of Plasmodium infection. Our lab demonstrated that Plasmodium exploits host aquaporin-3 (AQP3) by inducing its expression during infection. AQP3, a water and glycerol channel, localizes to the parasitophorous vacuole membrane (PVM) during infection and is essential for liver stage infection. My project focuses on the transcriptional regulation of AQP3 and other aquaglyceroporins. I will first obtain expression profiles of AQP3 and other AQPs in many cell lines infected with Toxoplasma via qPCR to confirm similar transcriptional upregulation to that seen during Plasmodium infection. To further look into this regulation, I will knock down FOXA2, a potential transcription factor of AQP3, in uninfected and infected (Toxoplasma) cells and probe differential regulation of AQP3 and other AQPs. Should AQP3 expression increase in cells infected with Toxoplasma and FOXA2 appear to be a transcription factor of AQP3 crucial to parasite load, the data would suggest that host AQP3 is utilized during Toxoplasma infection, potentially through the regulation of FOXA2.

The Role of Mechanosensitive Piezo Ion Channels in Ocular Lens Architecture and Function

Ariana Allen
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Biological Sciences

The purpose of this study was to determine the expression, distribution, and role of Piezo channels in the ocular lens. Expression and distribution of Piezo channels in developing and mature mouse lenses was analyzed by RT-PCR, RNA-seq, immunoblot and immunofluorescence analyses in wild type (C57BL/6J) and transgenic Piezo1-tdT (obtained from Jax laboratory) mouse lenses. To test the functional significance of Piezo channel activity in the lens, Piezo1 agonist (Yoda1) and antagonist (GsMTx4) were used in the organ-cultured mouse lenses in conjunction with histological, biochemical and biomechanical analyses. Both Piezo1 and Piezo2 channels are expressed in the mouse lens, with Piezo1 having a relatively higher expression and distributing to both epithelium and fiber cells. Pharmacological activation of Piezo1 in organ-cultured P30 mouse lenses by Yoda1 for one hour showed a significant increase in the level of phosphorylated myosin light chain (MLC) with no change in total MLC, suggesting an increased calcium influx due to Piezo1 activation leading to MLC phosphorylation. Yoda1 treatment for an extended period (24 hrs) led to cataract development in association with degradation of lens membrane proteins. On the other hand, inhibition of Piezo1 by GsMTx4 for 48 hours demonstrated a significant decrease in MLC phosphorylation with no change in either total MLC or beta-actin levels in P30 mouse lenses compared to controls. Piezo1 inhibition had no significant influence on lens tensile properties. Additionally, the membrane organization and stability of Piezo1 in the lens was found to be regulated by ankyrin-B, a well-recognized membrane scaffolding protein. This study reveals expression and distribution of Piezo mechanosensitive channels in mouse lens epithelium and fibers and a role for Piezo1 channel activity in regulation of calcium-dependent MLC phosphorylation, a critical regulator of contractile activity. Importantly, loss of lens transparency associated with dysregulation of Piezo1 channel activity appears to result from an augmentation of calcium-dependent calpain activity leading to degradation of lens membrane proteins. Collectively, this study reveals the physiological significance of Piezo channel activity in lens calcium signaling and function.

The Role of Abelson (Abl) Kinases in Medulloblastoma Cell Invasion, Proliferation, and Migration

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Medulloblastoma is the most common pediatric brain tumor, with approximately 400 new diagnoses in the United States each year. Though overall survival rates have improved dramatically in recent history, one persistent concern with medulloblastoma is leptomeningeal dissemination: the spread of tumor cells to regions outside the brain. Current standard-of-care for this condition is surgical resection followed by chemoradiotherapy. However, nearly all patients treated with this regimen continue to face severe adjuvant toxicities. Thus, it has become increasingly important to identify and develop new targeted therapies that provoke fewer side effects and exhibit greater specificity for metastasized medulloblastoma. One encouraging avenue of interest involves the Abelson (Abl) family of tyrosine kinases. Abl kinases (Abl1/2) were first discovered as oncogenes in leukemia, but have since been implicated in general cancer cell migration, invasion, adhesion, and even chemotherapy resistance. Elevated expression/activation of Abl kinases has been verified in several solid tumors, and preliminary data from our group suggest that Abl1/2 genes, mRNA, and protein are all highly expressed in medulloblastoma tissue samples and cell lines. Ultimately, the objective of this senior thesis was to investigate the role that Abl kinases play in medulloblastoma cell invasion, proliferation, and migration as potential drivers of leptomeningeal dissemination. Two potential molecular mechanisms underlying Abl-mediated metastasis, involving (1) integrin β1, E-cadherin, and Rac, and (2) c-myc, were investigated. In sum, data suggest that Abl kinases (1) hamper medulloblastoma cell proliferation by interfering with the capacity for healthy spheroid cluster growth, and (2) may affect migration/invasion by decreasing activation of a seemingly ubiquitous integrin signaling pathway – which may engage Rac/c-myc to initiate metastasis. Hyper-specific Abl kinase inhibition provided more compelling evidence for these conclusions than non-specific inhibition. As the first project dedicated to Abl kinases in leptomeningeally disseminated medulloblastoma, we hope this work provides novel direction for future studies – and will inform the field of pediatric neuro-oncology about the potential for Abl kinase inhibition as a treatment for leptomeningeally disseminated disease.

The role of DNA methylation at SNCA Intron1 in gene regulation: Mechanistic understanding of Parkinson's and implications for gene therapy

Jeffrey Gu
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Biological Sciences

Synucleinopathies comprise some of the most common neurodegenerative diseases, including dementia with Lewy Bodies (DLB) and Parkinson's disease (PD). Genome wide association studies have implicated alpha-synuclein gene (SNCA) as a risk factor for PD. Additionally, accumulating evidence shows that elevated levels of SNCA contribute to disease pathogenesis. However, studies reported neurotoxicity associated with robust reduction of SNCA levels, highlighting the important role of regulatory mechanisms within the SNCA gene. Methylation presents an appealing target of study as it aids in the regulation of gene transcription and thus gene expression. Moreover, previous studies have reported differential methylation levels at the SNCA Intron1 between PD and control samples. Other studies have shown conflicting results, reporting no differences in methylation levels between control and disease. The overarching goal of this project is to study the role DNA methylation plays in the SNCA Intron1 region. We took two different paths to accomplish this - our first specific aim focuses on comparing SNCA Intron1 methylation levels between patient and control samples, as well as between neuronal and non-neuronal cell populations. Our second specific aim takes a more translational approach by applying a novel all-in-one CRISPR-dCas9-based lentiviral vector system in human induced pluripotent stem cells (hiPSCs)-derived neurons from a PD patient with the triplication of the SNCA locus. This system is designed to downregulate SNCA Intron1 methylation levels at the single CpG level, and we hypothesize that its application will lead to the downregulation of SNCA expression and the rescue of disease-related cellular phenotypes. The insights gained from these studies will further our understanding of the complex disease mechanisms involved in PD and other synucleinopathies, as well as potentially pave the way for targeted epigenetic therapies.

Impact of Radiotherapy Delay on Survival in WHO Grade III Gliomas: An Analysis of the National Cancer Database

Bryce Starr
Faculty Mentor: David Kirsch
Biological Sciences

Anaplastic astrocytomas and oligodendrogliomas are primary brain tumors classified as World Health Organization (WHO) grade III. Standard of care treatment for these tumors includes surgical resection followed by adjuvant radiotherapy (RT) and chemotherapy; however, the optimal time interval between surgery and RT remains unclear. Therefore, this study aims to use a large cohort from the National Cancer Database (NCDB) to identify predictors for and clinical impact of time from surgical resection to initiation of RT in these patients.

The NCDB was queried for patients with WHO grade III gliomas diagnosed from 2004-2015. The time interval between surgery and the start of RT was grouped into 1-30 days, 31-60 days, 61-90 days and >90 days. Overall survival (OS) was estimated via Kaplan-Meier and log rank tests. Univariate (UVA) and multivariable Cox regression (MVA) modelling was used to determine predictors of OS.

A total of 8,886 patients (median age: 48 years) were included with a median time from surgery to RT of 35 days (Range: 1-706 days) and median OS of 51.3 months (Range: 0.85-155.6). On UVA, age ≤50, female gender, Hispanic or other ethnicity (not Caucasian or African American), KPS>60, achieving a gross total resection (GTR), unifocal disease, smaller tumor size, intensity-modulated RT (IMRT) and stereotactic radiosurgery, >15 RT fractions, low Ki-67, 1p19q co-deletion status, adjuvant chemotherapy, methylated gene status, and delaying RT 30-90 days predicted for improved survival. On MVA, initiation of RT 30-90 days following resection*, age <50*,unifocal disease*, smaller tumor size*, and treatment with chemotherapy (p=0.003) predicted for improved overall survival. For patients initiating RT 1-30 days following resection, the 1-, 5-, and 10-year OS rates were 76%, 38%, and 27%. For patients starting RT 31-60 days following resection, the 1-, 5-, and 10-year OS rates were 87%, 52%, and 37%, respectively and for the patients beginning RT 61-90 days following resection, the 1-, 5-, and 10-year OS rates were 89%, 57%, and 41%, respectively. This NCDB analysis suggests that surgery to radiation timing is an actionable prognostic variable in the treatment of grade III gliomas. Our data indicates that receiving radiation between 1 and 3 months after surgical resection is associated with improved overall survival. Further studies are needed to evaluate the correlation of other modifiable treatment variables associated with this disease.

This project was completed at MD Anderson Cancer Center under the supervision of Dr. Caroline Chung

Investigation of Eotaxin Production by Lung Fibroblasts in Obese Asthma

Karen Zhao
Faculty Mentors: Jennifer Ingram, Victoria McQuade, and Mark Ihrie
Biological Sciences

In obese allergic asthma, increased levels of leptin and Interleukin-13 (IL-13) recruit eosinophils to lung airways, which causes inflammation of airway tissue and contributes to airway fibrosis. Several studies have observed that increased numbers of eosinophils are found in the airway tissue of obese asthma patients, indicating more inflammation. The question I am studying is: what factors cause the observed increased tissue eosinophilia in obese allergic asthma patients? My hypothesis is that in obese patients with allergic asthma, increased airway fibrosis contributes to increased tissue eosinophilia through increased production of eotaxin, a chemoattractant for eosinophils, by lung fibroblasts. In my previous independent study, I studied this question by looking at lung fibroblasts from obese leptin-deficient mice. However, with this continuation, I will culture and experiment on lung fibroblasts from mice fed with a high-fat diet (HFD) and exposed to house dust mite (HDM, an allergen) as well as obese humans subjects with asthma to create an updated, more clinically relevant model of obese asthma. I will expose the lung fibroblasts to leptin, IL-13, and a combination of these factors, to measure the eotaxin gene and protein expression levels produced by the cultures, and I will quantify the number of eosinophils in samples of the human tissue.

Repurposing of Niclosamide to Treat Idiopathic Pulmonary Fibrosis

Barbara Zhao
Faculty Mentor: Christina Barkauskas
Biological Sciences

Idiopathic pulmonary fibrosis (IPF) is a fatal lung disease that results in progressive scarring and stiffening of the gas-exchange (or alveolar) region of the lung. There currently exist two FDA-approved treatments for IPF, pirfenidone and nintedanib, and both have been shown to slow down the progression of fibrotic scarring. Because these drugs are unable to halt disease progression or reverse pre-existing fibrosis, there is a clinical need for new ways to treat IPF. Niclosamide is FDA-approved as a treatment for tapeworm infections, and it has been shown to inhibit multiple pathways that contribute to the pathology of IPF, such as Wnt/B-catenin, STAT3, and mTORC1 signaling. With this in mind, we hypothesize that Niclosamide may be repurposed to inhibit the progression of fibrotic scarring in IPF by inducing apoptosis in fibrotic cells while having little effect on normal fibroblasts and lung epithelial stem cells. To assess the in vitro effect of Niclosamide, we have determined the IC50 of Niclosamide and its comparative effect on the proliferation and apoptosis of normal fibroblasts and fibrotic cells by administering Niclosamide in a 2-dimensional culture model.

Directed Differentiation of Human Induced Pluripotent Stem Cells into Cardiac Endothelial Cells

Alex Goff
Faculty Mentor: Ravi Karra
Biological Sciences

Cardiac Endothelial Cells (CECs) instruct Cardiomyocyte (CM) growth and function through various signaling pathways. Many of these pathways are still poorly elucidated and likely play important roles in cardiac disorders. Currently, few models are available to investigate CEC-CM communication. Here, we seek to create a model of CEC-CM signaling by differentiating hiPSCs into CECs and CMs, simultaneously. We have developed a novel co-differentiation protocol that ultimately isolates the two target cell populations from one differentiation via immunomagnetic selection for CECs using the CD34 marker and metabolic selection for CMs. In order to validate our protocol for generating CECs, we assay for endothelial identity with bright-field microscopy, the presence of endothelial markers, and AcLDL uptake assays. Our initial findings suggest there is heterogeneity within our hypothesized CEC population. Therefore, our next steps involve attempting to further enrich the population for pure CECs that will be appropriate for signaling and disease models.

Differing ranges of Picea abies and Abies alba drives fecundity responses to climate change

Ethan Ready
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Biological Sciences

In the coming decades, forest adaptation to climate change will be driven by responses of tree fecundity. In many mixed-species forests, each species faces different constraints on fecundity, in part based on how the local climate compares to the rest of the species' range. I studied the fecundity of a mixed-species forest dominated by Picea abies and Abies alba in the French Alps using crop counts, seed traps, and a hierarchical Bayesian model. The model used spring minimum temperature and moisture surplus/deficit in the two years before seeding as climate variables, with controls for diameter and light availability. Our results show that Picea abies, which is in the southern part of its range, and Abies alba, which is in the northern part of its range, have different fecundity responses to climate variables. Whereas Picea abies displayed a negative relationship with moisture surplus/deficit year anomaly and no relationship to moisture surplus/deficit variation by site, Abies alba had a positive relationship with moisture surplus/deficit year anomaly and variation by site. With positive trends in moisture surplus/deficit, we can expect forest composition in the study area to shift in favor of Abies alba as the climate changes. In other mixed-species forests, studying species ranges can provide insight into how fecundity changes may determine forest adaptation.

Dance Injuries and Biomechanics: Load and Joint Stability Associated with External Rotation of the Lower Extremities

Gabrielle Cooper
Faculty Mentors: Daniel Schmitt, Angel Zeininger and Blythe Williams
Biological Sciences

Physical activities generate ground reaction forces when the body applies loads to the ground. Repetitive, high impact loads over time can be injurious to bones and joints. Dancers are at an elevated risk of injury due to do the high frequency of jumping in dance activities. A unique feature of ballet technique is the use of turnout. Ballet and ballet-influenced styles incorporate external rotation with the technical objective of 90 degree contribution from each hip. The use of turnout may increase stress on lower extremity joints, particularly when dancers turnout past the range of motion of the hip, therefore contributing to turnout from the knee or ankle joint. Therefore, jumps landed on an externally rotated leg may be injurious to lower limb joints. The purpose of this study was to investigate the effect of turnout on ground reaction forces when landing from a jump in trained dancers. It was hypothesized jumps landed with a greater degree of turnout would display a greater peak vertical ground reaction force. Three types of ballet jumps performed at varying degrees of external rotation were analyzed through motion capture to record turnout angle of the landing foot. A force plate recorded ground reaction forces. Six female undergraduate dancers, all with >10 years of dance training and >5 years of ballet training, performed sauté, jeté, and grand jeté jumps in either a parallel, natural turnout, or maximum turnout position. ANOVA, T-tests, and regressions were used to test for significant differences between degree of turnout and peak vertical landing force. Preliminary results for the jeté jump do suggest lower peak vertical force when subjects landed in a natural turnout position. A more comfortable turnout position may allow dancers to better implement technical strategies to reduce landing impact force. Furthermore, beginning data suggest for the grand jeté peak vertical landing force decreased with increased degree of landing turnout. Therefore, turnout may provide some degree of protection against high impact landing forces. This may suggest an unnatural degree of turnout functionally causes a reduction in power and jump height, consequently reducing peak vertical landing force. Still, survey responses from subjects showed increased strain on lower extremity joints as well as decreased stability was felt with increased degree of landing turnout suggesting any benefits of reduced peak vertical landing force may be mitigated by other factors.

Oxytocin and vasopressin 1a receptor neuroanatomy in monogamous and non-monogamous Eulemur

Annika Sharma
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Biological Sciences

Oxytocin (OT) and arginine vasopressin (AVP) are two mammalian neuropeptides with important roles in mating and social bond formation. Many functional models for OT/AVP directly stem from work examining differences in these hormonal systems between closely related rodent species, but translating these findings to human biology is not straightforward. Non-human primates offer an opportunity to bridge this gap. This project makes use of natural variation in mating systems within Eulemur, a genus of strepsirrhine primate, to characterize interspecific variation in the OT/AVP system. Species within Eulemur exhibit both monogamous and non-monogamous mating systems—the only primate genus known to possess such variation. We thus performed oxytocin receptor (OXTR) and vasopressin receptor (AVPR1a) autoradiography on banked Eulemur brain tissue from 12 individuals, representing seven species, to measure and compare receptor densities across the brain. We find conserved binding in several regions, such as parts of the striatum and regions involved in visual attention, consistent with previous work in non-human primates. However, in partial support of the prediction that brain organization of OT/AVP underlies monogamous pair-bonding, we also find some evidence of differential OXTR/ AVPR1a expression in target brain regions including the reticular tegmental nucleus, nucleus prepositus, lateral geniculate nucleus, and ventral anterior nucleus of the thalamus. Mapping differences in OXTR/AVPR1a distribution across Eulemur and other primate species better positions the field to understand evolutionary mechanisms driving diversity and maintenance of mating systems in primates, while also shedding light on its neurobiological bases.

Testing the benefits of sociality: A comparison between solitary and social lemurs' learning styles and problem-solving abilities using puzzle boxes

Natalie Tarn
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Biological Sciences

Primates are unusual amongst mammals in the high degree of sociality that they display. Social living could have a positive impact on problem-solving and learning. Here, we test if lemur species' differences in sociality will influence their ability to solve a puzzle box. Lemurs are an interesting option as they include a variety of solitary and highly social species. The Duke Lemur Center houses both the solitary Daubentonia madagascariensis (aye-aye) as well as social species including the Eulemur flavifrons (blue-eyed black lemur), Propithecus coquereli (Coquerel's sifaka). The comparison of these species should give us insight into how sociality affects problem-solving using puzzle boxes.

Through focal animal sampling, Manipulative actions such as grasping, pulling, and pushing and dominance interactions that influence access to and how they solve the puzzle box was observed preliminarily. A puzzle box with two possible solutions will be introduced to the lemurs in order to compare the differences in learning between the solitary and social species. We will determine species differences in solving the puzzle box due to different social settings and identify intraspecies differences in their ability to solve the puzzle box. We hypothesize that social species (E. flavifrons and P. coquereli) will be more successful at solving puzzle boxes as compared to solitary species (D. madagascariensis).

The Effects of Sleep on Mental and Physical Performance Among College Athletes

Coleman Williams
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Biological Sciences

Sleep is critical for the mental and physical performance of collegiate athletes, yet modern lifestyles and stress can greatly impact normal sleep patterns. Sleep deprivation has many consequences, including decreased concentration, delayed reaction times, increased negative emotions, and damaging health effects. In this research, I recruited a group of ten Duke University baseball players. Over 10 days, I tracked their sleep using wrist actigraphy devices and surveys, and I assessed their mental and physical performance using a variety of physical and mental tasks. I found that these Duke athletes were consistently underestimating the hours of sleep they received per night. Additionally, my analyses revealed that increased sleep duration led to improvements on a concentration grid task, increased self-reported mood, a decrease in heart rate, and increased exit velocity when throwing a baseball. These results support the hypothesis that college athletes perform better mentally and physically when they increase their amount of sleep per night.

Olfactory receptors for the discrimination of specific enantiomers

Conan Juan
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Biological Sciences

Olfaction is mediated by the binding of odorants to olfactory receptors (ORs) in the olfactory epithelium. Odor recognition follows a combinatorial coding scheme, where one OR can be activated by a set of odorants, and one odorant can activate multiple ORs. This enables detection and discrimination against a myriad of volatile odorant molecules. Enantiomeric odors are stereoisomers that are mirror images of each other. They have identical physical properties but are unique molecules that are perceptually distinct. In humans for example, (+)-Carvone is perceived as the smell of caraway, while (-)-Carvone is perceived as spearmint. Furthermore, behavioral studies with CD-1 mice suggest that they also have the ability to discriminate between (+)-Carvone and (-)-Carvone, among other enantiomeric pairs. Here, I hypothesize that these perceptual differences are driven by receptor-level discriminability of enantiomers. To test this hypothesis, I use in vivo phosphorylated ribosomal subunit capture followed by RNA-Seq, in situ hybridization, and in vitro heterologous receptor expression. Through the use of multiple approaches, I am able to rigorously identify and demonstrate ORs capable of discriminating enantiomers both at the in vivo and in vitro levels.

Evolutionary fitness bottlenecks of doxorubicin resistance in osteosarcoma

Anna Slingerland
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Biological Sciences

Chemotherapy treatments for osteosarcoma impose selective pressures on heterogenous cancer cell populations and often leave drug-resistant cells as the fittest survivors able to replicate and render drug treatments ineffective. The development of drug resistance is a primary reason for why osteosarcoma is one of the only types of cancer for which the prognosis given today is nearly identical to the prognosis given in 1988. Studying cancer cell populations during acquisition of drug resistance could provide insight that can ultimately be exploited for therapeutic purposes. The first aim of this study is to determine if doxorubicin-resistant human osteosarcoma cells retain their acquired drug-resistance when released from doxorubicin for varying periods of time. The second goal was to quantify the fitness bottleneck events that occur during the development of doxorubicin resistance. This study uses a novel population lineage tracing system based on CRISPR/Cas9 editing of barcoded cells and IncuCyte real-time imaging to track population bottlenecks during in vitro models of chemotherapy regimens. Results show that doxorubicin-resistant osteosarcoma cells were found to retain strong drug-resistance "memory" regardless of release duration. DNA sequencing of the CRISPR/Cas9 barcodes showed evidence of the emergence of a highly proliferative subclone between two and four weeks of release. RNA sequencing showed remarkable similarities in gene expression between doxorubicin-resistant and released cell populations. Together this data suggests that doxorubicin-resistance is irreversible and that some resistant clones have a significantly higher proliferation rate than others. Analysis of RNA sequencing data pinpoints candidate genes STEAP4, CYP3A7, ABCB1, and ABCC9 to be the resistance drivers and SULT1B1, ALK, and SPNS2 to be potentially actionable targets among the gene regulatory networks of the resistant subclones.

Assessing Region Specific Neurophysiological Effects of UNC9994A Administration?

Alexandra Fink
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Biological Sciences

Schizophrenia, a debilitating psychiatric disorder, is characterized by positive symptoms, (hallucinations), negative symptoms (anhedonia and apathy), and cognitive symptoms (decreased executive functioning). Currently, antipsychotic medications used to treat schizophrenia seek to target the positive symptoms of schizophrenia by decreasing excess striatal dopamine by acting through the D2 receptor G protein pathway. However, they lack efficacy in decreasing the cognitive symptoms of the disease caused by lack of dopamine in the prefrontal cortex. A recently developed drug, UNC-9994A(94A) acts through the D2 receptor B-arrestin2 pathway, allowing it to act as an antagonist in the striatum and an agonist in the cortex of mice. This allows 94A to treat both the positive and negative symptoms of schizophrenia. In our study, we seek to assess how 94A affects single unit recordings and local field potentials (LFPs) in the striatum and prefrontal cortex during antipsychotic action. Phencyclidine (PCP) is used to model schizophrenia in mice. One of the properties of 94A is decreasing PCP induced hyperlocomotion. Mice will be given 94A or vehicle and then given PCP before being placed in an open field arena for 160 minutes. LFP data will be analyzed to provide a better understanding of the neurophysiological impact of 94A administration as well as provide further evidence for its utility as an antipsychotic medication.

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Identifying Extracellular Vesicle-Associated Biomarkers in DYT1 Dystonia

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DYT1 dystonia is a hereditary, early-onset movement disorder characterized by involuntary, sustained, and disabling muscle contractions. There are currently no effective oral drugs for treating the disease or clinical biomarkers for assessing a DYT1 patient's prognosis or treatment response. Using mass spectrometry-based untargeted proteomics, I have discovered genotype-dependent differences in extracellular vesicle proteins derived from an in vitro DYT1 mouse model. I also identified a subset of these candidate biomarkers that show rescue by a novel dystonia therapy, ritonavir. These discovery-phase protein biomarkers are thus a first step toward clinical assays that could fulfill unmet needs in DYT1 dystonia treatment.

Immune profiling of murine breast cancer models

Lauren Sheu
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Biological Sciences

Due to breast cancer's heterogeneous nature, subtypes are treated with different forms of therapeutic intervention. Estrogen receptor-positive (ER+) and HER2-positive (HER2+) breast cancers overexpress ER and the HER2 oncogene, respectively, and respond favorably to targeted therapy. Triple-negative breast cancers (TNBCs) lack ER and HER2 overexpression, so it is especially difficult to develop TNBC-targeted therapies. Immunotherapy has recently emerged as a promising therapeutic approach for breast cancers, especially TNBCs, as the immune system plays a major role in tumorigenesis and metastasis. For example, select factors in the tumor microenvironment (TME) induce the production of pro-tumor M2 macrophages, which perform a variety of immunosuppressive functions. M2 macrophages, along with other cell types such as regulatory CD4+ T cells, are thought to promote tumorigenesis. Other immune cell subsets (e.g. dendritic cells, natural killer cells, cytotoxic CD8+ T cells) are associated with preventing tumorigenesis. In order to develop effective, targeted immunotherapies for breast cancer, however, more information is needed on the immune profiles of breast cancer subtypes. As the breast tumors are heterogeneous, the immune cell populations and proportions present in the TME differ between subtypes, and, as a result, warrant unique immunotherapeutic approaches. We intend to investigate immune cell infiltration in the TME of the following murine breast cancer models—E0771 (C57Bl6), 67NR (BalbC), 4T1 (BalbC), and AT3 (C57Bl6). Exploring immune infiltration in TME of each model will inform immune cell-targeted methods for breast cancer immunotherapy.

Endocytosis of TGF-beta receptors in Endothelial Cells

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Biological Sciences

The transforming growth factor-beta (TGF-beta) superfamily is a group of cytokine growth factors that play an essential role in regulating various cellular processes in all multicellular organisms, including proliferation, apoptosis, and angiogenesis, through the TGF-beta pathway. Given the wide range of cellular processes that the TGF-beta pathway mediates, it is unsurprising that mutations of the pathway frequently result in human disease, such as cancer and blood disorders. ALK1 and endoglin are two receptors in the TGF-beta pathway that play an important role in endothelial cells, which line the interior of blood and lymphatic vessels. Mutations in ALK1 and endoglin result in the human vascular disease, Hereditary Hemorrhagic Telangiectasia (HHT). While the critical role of TGF-beta receptor signaling in endothelial cell biology has been established, the mechanism of signaling through the ALK1 receptor is not fully understood. Additionally, though preliminary data demonstrates that endocytosis of the TGF-beta receptors occurs in endothelial cells, it is unknown what the mechanism of endocytosis is and whether endocytosis is required for downstream signaling of the TGF-beta pathway to occur. To determine whether endocytosis was required for TGF-beta signaling in endothelial cells, endothelial cells were plated and treated with two types of endocytosis inhibitors (Nystatin, which inhibits caveolin-mediated endocytosis, and Pitstop2, which inhibits clathrin-mediated endocytosis). BMP9, a ligand that specifically induces TGF-beta signaling through the ALK1 receptor, was then added to the cells to induce downstream signaling. Results showed that when clathrin-mediated endocytosis was inhibited, TGF-beta signaling was unable to occur, providing evidence that (1) endocytosis of ALK1 was necessary for TGF-beta signaling, and (2) endocytosis of the ALK1 receptor occurs through the clathrin-mediated pathway. Further studies can be performed to establish whether there is a dose-dependent effect of adding the BMP9 ligand on endocytosis of ALK1 for TGF-beta signaling in endothelial cells, which could determine whether the effects of endocytosis inhibition can be overcome through saturation of the TGF-beta receptors with the BMP9 ligand. This research establishes endocytosis as a critical component of TGF-beta signaling, and future research can be conducted to investigate the role of endocytosis in the pathogenesis of HHT.

The role of BRD4-NUT fusion protein in the radiosensitization of NUT Carcinoma

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Biological Sciences

NUT carcinoma is a squamous cell carcinoma that is characterized by a 15;19 chromosomal rearrangement resulting in a fusion oncoprotein between a bromodomain containing protein (BRD4) and the nuclear protein in testis (NUT), termed BRD4-NUT. The mean survival for NUT carcinoma is less than 12 months. NUT carcinoma can be treated with BET family inhibitors that target bromodomain containing proteins, however the duration of treatment and remission is limited by the toxicity of the BET inhibitors. This treatment limitation shows a need to understand and develop alternative treatments, such as radiation therapy. We are investigating the role of BRD4-NUT oncoprotein in the radiosensitivity of NUT carcinoma cells. BRD4-NUT fusion leads to the formation of megadomains in chromatin via positive feedback from histone acetylation. Within the megadomains, transcriptional changes that support dedifferentiation and/or proliferation of cells lead to oncogenesis. Using patient derived cell lines, we will study the role of the megadomains in the DNA damage response (DDR) following radiation. Our hypothesis is that BRD4-NUT megadomains affect DDR machinery kinetics and recruitment to the sites of double strand breaks following radiation. We will analyze cell survival following dissolution of BRD4-NUT oncoprotein foci. We will also induce BRD4-NUT foci formation in non NUT carcinoma cells to analyze the resulting cell survival phenotype from the gain of function. We also want to elucidate the mechanism by which DDR machinery is affected by the BRD4-NUT fusion, so we will be using mRNA sequencing to analyze levels of BRD4 isoform B as well as immunoprecipitation (IP) to identify proteins pulled down in NUT cells.

Regulation of SLC7A11 (System xCT) by ABL Kinases

Felix Steinruecke
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Biological Sciences

SLC7A11, also known as System xCT, is an amino acid antiporter that mediates the exchange of extracellular L-cystine and intracellular L-glutamate across the plasma membrane. SLC7A11 is upregulated in several cancers, including lung, breast and brain, enabling redox homeostasis, chemoresistance, and poor prognosis. Inhibition of SLC7A11 has been shown to reduce malignant glioma growth, peritumoral neuronal cell death, and seizures. However, the effectiveness of xCT inhibitors has been limited by their toxicity and inability to cross the brain-tumor barrier. Global transcriptome analysis of targets controlled by the ABL family of non-receptor tyrosine kinases revealed SLC7A11 as being significantly downregulated in ABL-inhibited cells. Analysis of breast, lung, and glioma cancer cells knockdown for ABL1 and ABL2, or treated with ABL kinase allosteric inhibitors revealed reduced SLC7A11 mRNA and protein levels. Further, ABL inhibition impaired System xCT function as measured by decreased levels of intracellular glutathione and extracellular glutamate. NRF2 has previously been shown to regulate SLC7A11 expression following oxidative stress. Analysis of ABL-inhibited cells revealed reduced NRF2 protein levels and NRF2 target genes. NRF2 rescue experiments in ABL-inhibited cells restored SLC7A11 expression and function. These results suggest a novel treatment modality using ABL inhibitors to target SLC7A11 expression and function.

Regulation of Caskin2 expression under laminar shear stress

Tong Wu
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Biological Sciences

Vascular homeostasis and endothelial cell (EC) quiescence are required for a healthy vasculature and the prevention of atherosclerosis, the leading cause of death in the US. However, the mechanisms regulating these processes are not well understood but would provide insights into the mechanisms of atherosclerosis. Caskin2 is a novel scaffolding protein shown in our lab to play a mechanoresponsive role in regulating vascular homeostasis and EC quiescence. Preliminary data demonstrated that Caskin2 overexpression in ECs upregulates endothelial Nitric Oxide Synthase (eNOS) in vitro, and both proteins are upregulated under atheroprotective laminar shear stress (LSS). We hypothesized that KLF2, an important regulator of LSS-mediated gene expression, is a transcription factor that regulates Caskin2 via its promoter. qPCR analysis revealed that KLF2 upregulated Caskin2 mRNA under LSS. Truncation of the Caskin2 promoter revealed that the majority of Caskin2 promoter activity is localized in the 400bp region upstream of the TSS, which is upregulated with KLF2. Furthermore, AP1, a transcription factor associated with inflammation and atheroprone phenotype, downregulated Caskin2 promoter activity, especially in the 400 bp region. Therefore, the results from these studies demonstrate that Caskin2, a novel regulator of atherosclerosis, is regulated by KLF2 and deactivated by AP1 during laminar shear stress. Further studies on the mechanisms of LSS-dependent Caskin2 gene expression will provide a better understanding of how vascular homeostasis and EC quiescence are regulated, which is important in improving cardiovascular health.

Identifying cancer malignancy with a novel small-molecule heat shock protein 90 (Hsp90) inhibitor

Kelly Yang
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Biological Sciences

Heat-shock protein 90 (Hsp90) makes up 2% of total cell protein mass and chaperones over 200 proteins, including many well-known oncogenic kinases. Hsp90 is upregulated in cancer cells, where they play an integral role in buffering proteomic stress of rapid cell division. Hsp90 is also associated with malignancy; higher levels of Hsp90 tend to worse prognoses. Current cancer screening methods largely focus on visible abnormalities and are not attuned to molecular changes, which can occur before anatomical changes and tissue microcalcifications. When detected early, cancers may be easier to treat. Utilizing the differentiation in Hsp90 expression between healthy and malignant cells could be an important tool for earlier diagnoses.

This research project aims to identify a fluorescent, small-molecule Hsp90 inhibitor. The first part of this study compares two novel Hsp90 inhibitors, HS-273 and HS-279. Cancerous, healthy and immune cell lines were treated at various concentrations to determine which drug had better cellular uptake and fluorescence. The stronger indicator is then compared to fluorescence profiles of non-permeable Hsp90 probes previously characterized by our lab. Additionally, Hsp90 is upregulated in active immune cells, which are key components of the tumor microenvironment. We hypothesized that our novel Hsp90 inhibitor would be able to identify resting vs. active immune cells, and carried out various treatments on resting vs. LPS-activated THP-1 macrophages. Taken together, a strong fluorescent indicator for malignancy and inflammation in the tumor microenvironment could have important clinical implications.

Reconsidering the Oyster: Realities and Trajectories of Oyster Mariculture in North Carolina

Lara Breitkreutz
Faculty Mentors: Lisa Campbell, Wesley Hogan and Thomas Schultz
Creative Arts

I desire a more comprehensive understanding of the oceans as resource, and our changing relationship to the ocean in the midst of an anthropogenically altered landscape and uncertain future. I turned my attention to an issue of local relevance, the emerging North Carolina oyster mariculture industry. Historically, the oyster was held to high cultural and economic regard, but changes in our use of the coastal landscape had significantly reduced their numbers. Now, oysters are increasingly recognized for their potential in contributing to our food future, as their cultivation is associated with a myriad of environmental benefits unseen within other agricultural systems, from water filtration, the mitigation of nutrient loading, and enhancing ecosystem biodiversity and resilience through the provisioning of structurally complex habitat. Realizing the coupled economic and environmental benefits that come with replenishing our waterways through farming these shellfish, we are reconsidering the oyster within our ecosystems and coastal communities. Based on interviews with farmers, distributers, scientists, and oyster enthusiasts, I strive to honestly communicate the current status of oyster mariculture through expressed and observed industry constraints and opportunities, and explore how proposed environmental solutions, and how we perceive them from afar, actually align with the realities, the communities, within which they unfold. The industry is confronting challenges of conflicting water use, the need for new distribution pathways, and differing perspectives on an accepted trajectory. The science is actively unfolding, bringing needed research about the impacts of oyster mariculture to the surface for scrutiny. I use the documentary process to collect stories, to explore the realities of the emerging industry, and to ultimately piece together a thoughtfully researched visual narrative, the oyster front and center in considering our relationship with the natural world.

Harnessing the Power of Storytelling to Understand Complex Narratives and Drive Community Change in Israel

Andrew Carlins
Faculty Mentor: Malachi Hacohen
Creative Arts

With the land mass of New Jersey, and home to 8.7 million inhabitants, Israel receives a lot of attention in the media relative to its population and size. As two Jewish-American college students, my co-producer, Grant Besner (T'19), and I, a Duke University sophomore, were incredibly fascinated by this young nation and wanted to dive deep and build a nuanced understanding of it. We felt that there was an important story to be told beyond the media's politicized portrayals of Israel that juxtapose a modern-day miracle to a merciless occupier: the story of the incredibly diverse people residing in Israel! Over the summer, we spent ten weeks interviewing Israelis from all walks of life to create a podcast called "Isthatraeli?" Our interviews ranged from an Eritrean asylum seeker to the former American-Israeli spokesperson for the Israeli Defense Forces. Each episode paints a nuanced portrait of Israel, a country, the complexities of which conventional language cannot grasp. Our base was the African Refugee Development Center in Tel-Aviv, but the project took us all over the country. By helping people share their stories on a common platform, our hope is that listeners will learn, as we have through this journey, to view macroscopic issues through diverse perspectives. The podcast is published at www.isthatraeli.com.

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Multi-Disciplinary Development of a Low-Cost Gastroschisis Silo for Use in Sub-Saharan Africa

Arushi Biswas, Caroline Salzman, Patrick Wilson, Muthukurisil Arivoli, Nolan Burroughs
Faculty Mentors: Ann Saterbak and Tamara Fitzgerald
Health/Clinical Research

Purpose:
Gastroschisis silos are often unavailable in sub-Saharan Africa, contributing to high mortality. We describe a collaboration between engineers and surgeons in the U.S. and Uganda to develop a silo from locally available materials.
Methods:
Design criteria included: < $5 cost, 5±0.25 cm opening diameter, deformability of the opening construct, ≥ 500 mL volume, ≥ 30 N tensile strength, no statistical difference in leakage rate between low-cost silo and preformed silo, ease of manufacturing, and reusability. Pugh scoring matrices were used to assess designs. Materials considered included: urine collection bags, IV bags, or zipper storage bags for the silo; female condom rings or O-rings for the silo opening construct. Silos were assembled with clothing irons and sewn with thread. Colleagues in Uganda, Malawi, Tanzania, and Kenya investigated material cost and availability.
Results:
Urine collection bags and female condom rings were chosen as the most accessible materials. Silos were estimated to cost < $1 in sub-Saharan Africa. Silos yielded a diameter of 5.01±0.11 cm and a volume of 675±7 mL. The iron+sewn seal, sewn seal, and ironed seal on the silos yielded tensile strengths of 31.1±5.3 N, 30.1±2.9N, and 14.7±2.4N respectively, compared to the seal of the current standard of care silo of 41.8±6.1 N. The low-cost silos had comparable leakage rates along the opening and along the seal to the spring-loaded preformed silo. The silos were easily constructed by biomedical engineering students within 15 minutes. All silos were able to be sterilized by submersion.
Conclusion:
A low-cost gastroschisis silo was constructed from materials locally available in sub-Saharan Africa. Further in vivo and clinical studies are needed to determine if mortality can be improved with this design.

Urine Metals Analysis Using a New Automated Sample Introduction System for ICP-MS

Jordyn Blake
Faculty Mentor: Nimmi Ramanujam
Health/Clinical Research

Clinical laboratories need to rapidly and accurately analyze thousands of biological samples for trace metal contaminants by ICPMS. This requirement means laboratories must constantly look for new techniques to maintain high sample throughput requirements. Many clinical labs have taken advantage of the FAST technology introduced by Elemental Scientific, Inc (ESI) in 2006. The FAST is an automated sample introduction system for ICP and ICPMS which increases instrument efficiency up to five-fold by reducing time otherwise wasted performing sample flush, read delay, and wash.

SampleSense FAST is the most recent advancement in FAST technology. SampleSense couples an autosampler with an inert valve having integrated optical sensors to automatically detect the presence of a non-segmented liquid sample. SampleSense eliminates valve timing parameters, method adjustments to account for timing differences associated with variations in sample viscosity, or even long-term instrument hardware variables that can affect analysis timing. Upon detection, the sensed sample is injected to the ICPMS nebulizer and the ICPMS analysis is triggered. Un-sensed samples are not triggered for analysis and ICPMS QC software can be configured to identify and report un-sensed samples.

This work will show the performance of the SampleSense FAST valve for the analysis of urine samples. Linearity for calibration curves using matrix matched calibration standards, precision for a typical analytical run, and accuracy to New York Department of Health (NYDOH) proficiency testing (PT) samples will be presented.

Raman Spectroscopic Characterization of Tissue Necrosis due to Therapeutic Ethanol Ablation

Soomin Myoung
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Health/Clinical Research

Ethanol ablation of cancerous and precancerous tissue offers promise as a simple, inexpensive therapy in low resource settings which lack infrastructure, trained personnel, and resources necessary for conventional treatments. Previous studies showed that ablation by injected ethanol-ethylcellulose (ETOH-EC) is effective in reducing tumor size and further development of this therapeutic approach requires understanding the dose response of ETOH-EC concentrations vs. tissue necrosis. Integrated experimental and computational methods were applied to analyze this, including use of confocal Raman spectroscopy to map the time-space history of ETOH-EC concentrations during transport through tissue. Given that Raman can provide a molecular blueprint of tissue composition and structure, it was used in this context to map tissue necrosis after ETOH exposure, working to delineate the dose response. To accomplish this, an ex-vivo assay was developed to quantify tissue necrosis due to ethanol ablation using confocal Raman spectroscopy. Peaks were quantified and stratified as functions of ETOH concentration. Linear fitting of Raman peak heights vs. ETOH concentration gave strong correlations at vibrational changes associated with tryptophan, collagen and phospholipids respectively. The ratio of the peaks was used to reduce systematic errors, giving a metric with higher sensitivity and correlation with tissue necrosis. Raman spectral analysis after tissue incubation with ranging ethanol concentrations gave correlations vs. concentration indicative of ranging structural changes and the peak height ratio gave a strong correlation. We propose using this ratio as a metric for tissue necrosis. Current experiments include temporal ETOH exposure. Quantifying the dose-response of ethanol ablation of tissue will facilitate development of ETOH-EC injections to maximize necrosis within tumor boundaries while minimizing damage of surrounding healthy tissue.

CaMKK2 knockout in mice challenged by orthotopic GBM leads to upregulation of MHC II on TAMs and an increase in accumulation of CD4+ TILs

Molly Chakraborty
Faculty Mentor: John Sampson
Health/Clinical Research

Glioblastoma (GBM) is the most lethal primary brain tumor in adults, with the median survival time for GBM patients being only about 15 months. Although immunotherapy treatments have been successful in more immunogenic tumors, it has shown very limited success in GBM. This could be because it is difficult for T cells to infiltrate the tumor, and the tumors have a very immunosuppressive tumor microenvironment (TME) that can often consist of up to about 30 percent tumor associated macrophages (TAMs) by mass. Thus, two ways of possibly improving immunotherapy treatments on GBMs would be to increase the number of tumor infiltrating lymphocytes (TILs) present, and to target tumor-supportive cells such as TAMs. Calmodulin Dependent Protein Kinase Kinase 2 (CaMKK2) is a gene that has been shown to be highly expressed in myeloid cells and is known to alter their phenotype. Recent studies in breast cancer have shown that myeloid cells adopt a more immunostimulatory phenotype in murine knockout CaMKK2 models. However, it is not well understood how CaMKK2 causes this immunosuppressive effect and warrants further exploration. The data from our experiments help to answer this question. High-dimensional flow cytometry with 15 parameters was used in order to determine the identities of immune cells found in the tumor of wildtype and CaMKK2-/- mice. The results of our experiments show that there appear to be more CD4+ TILs present in the TME of knockout mice and that there is an increase in MHC II expression on TAMs found in knockout mice. Since CD4+ TILs recognize peptides presented on MHC II molecules, and there is an increase in the number of CD4+ TILs and expression of MHC II on TAMs in knockout mice, we hypothesize that a stronger immune response could be instigated against the tumor. Therefore, it can be concluded that a possible reason that knocking out CaMKK2 leads to a less immunosuppressive TME is because MHC II expression on TAMs is upregulated, and the number of CD4+ TILs in the TME is increased. Whether or not the increase in MHC II expression causes the increase in the number CD4+ TILs requires further exploration. This makes CaMKK2 a promising therapeutic target to treat tumors with immunosuppressive TMEs such as GBM.

Alterations in white matter connectivity associated with changes in cognition in older surgical patients

Richard Huang
Faculty Mentor: Miles Berger
Health/Clinical Research

As the population of older patients grows significantly, many more older patients will undergo surgery and anesthesia. A major concern to this growing demand is understanding the increased risk of experiencing negative cognitive outcomes post-operation in this elderly population. Past work has demonstrated changes in functional network connectivity in the brain and cognitive decline after surgery and anesthesia in older patients. However, there are limited works to identify anatomical changes that arise after operation and how they correlate with changes in cognitive function. In this study, 48 surgical patients over the age of 60 undergoing surgery with general anesthesia participated in a neuropsychological testing battery and MRI scan at baseline pre- op and six-weeks post-op time points. Factor analysis on neuropsychological testing scores were used to generate measures of delayed memory, immediate memory, executive function, and information processing speed. Connectometry analysis was then performed via DSI Studio on the diffusion data using q-space diffeomorphic reconstruction with 5000 randomized permutations. Quantitative anisotropy (QA), a measure of the density of water diffusion in the brain, was used as the metric of analysis. Paired longitudinal analysis demonstrated no significant changes (FDR < 0.05 or length > 20mm) in whole brain tract QA connectivity from before to six-weeks after surgery and anesthesia. However, multiple regression analysis showed significant positive associations in the corpus callosum (CC) and middle cerebellar peduncle (MCP) between changes in tract QA and in delayed and immediate memory performance. Changes in QA in the CC and MCP were also negatively associated with changes in executive memory performance. Changes in information processing speed performance were positively associated with QA changes in the CC and negatively associated with QA changes in the MCP. These associations demonstrate the importance of inter-hemispheric communication and cerebellar function in the mediation of cognitive task performance post-operation. Additional research is necessary to understand the physiological interpretation of QA to better elucidate a mechanism of post-operative cognitive change in an older patient demographic.

Mechanisms of Pulmonary Hypertension in Chronic Kidney Disease

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Health/Clinical Research

Chronic kidney disease (CKD) is a complex disease characterized by the reduction of kidney function over a period of time, affecting more than 20 million people in the United States. The number of patients with CKD are continuing to rise, especially those with preexisting hypertension and diabetes. Patients with CKD are likely to display evidence of pulmonary hypertension (PH). In fact, 21-41% of patients with CKD exhibit PH, and this statistic increases up to 60% for patients with end-stage kidney disease (ESKD). Although there is increased risk and mortality associated with PH and CKD, there are not currently any effective target therapies for this condition. There is not much research that has explained the underlying mechanisms linking PH to CKD and this relationship currently poorly understood. In this study, we are investigating the link between PH and CKD. We hypothesize that CKD produces alterations in pulmonary vasoconstriction leading to PH. To test this hypothesis, we developed mice models that reflect the presence of PH with CKD by giving them an adenine diet for 12 weeks and tested the levels of potential chemical mediators of pulmonary hypertension in chronic kidney disease, particularly ADMA and serotonin. Significant elevated levels of serotonin and ADMA were present in mice after 12 weeks of adenine diet. Given previous evidence for the association of serotonin in mice with CKD as well as with PH, our results support that serotonin plays a role in the development of PH in mice with CKD by altering pulmonary vasculature. Furthermore, the elevation of ADMA suggests that it could be another marker for the presence of PH and its role in the nitric oxide pathway may be a possible causal factor. With further investigation, effective therapy targeting serotonin and ADMA could be developed and used to treat patients with CKD who also have PH, decreasing mortality and improving overall outcomes.

The role of Sox9 expression in acute kidney injury induced renal maladaptive repair

Xuanyu Zhou
Faculty Mentor: Tomokazu Souma
Health/Clinical Research

Clinically, two distinguishable but interrelated syndromes, acute kidney injury (AKI) and chronic kidney disease (CKD), are identified in patients with kidney disease.1 The transition of AKI to CKD is a major contributor to CKD pathogenesis, a syndrome caused by renal maladaptive repair.3 Past research identified the essential functions of the transcription factor SRY-box9 (SOX9) as an acute epithelial stress response in renal repair after an upregulation of Sox9 in proximal tubular (PT) cells had been identified.3 Sox-9 lineage cells were observed to help renal regeneration of PT epithelial cells.3 However, Sox9 upregulation in the heart and liver tissues had also been established as an important contributor to fibrotic scarring and organ failure.2,4 Fibroblast-specific deletion of Sox9 in heart and liver tissues has shown to significantly reduce heart and liver dysfunction, scarring and inflammation.2,4 Given the lack of literature in the function of SOX9 expression in renal fibrosis, we decided to test if SOX9 is activated in renal fibroblasts to assess whether the expression of SOX9 would contribute to scarring in post-AKI renal maladaptive repair. To test this hypothesis, we employed a genetic lineage tracing approach by using a Sox9CreER; Rosa26tdTomato mouse line. This tamoxifen-inducible reporter mouse line allowed us to visualize Sox9-lineage cells by red fluorescence. We induced renal maladaptive repair and fibrosis through a unilateral ureteral obstruction (UUO) model. We then observed fibroblasts by immunofluorescent staining with anti-platelet-derived growth factor receptor beta (PDGFRb) antibody, PDGFRb-positive fibroblasts were detected with green fluorescence. The Sox9-lineage renal fibroblasts/myofibroblasts emit yellow fluorescence. We observed a vast majority of renal fibroblasts were negative for red-fluorescence, and a few Sox9-lineage renal fibroblasts/myofibroblasts were detected in the medulla of contralateral uninjured kidneys and both cortex and medulla in the injured kidneys. Thus, while more research is required, we conclude that kidney fibrosis may have a different molecule mechanism compared to other organs.

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Effect of CDKAL1 polymorphisms on insulin translation and Type 2 Diabetes susceptibility

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Type 2 Diabetes (T2D) affects over 30 million people and is the seventh leading cause of death in the United States. Genome-wide association studies have found that people with single nucleotide polymorphisms (SNPs) within intron 5 of Cdkal1, a gene associated with insulin translation and processing, have an increased risk of developing T2D. In pancreatic Beta-cells, the Cdkal1 gene encodes a methylthiotransferase, which uses S-adenosylmethionine radical to catalyze the addition of a methyl-thio group onto the adenosine nucleotide at position 37 of the anticodon loop of tRNALys3, an important tRNA required for lysine incorporation during translation. Without this modification, tRNALys3 becomes inefficient and the frequency of mutations increases, emphasizing the crucial role tRNA modifications play in improving codon recognition and maintaining translational fidelity. Because the Cdkal1 gene is required to properly modify tRNA, Cdkal1 SNPs may be affecting how Cdkal1 mRNA and protein are produced. If tRNALys3 is not modified because the function of the Cdkal1 gene is compromised, insulin precursors may not be able to be processed correctly, due to a lack of modified tRNAs. In order to understand how Cdkal1 SNPs and the lack of a properly functioning tRNA modification enzyme can cause T2D, a Cdkal1 knockdown mouse Beta-cell line was produced and induced for insulin. When wild-type (WT) and Cdkal1 knockdown cells were subjected to glucose stimulation, the knockdown cell line demonstrated significantly decreased insulin production compared to the wild-type. We will continue to study the Cdkal1 protein, insulin precursors, and mature insulin production using a Cdkal1 knock-out cell line. To understand the role of Cdkal1 variants in T2D disease risk, Cdkal1 knock-out cells will be transfected with WT human Cdkal1 DNA to rescue the production of cdkal1 protein in correctly processing the mRNA, translating and secreting insulin. SNPs within intron 5 will be introduced to rescue knockout mouse cells to probe and study the protein, pre-mRNA, and mature mRNA production. We will determine the role of Cdkal1 gene in transcription and translation of insulin, as well as the process behind these functions. Sequences will then be analyzed to understand how the lysine codon is translated when tRNALys3 lacks the modification. This project will provide insight for us to understand how Cdkal1 SNP-associated T2D develops.

Gaze tracking in piano players: analysis of visual patterns and methodological approaches

Bryce Polascik
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Health/Clinical Research

Purpose: To quantify differences in visual attentiveness using head mounted gaze tracking technology in piano players with different levels of experience while playing memorized pieces of varying difficulty. To analyze and compare the gaze tracking data using 3 different analytical methods. **Methods:** Subjects who were currently taking or had previously taken piano lessons were enrolled. Each participant wore the OmniView-TX Head-Mounted Eye Tracking Headset. In the Target Trials, subjects repeatedly played the first piece while looking at 10 specific visual targets over 10 sec intervals. Each subject was given 10-20 minutes to memorize each of the 3 pieces: Chopsticks (very easy), Heart and Soul (easy), Buffoons (intermediate). With the gaze tracking headset activated, each subject performed each piece in the Performance Trials. Image stacks from videos were used to score the foveola, crosshair, and fovea circle using ImageJ. A questionnaire gathered data on confounding variables. **Results:** One target trial and 3 performance trials were completed and gaze tracking data was collected on one less experienced and one more experienced pianist. For 10 targets, the average % hits was highest for the fovea for both subjects across all ten targets. For the fovea, the average % hits was ~ 50% for inexperienced player vs 10-20% for foveola and crosshair and ~ 50% for experienced player vs 30-40% for foveola and crosshair. There were more % hits for static than moving targets. The less experienced pianist focused on hands and keys irrespective of piece difficulty – 97%, 100%, 100%. The more experienced participant initially fixated elsewhere (57%) and increasingly fixated on hands and keys as piece difficulty increased – 43%, 70%, 76%. Both preferred hands vs keys, except the experienced pianist fixated on keys for the most difficult piece. The inexperienced pianist fixated most on the right hand. **Conclusions:** Less piano playing experience may be associated with preferential foveal fixation on the hands and keys when playing memorized sheet music irrespective of song difficulty, whereas more piano playing experience may not be, unless piece difficulty increases. We recommend using foveal fixation as a means to evaluate gaze location due to its superiority over foveolar fixation and gaze-tracker crosshair in maximizing data capture. Further study is warranted to determine the threshold of piece difficulty in assessing gaze location as a function of experience level.

Addressing Hepatitis C in the American Incarcerated Population: Strategies for Nationwide Elimination

Selin Ocal
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Health/Clinical Research

The prevalence of Hepatitis C virus (HCV) in the US incarcerated population is disproportionately high, and when inmates with infection are released back into the general population, they play a substantial role in the spread of disease. This review provides support for targeting the jail/prison population to eliminate HCV in the general population. It will also summarize various screening/treatment models to curtail the burden of disease behind and beyond bars. Transitioning from risk-based testing to opt-out testing in prisons/jails would be cost-effective through greater identification of cases and treatment to prevent complications from cirrhosis. Other innovative strategies, such as the nominal pricing mechanism or the "Netflix" DAA subscription model, have the potential to be cost-effective and to increase access to treatment. Addressing HCV in the incarcerated population is a strategy to bring the US closer to successfully eradicating the epidemic. Such findings should incentivize policymakers to implement care models that target this population.

Bottom's Up! Rectal Nutrition in Turn-of-the-Century Surgery

Natalie Gulrajani
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Health/Clinical Research

The implementation of anesthesia and asepsis in the late 19th century enabled intra-abdominal surgery. While these cases provided extraordinary opportunities for surgeons and patients alike, they also created new problems, such as ileus. In an era before IV fluids were common, and decades prior to the discovery of total parenteral nutrition (TPN), surgeons watched their patients die of dehydration or starvation after otherwise successful procedures. In response, they devised novel interventions to resuscitate their patients. By far the most widespread –and the modality perceived to be most effective– was fluids and nutrition delivered rectally by enema.

As early as 1868, physicians recorded using enemas to hydrate and nourish their postoperative patients. Multiple studies assessed its efficacy over the years as the method spread rapidly throughout the United States and Europe. Best described by Chicago surgeon J.B. Murphy (of Murphy's sign), and popularized by leading physicians such as Rudolph Matas, rectal alimentation appears in hundreds of contemporary articles as well as in meeting programs of the American Surgical Association, Southern Surgical Association, and others. Despite several studies negating its value, the process was regarded as the most effective means of providing post-operative sustenance, so much so that the physicians of Presidents Garfield and McKinley utilized rectal nutrition in an attempt to resuscitate their dying patients. In addition to normal saline and glucose solutions, nutritive enemas often included ingredients such as milk, sherry wine, eggs, bourbon, and beef juice. By the early 20th century, physicians began to experiment with IV fluids, yet the use of rectal hydration remained a valid treatment option for several decades until the IV drip finally won favor, eventually supplemented by TPN.

Examining the rise of rectal nutrition illuminates the process of surgical innovation: how surgeons recognized a clinical problem, creatively devised rational solutions, determined its efficacy, and disseminated these ideas to their colleagues to ensure widespread practice. Its 60 year retention, despite mounting evidence against its efficacy, highlights both the longstanding tension between data and personal experience as well as the lack of viable alternatives. Exploring the eventual downfall of rectal nutrition similarly exposes how surgery changes as new interventions continually replace, and improve upon, the status quo.

Characterizing Heart Transcriptome Codon Usage Bias for Orthogonal Gene Therapeutics in Heart Failure

Bing Ho
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Health/Clinical Research

In 2018, 1 in 9 deaths in the U.S. were attributed to heart failure (HF). Currently, most treatment options only mitigate the symptoms of HF, with the dysregulation of contractile heart proteins primarily responsible for improper contraction. However, cardiovascular research has been focused on developing methods to utilize gene therapy to treat individuals with heart failure. However, clinically applicable results are scarce due to off-targeting effects. Thus, this project expects to demonstrate that physiologically critical heart proteins are regulated by the usage of rare synonymous codons- ideal candidates for improving the specificity of gene targets in cardiovascular treatment. Guided by the human heart Codon Usage Table, the identification of the "TCG" serine codon as an infrequently utilized synonymous codon- 5.5% prevalence- in the heart allowed me to identify the phospholamban (PLN) protein for further study due to its ubiquitous usage of the "TCG" codon within its coding sequence. PLN was of interest due to its five-fold over expression in the human heart and role in reducing heart contractility through calcium handling with sarcoendoplasmic calcium ATP-ase. I plan to transfect Human Embryonic Kidney (HEK) cells with human phospholamban vectors utilizing lipofectamine transfection assays and create five synonymous mutants through site-directed mutagenesis at the serine 16 position of PLN (e.g. TCG → TCC, TCG → TCC, etc.) to determine if differences in synonymous codons will upregulate PLN expression in HEK cells. Next, I will quantify changes in PLN mRNA/ protein content with RT-qPCR and western blotting to analyze how synonymous codon usage at the Ser16 position influences transcriptional and translational expression of PLN. The goal of the project is to demonstrate that codon usage bias is a physiologically relevant regulator in cardiac protein expression. Consequently, demonstration of these results would identify new target proteins for cardiovascular gene therapies with high specificity and further the field of translational cardiac research. Characterization of codon usage bias in contractile regulating proteins is necessary for addressing questions on how to improve the effectiveness and specificity in individuals affected by heart failure as academic interest in personalized medicine grows.

Study of the development and aging of the brain through metabolic, inflammation and quality control pathways

Ketty Bai
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Health/Clinical Research

The purpose of this study was to investigate the activity of metabolic pathways in mice brain models at different stages of aging. Certain pathways, such as lysosomal biogenesis and autophagy pathways, are known to decline with age. Dysfunction of these pathways leads to neurodegeneration in the brain, which can manifest as a variety of neurodegenerative diseases, such as Alzheimer's and Parkinson's disease. qPCR analysis and immunohistochemistry were performed on brain samples from mice categorized into different age groups. Markers of glycolysis, chaperones, ER stress, inflammation, and autophagy pathways were selected and studied. Preliminary results from qPCR indicate that younger age groups have significantly higher transcription levels of markers of certain cellular pathways in brain cells, with the exception of inflammation, suggesting a decline in transcriptional activity of protein quality control and bioenergetic pathways in the aging brain. Initial immunohistochemistry revealed an increase in neuroinflammation and a decrease in neurogenesis in the dentate of the hippocampus of the aging brain. The ultimate goal of this study is to better our understanding of brain pathways in order to find more effective therapeutic candidates for neurodegenerative diseases.

The MARBLE Study: Modulating ApoE signaling to Reduce Brain inflammation, deLirium, and postopErative Cognitive Dysfunction

Shayan Smani
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Health/Clinical Research

Background/Objectives: Perioperative neurocognitive disorders (PND) such as postoperative cognitive dysfunction (POCD) and delirium are common complications in older adults associated with increased 1-year mortality and long-term cognitive decline. One risk factor for worsened long term cognitive trajectory after anesthesia/surgery is the APOE4 allele, which increases the risk of late onset Alzheimer's Disease (AD). ApoE4 may elevate AD risk partly by increasing neuroinflammation, which is also thought to play a role in POCD and delirium. Thus, the MARBLE study (Modulating ApoE signaling to Reduce Brain inflammation, deLirium, and postopErative cognitive dysfunction) is designed to evaluate the safety of modulating ApoE4 signaling with the ApoE4 mimetic peptide CN-105 in older surgical patients. Design: Randomized, blinded, placebo-controlled phase II sequential dose escalation trial. The primary objective is to evaluate the safety of perioperative CN-105 administration. Secondary objectives include measuring the feasibility of perioperative CN-105 administration and its efficacy for preventing POCD, delirium, and neuroinflammation. Setting: Duke University Health System. Participants: Non-cardiac, non-neurologic surgery patients age ≥60 years (N = 201). Intervention: Intravenous administration of CN-105 or placebo every 6 hours (starting immediately prior to surgery), up to 13 doses total. Measurements: Participants undergo cognitive testing within two months before surgery and six weeks after surgery. Delirium screening is performed on postoperative days 1 to 5 or until hospital discharge. Blood and Cerebrospinal Fluid (CSF) samples are obtained before surgery, and 24 hours and 6 weeks after surgery to measure CSF tau, phospho-tau, amyloid beta (Aß) and IL-6, IL-8, MCP-1, and G-CSF levels. Electroencephalogram (EEG) recordings are performed to identify neurophysiologic correlates of neuroinflammation, delirium and/or POCD. Conclusions: MARBLE uses a transdisciplinary approach to study the safety and efficacy of CN-105 for reducing neuroinflammation and preventing delirium and POCD in older surgical patients, potentially offering further insight into the pathogenesis of these syndromes.

NUAK2 inhibition and lipotoxicity in Prostate Cancer

Megan Zhao
Faculty Mentor: Everardo Macias
Health/Clinical Research

Obesity has been shown to worsen outcomes in various cancer types, including prostate cancer (PC). PC is already the second leading cause of cancer-related death in men, but with the added risk factor of obesity, PC-specific mortality increases significantly with increasing BMI. In an in vivo shRNA kinome screen, the kinase NUAK2 was identified as essential to the growth of tumors in obese mice but not lean mice, presenting a unique target for obesity-related PC. Not only is NUAK2 expression elevated in more aggressive PC, metastatic PC rapid autopsy biopsies also show increased NUAK2 enzymatic activity as compared to localized tumors. Our previous unpublished in vitro studies have confirmed NUAK2 as an actionable target in PC cell lines through the use of semi-specific small-molecule inhibitors, WZ4003 and HTH-02-006. Both compounds slowed cell proliferation, spheroid growth, migration, and Matrigel invasion. The goal of this current study is to examine whether NUAK2 is a protective factor against lipotoxicity in PC cells, and as a result, to identify a way to exploit the necessity of NUAK2 in obesity-related PCs. To model the interaction between PC and obesity in vitro, NUAK2 was pharmacologically, as well as genetically-inhibited, in PC cells, which were then supplemented with Palmitic Acid (PA) or LipoGro. In both approaches, the depletion of NUAK2 increased the sensitivity of cells to fatty acid-induced cell death, suggesting NUAK2 may be essential for tumor cell growth under obese-like conditions. Our current in vivo study models NUAK2 inhibition in mice on a high-fat diet versus a control diet. NUAK2 has been shown to act in a feed-forward loop in other types of cancers, but its role as an upstream regulator of Hippo-YAP pathway effectors YAP and TAZ still requires validation, especially in the context of obesity. There remains a need for additional examination of how targeting NUAK2 can be harnessed to combat obesity-enhanced PC.

Investigating Barriers to Vaccination Among Durham County's Vulnerable Populations

Aditya Santoki
Faculty Mentor: Nathan Boucher
Health/Clinical Research

As antivaccination movements increase in the United States, underlying structural barriers to vaccination are often ignored. This study was examines barriers to vaccination in an adult population to uncover factors leading to lower or higher vaccination rates in higher need populations. This study was approved by the Duke University Campus Institutional Review Board. Fifty-four patients at the Adult Immunizations Clinic of the Durham County Department of Public Health were interviewed throughout June and July 2019. Subjects were enrolled on a voluntary basis followed by oral consent. Eligible subjects included English-speaking adults receiving vaccines aged 19 or older. Anonymous and confidential interviews—all in-person by the same trained interviewer—were conducted verbally. This study found that a large proportion of study participants were referred by their provider to receive vaccines at the health department. It was also found that having a provider appeared to lead to a decrease in vaccine hesitancy. However, this study showed that an enhanced patient understanding of vaccines was not necessarily contributing to the aforementioned apparent decrease in vaccine hesitancy. Patients who had an understanding of the importance of public health had the same rate of vaccine hesitancy as those who had no reason for receiving vaccines. The provider plays an essential role in reducing vaccine hesitancy. However increases in vaccine uptake due to provider-level interventions may not necessarily be due to an enhanced understanding of vaccines or their importance to public health.

Every Contact Leaves a Trace: Nadia Kaabi-Linke's Transfer Prints, 2008-2016

Jessica Chen
Faculty Mentor: Kristine Stiles
Humanities

In this presentation, I examine contemporary artist Nadia Kaabi-Linke's series of "transfer prints," a body of work that covers the years 2008 to 2016. Kaabi-Linke, who is Tunisian-Ukrainian and now lives in Berlin, uses faint traces of human activity – paint chips, fingerprints, dust – to create installations, drawings, prints, and paintings that investigate themes of remembrance, pain, and existing between cultures. The "transfer print" series relies on a technique of recovering marks and traces from different surfaces, a method that may be considered forensic. She has taken prints from walls, bridges, subway stations, and bodies across the globe: Tunisia, Germany, and the United Kingdom, and Egypt. Her work seeks to question the limits of one's ability to know and connect to the past. I focus on a single work of hers, Sepulchre (2014), a print of a German tomb that was damaged and never repaired in the Battle of Berlin. The implications of the tomb's location in the cemetery, Kaabi-Linke's transfer print method, and the tomb's relationship to bodily trauma are key components of my analysis.

Mapping Social and Spatial Encounters in Eighteenth-Century Venice

Noah Michaud
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Humanities

This poster highlights historical research undertaken for Senses of Venice, a recent interactive exhibition at Duke University Libraries (August 15, 2019-January 21, 2020). Senses of Venice explores the world of Venice through holdings in the university's rare book & manuscript library, in particular its recently-acquired map of Venice by Ludovico Ughi, first printed in 1729 (Iconografica rappresentazione della inclita citta di Venezia…). The three complementary digital displays of the exhibition are grounded in extensive research of primary documents and secondary literature, as well as on-site study of Venice and its art and culture. Specifically, this poster contextualizes the display entitled, "A Day in the Life" and the research methods I used to identify the predominant socio-artistic circles of eighteenth-century Venice and also to determine the paths select Venetians routinely took throughout the city. This touchscreen/projection display includes a series of animated, day-long narrative journeys for four prominent Venetians active at the time of the Ughi map's production—Giacomo Casanova, Rosalba Carriera, Caterina Sagredo Barbarigo, and Consul Joseph Smith. This public-facing research project exemplifies how to integrate both digital and conventional art historical methods to create an exhibition with invaluable research and presentation strategies for academic specialists and the general public.

Political History of Prisons: The Architecture of People in Raleigh's Central Penitentiary

Paloma Rodney
Faculty Mentor: Paul Jaskot
Humanities

My research analyzes the political history of prisons, using Raleigh's state penitentiary, Central Prison, as the principal case study. My guiding question is the following: how does the examination of space and place help us better understand social interaction/change? In particular, I am studying the socio-economic development of Raleigh, the capital city of North Carolina, in two spheres – racially and industrially – and am trying to understand Central Prison's role in both. Racially, Raleigh's development is not as clearly delineated as in northern cities which had defined boundaries that divided the races; instead, as Raleigh developed, it abided by Tom Hanchett's "salt and pepper theory" in which black and white people lived together in certain zones of the city. The city, however, became more segregated with the rise of industry and the Reconstruction's failed policies in the mid 1870s. The prison, situated closer to the black side of town, yet across the street from Raleigh's most prestigious all girls' school, St. Mary's, allows for an interesting opportunity to query the experience of location, spatial relationships, and their meanings, and begs the question: what message was the prison, and therefore, the state government trying to communicate to the people of Raleigh? My research to date indicates that the prison makes a statement regarding the alienation of the black self and a portrayal of state power. Such power was complicated with the added tension of the Union's new presence making a bold architectural statement in the recently defeated southern capital with Central Prison.

A Self-Defined Sex Being: Self Portraiture as Black Feminist Fantasy for the Purpose of Black Feminist Liberation

Ashleigh Smith
Faculty Mentor: Jasmine Cobb
Humanities

Through careful visual analysis and critical interrogations of what Patricia Hill Collins terms "controlling images" in the art historical canon, this project examines the strategies utilized by artists Carrie Mae Weems and Renee Cox in their self-portraiture to construct visuals of what I describe as "black feminist fantasies" for the purpose of liberation. These black feminist fantasies involve black women with clearly self-defined sexualities. As works that exhibit self-defined sexuality, the very creation and dissemination of Weems' and Cox's images act as conduits through which black feminist fantasy becomes liberation. Weems' and Cox's works consciously subvert the canonical genre of "self-portraiture" in doing so, and thus offer new images to replace the "controlling images" of the canon's past.

In applying a black feminist framework and a "social constructionist" definition of sexuality that understands sex roles and rules to be socially and culturally constructed, my argument acknowledges and condemns the West's strategic manipulation of the black female subject for the purpose of her social control. Often depicted as sexually deviant and in need of repression, these images reflect a cultural disposition which manifests as a reality in which black women are offered little space to conceptualize their sexuality as normative and self-possessed. Self-portraiture, and the positioning of the creator as subject, offers the subject that opportunity for self-definition. Aware of this, both Cox and Weems utilize this strategy to portray and actively take part in a self-defined sexuality—enacting liberation both in practice and presentation.

Where Are You from? Problematizing Jordanian National Identity

Natasha Rothenbucher
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Nation building projects in Jordan are incomplete, leading to problems in the creation of a national narrative and subsequently, to gaps in the national identity. How do these gaps manifest themselves in everyday life, problematizing the dominant belief in a cohesive 'Jordanian national identity?' Nation building and the construction of a national narrative began following the establishment of the nation-state of Jordan in 1946, led by the royal family and enforced by those working within the government. Through these agents of the Jordanian government, the diffusion of the national narrative was launched as a means of solidifying the national identity. It takes form through a series of nationalized economic and cultural projects, including the Palestinian mass migration to Jordan; the construction of the modern education system; and the rise of tourism and soccer industries. Examining these projects as well as interviewing a set of ordinary Jordanians highlights citizens' reluctant attitudes regarding issues of longing and belonging within the prescribed national identity framework.

Protein Binds: Decoding Factory-Farmed Meat in the American South

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Our contemporary moment is one in which foodways are increasingly industrialized and standardized, with multinational monopolies like Tyson and Smithfield controlling much of the manufacturing and marketing of meat products in the United States. Nevertheless, as the machines become smarter and more efficient, the processes consistently become messier and more harmful, and painful externalities emanate throughout the country. This project is about that ever-escalating mess, the human and environmental cost of untenable growth, and how factory-farmed meat is woven into the stories we tell about the modern American South. In my first chapter, I focus on Tobe Hooper's 1974 film The Texas Chainsaw Massacre to illustrate the economic and moral degradation of the Southern rural identity at the hands of industrialization. I argue that the monopolization of the meat industry created a paradox within the Southern cultural imagination: Meat consumption is deeply tied to a pastoral history and system of values (although this does not go without its own scrutinization), while the actual production of these meat products has become increasingly mechanized and inhumane. The film's gory and exploitative content are markers of not only the film's artistic qualities but also of its value as an analytical tool, a distorted lens through one can view the more distorted and disturbing facets of the modern American meat industry. For my second chapter, I focus on the contemporary situation of the Southern meat industry, this time shifting my attention to the hog farms in eastern North Carolina. The hurricane-prone nature of this region has led to widespread flooding of these farms, and I investigate the figurative power of the flood within the American South. In essence, the deluge has played a fundamental role in the region's history and has been a prominent motif in Southern literature and religious rhetoric, alike. The flood narrative, as it drowns structures of security and familiarity, exposes in its wake the otherwise obfuscated machinations of these systems, and this makes its connection to the hog farming industry especially revelatory. In addition to being historically grounded, my work evokes various conceptual frameworks, including Julia Kristeva's theory of the abject, the American Grotesque school of literature, the pastoral analyses developed by Leo Marx, and Michel Foucault's writings on the biopolitical.

Imperial Animosities in Strange Case of Dr. Jekyll and Mr. Hyde

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Humanities

Robert Louis Stevenson wrote Strange Case of Dr. Jekyll and Mr. Hyde in 1886 when Ireland, then controlled directly by a British parliament in England, was undergoing an agrarian and religious crisis. As a result of this poor English governance, Ireland demanded Home Rule (the right to govern itself from Dublin) which was in opposition to the British sentiment of a unified Empire. Meanwhile, a rapidly-industrializing England experienced a mass influx of Irish immigrants in pursuit of English jobs, strengthening British xenophobia against Irish migrants. Post-colonial scholars such as Robert Mighall and David Punter have argued that Stevenson draws from Darwinism to portray Hyde as a racially alien Celt and culturally inferior Irish alternative to Dr. Jekyll's sophisticated English presence. However, this exclusively anti-Irish reading of Strange Case is incomplete because it does not examine the significance of Dr. Jekyll's own demise in conjunction with Hyde's death.

This paper argues that Stevenson employs Hyde's bio-cultural differentiation from Jekyll and Jekyll's lack of agency over Hyde as a metaphor to critique the Anglo-Irish politics of the Victorian era. In depicting Hyde as an embodiment of the "savage" Irish, and Jekyll as a representation of the deteriorating Empire, Stevenson illustrates how the lack of transnational accommodation led to mutually destructive consequences for England and Ireland. I thus depart from scholarly convention by arguing that Stevenson not only demeaned the Irish through the "ape-like" Hyde, but—just as critically—critiqued England's incompetent governance of Ireland through English Jekyll's lack of control over Irish Hyde's sinister appearances. This paper re-contextualizes the climactic death of Dr. Jekyll as a manifestation of Stevenson's increasing skepticism about the Empire's viability and his evolving personal stance on Irish Home Rule.

England's reluctance to challenge its ethnocentric beliefs about Ireland and accept its hybrid identity led to the financial ruin of Ireland in the nineteenth century along with the downfall of the British Empire as a global hegemony, a political failure which Stevenson was able to augur and mediate through the genre of the novel. This completed paper uses a New Historicist approach to offer a holistic post-colonial interpretation of Strange Case and analyze Stevenson's metaphorical warning against the perils of nationalism in the Victorian Era.

Alice in the Anthropocene

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Humanities

When Alice falls down the rabbit hole in Alice's Adventures in Wonderland, she finds herself in a beautiful, balanced ecosystem, although she does not see it, and, upon her entry, she disrupts it. In her ignorance, she cannot exist harmoniously with the creatures of this nature, and she brings trauma and violence wherever she goes. Reading Alice in an ecocritical light, I seek to explore the relationship Alice has with her new environment and examine how her interactions may be representative of the human-nature relationship that began developing in Victorian England as a result of industrialization. As Jesse Oak Taylor writes about in his article "Where is Victorian Ecocriticism?" the Victorian era was an influential time for environmental studies, as at this point in history the relationship between humans and their environment changed drastically, sparking the beginning of a new geological era, the Anthropocene. Whether intentionally or not, I believe that in creating Alice and her relationship with Wonderland, Carroll depicted the relationship Victorians had with their environment. While Michael Lee comments on Alice's mentioning of Dinah as a means to navigate the social world of Wonderland in his article "Eating Things," and James Kincaid claims it represents her brutality in his "Alice's Invasion of Wonderland," I argue that it portrays the ignorance and insensitivity that nearly all humans possess towards their environment. I also argue that the violence she brings to Wonderland, although harmful, is not malicious, as Kincaid portrays it. Rather, it stems from misunderstanding and lack of consideration. By the end of this paper I hope to have proven that Alice is no brutal tyrant, yet she is also not innocent. Like the Victorians, she is merely human: ignorant and inconsiderate of the destructive consequences her actions have on the environment.

As White As Their Masters: The White Slave in Antebellum Abolitionist Propaganda

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Humanities

In the decades leading up to the Civil War, references to the white slave proliferated in abolitionist rhetorical and literary texts. These works constituted a distinct brand of abolitionist propaganda intended to inform and craft Northern understandings of race and racial difference with the aim of arousing their abolitionist sentiments. Although purveyors of proslavery thought insisted that whiteness was a fixed and demarcated identity, the reaction of white observers to white slave propaganda unearthed a deep-seated insecurity within a race ideology designed to maintain and perpetuate white hegemony. Freedom suits and racial identity trials of the early to mid-19th century involving white slaves demonstrated how Southern courtrooms became spaces for contesting and reimagining white constructions of race and gender. Using the white slave as a protean subject, one who could be recast to suit particular political scenarios, black and white abolitionist authors simultaneously subverted and accommodated racialist discourse espoused by proslavery ideologues. The practice of photographing white slaves and displaying them before audiences, which gained prominence in the 1850s and continued through the Civil War, exemplified evolving abolitionist tactics that culminated in the white slave campaign of 1864. Read as an alternative archive, white slave propaganda exposed the fragility of white identity and rendered the white slave as a fixture of radical antislavery agitation.

A Victorian Woman who had the Best of One World: Isabella Bishop, Family & Career, 1831-1904

Lexi Kadis
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Humanities

Isabella Bishop (née Bird) was a renowned Victorian woman travel writer. Over the course of her career, which spanned the latter half of the nineteenth century, she explored five continents and published eleven travelogues that received popular and critical acclaim. In spite of her remarkable success as a travel writer, the current scholarly literature does not take seriously her professional development. It portrays her travels as flight from the Victorian cult of domesticity and her career aspirations as rebellion against women's confinement to the domestic sphere. Through a biographical micro-study of Bishop's life and career, this thesis presents Bishop's travels not as escape from familial responsibilities but rather as strategic choices taken in line with her professional goals. In doing so, it uncovers how her career aspirations changed over time as she evolved from a travel writer into a public intellectual, and how her professional formation was positively affected by her family relations. Bishop's story challenges the traditional scholarly representation of women writers in the Victorian period as having to choose between family and career. This thesis spotlights Bishop—a Victorian woman who was deeply devoted to her family as well as her travel writing career—in order to refute this reductive generalization.

Black Community Organizing & Urban Change in early 20th Century Atlanta

Gino Nuzzolillo
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At the turn of the 20th century, the city of Atlanta flaunted its status as capital of the New South — bursting with civic pride, focused on commerce, and devoid of racial conflict. W.E.B. Du Bois commented that the nation "talked of [Atlanta's] striving," an image effectively projected by the city's elite Black and white communities. For all of its New South aspirations, however, stark inequality along lines of race, class, gender, geography, and access to the Atlanta's many resources defined daily life. In September 1906, a violent massacre — which left dozens of Black Atlantans dead at the hands of a white mob — tarnished Atlanta's New South veneer and made clear the ways in which competing visions of a "New South city" were playing out in Atlanta's streets, saloons, and neighborhoods. This thesis focuses on these many visions, primarily from the perspective of diverse Black community organizers, social workers, educators, and preachers who articulated their world-views and put them into action. Using personal papers, maps, city ordinances, conference proceedings, and newspaper archives, this thesis tells the story of how Black Atlantans made claims upon, and asserted a right to, a rapidly changing Atlanta from 1890 to 1930.

Journey of Dreams - a collection of stories from Palestinian refugees in Lebanon about hope, success, happiness and dreams.

Soraya Durand
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My project documents a series of Palestinian refugees in Lebanon who share their stories of hope, success, happiness and light in a world that usually depicts them as lacking these fundamental components of life. Through a series of short documentaries, the final product will be a website (that will be ready by end of May 2020) where all their stories will be interweaved on a social media platform where people who know little about the Israeli/Palestinian conflict and the rise in significance of host nations can learn more. I spent weeks in Lebanon in the summer of 2019 documenting these stories and what was first going to be a larger documentary project has turned into an interactive docu-website. This website, named after the project itself, 'Journey of Dreams' will consist of more than just short documentary series of the Palestinian refugees. It will serve as a tool to spread awareness of Middle Eastern history (specific to the refugee influx in Lebanon) and a mechanism to start re-thinking of the way one sees/the West portrays Palestinian refugees. The hope is to keep this docs-website alive, which means to keep adding documentary series throughout each year and updating facts and having conversations on it. I would like to think of this project as forever ongoing! I am excited to share it with both the Duke community and everyone I was lucky enough to work with in Lebanon last summer. Thank you to everyone at the Hart Leadership Program at Duke for funding this project and for believing in my capabilities for turning it into a reality.

To Save Them From Despair: Simone de Beauvoir's Reader Response Theory

Anna Kasradze
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Humanities

In her 1964 essay "What Can Literature Do?," novelist and philosopher Simone de Beauvoir presented a theory of reader response in which the reader of literature "changes universes" through "identification" with "the voice of the author." Although Toril Moi recognizes the originality of Beauvoir's conception of identification, Beauvoir's theory has yet to enter the reader response canon, not least because subsequent theory would demonstrate the shortcomings of such concepts as "identification" and "the author." This paper re-examines Beauvoir's theory to show that it accommodates these critiques and offers an original contribution by theorizing the stakes of literary identification for the reader.

This paper excavates Beauvoir's reader response theory from her philosophical works and descriptions of her own reading in Memoirs of a Dutiful Daughter (1958). While her theoretical works present her view of the general, baseline experience of literary identification, her memoirs overflow with more specific psychological insights into the literary identifications she experienced and their profound existential significance for her. In Beauvoir's reader response theory, literature offers the reader recognition of her most alienating experiences, endows them with significance, and thus reintegrates her into "the human community." For Beauvoir, literary identification is immensely important because it "save[s readers] from despair."

I then compare Beauvoir's theory to subsequent reader response theories, particularly phenomenological (Iser, Poulet), psychoanalytic (Holland, Bleich), and other models that describe the process of literary identification as an intimate relationship (Gibson, Proust). I show how the identification relationship Beauvoir theorizes differs from these other relationship models, particularly in its focus on recognition, validation, and de-alienation. Finally, I demonstrate the uniquely ambitious existential stakes Beauvoir attaches to literary identification.

Weak Ties and Organizing: Evaluating the Significance of Granovetter's Social Network Model for Social Movements

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Granovetter (1973) proposed his highly influential thesis stating that, counter to our assumptions, weak ties among participants are more important for the development and effectiveness of social movements than strong ties. His thesis has gained relevance again in the age of social media, under which weak ties have rapidly proliferated. When we analyze contemporary social movements, however, such as the Istanbul Gezi Park protests, we come across a wide range of methods of communication and information flow that do not necessarily align with Granovetter's thesis. This essay studies the explanatory power of his thesis in relation to these contemporary developments. Using Erdem Yörük's account of the origins of the Istanbul Gezi Park protests of 2013 in his article, The Long Summer of Turkey, I claim that the hypothesis is: i) insufficient in theorizing why specific groups and individuals (as opposed to any group or individual) work together to initiate social action, and ii) superfluous through its reliance on weak ties as the ideal form of organization. I argue for, instead, adding a second dimension to what constitutes a tie beyond strength to address this insufficiency, while also questioning the assumptions in Granovetter's model that give primacy to weak ties, stating that this primacy is premised on arbitrary selection of certain assumptions over others and may not necessarily reflect information flow among individuals in social movements.

Vaccination History at the British National Archives

Anne Crabill
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Humanities

I worked with the British National Archives' Education and Outreach team to conduct research and create teaching materials in line with UK high schools' history of medicine curriculum. I focused on smallpox vaccination efforts and anti-vaccine movements during the latter half of the 19th century. After combing through thousands of letters stored in the Ministry of Health's records, I synthesized my findings into a digital lesson plan that complicates that traditional linear narrative about smallpox vaccination as well as a supplementary how-to guide to help first-time researchers navigate the details of archival research.

An Analysis of the Relationship Between John and the Synoptics: Critiquing Percival Gardner-Smith's Saint John and the Synoptic Gospels

Caleb Cooke
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Humanities

Percival Gardner-Smith's Saint John and the Synoptic Gospels inspired a revolution among New Testament scholars by calling into question the existing findings of past scholars. According to Gardner-Smith, his "fresh examination" proves that there is no literary relationship between John and the synoptics; instead, the relationship is better described as sharing attributes originating in a common "basin of oral tradition." To indicate what the primary evidence as a whole indicates regarding the relationship between John and the synoptics, I examined the Greek text of each gospel, making note of distinctive overlaps that prove John's dependence on the synoptics; simultaneously, I critiqued Gardner-Smith's handling of the primary evidence of the Greek text. Upon examination of Gardner-Smith's discourse on John and the synoptics, problems arise at a rate that makes Gardner-Smith's Saint John unsuitable for use moving forward. Gardner-Smith grossly mischaracterizes the work of scholars before him, conducts an examination of primary evidence that overemphasizes minor differences as opposed to minor similarities, and fails to clearly define pieces of his argument (i.e. "oral tradition"). Ultimately, Gardner-Smith fills Saint John with generalizations that misrepresent the evidence that proves the literary relationship between John and the synoptics. For the sake of those that subscribe to Gardner-Smith's theory of oral tradition, a more useful text to centralize the theory around is C.H. Dodd's Historical Tradition in the Fourth Gospel, which provides a more complete analysis of the question at hand.

A Moral Crusade: The Preservation of Segregation by Southern Baptists in Alabama from 1930-1968

Morgan Hundley
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Humanities

Preserving segregation in the south became a primary goal of southern baptists in Alabama from 1930-1968 because this institution was threatened by the nationwide push for integration in the 1960s. However, the preservation of this social construct was harder to maintain in the 20th century because segregationists could not rely solely on the bible for justification like their ancestors had in the 19th century. They had to go beyond its pages in order to sanctify their beliefs and practices. The southern baptist denomination was the largest, and subsequently, the most influential tradition in Alabama during this time period, therefore, analyzing their response to this "crisis" is especially crucial for a well-rounded understanding of racism, segregation, and religion in Alabama during the mid-20th century. Although the focus of studies on race and religion in the American south during the 20th century have primarily centered around the role of religion on the side of the integrationists', this paper reveals that the same is true of segregationists, particularly in Alabama. There were several factors that contributed to the success of the southern baptist denomination in preserving segregation. The ideological and physical structuring of the southern baptist denomination provided several pathways that allowed for the growth of a domineering conservative faction in this tradition which also pushed for segregation. The limitations of a biblical argument in support of segregation forced segregationists to use mechanisms in the secular world to further their religious cause. The conservative faction of the southern baptist denomination's response aided integration in continuing segregation. The role that the press, particularly Leon Macon of the Alabama Baptist, the primary source of information for southern baptists from 1950-1965, played in cohering the secular and political spheres that prevented integration and furthered segregation. The size of this denomination combined with its biblical arguments, overarching conservative faction, and persistent publications not only painted segregation as a moral crusade in the secular and religious realms, but it also prevented the entire state of Alabama from progressing at the same pace as the rest of the nation in regards to race relations.

The role of Genre Theory in viewing generalist and specialist tutoring in a continuum

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Humanities

Even today, the ongoing debate between specialist and generalist tutoring is still changing the ways writing centers are established and viewed. Not only has the debate traversed topics of writing and tutoring, but it has also led to a reconsideration of the definition of literacy and whether the tutor's literacy (I expand this definition to include "the ability to gain knowledge and utilize skills that are required to communicate effectively within a specific social context), a reliable indicator of the effectiveness of writing consultations, is dependent on the amount of knowledge these tutors have. Building on this finding, the current conference presentation aims to further expand the definition of tutor literacy and ways it could apply when looking at generalist and specialist tutoring.

Synthesis and Fluorescent Labeling of Histatin-5

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Physical Sciences

Histatin-5 (Hist-5) is a salivary, antimicrobial peptide that provides the first line of defense against the opportunistic fungal pathogen Candida albicans. Candida infections are most common among immunocompromised individuals, which has led scientists to study histatins as potential therapeutic agents. Although the candidacidal activity of Hist-5 has been well-documented for years, its mechanism of action is not fully understood. Fluorescent labeling of Hist-5 will visualize its internalization into fungal cells and will allow us to further elucidate its mechanism. Hist-5 was labeled with the fluorophores fluorescein isothiocyanate (FITC) or rhodamine B isothiocyanate (RBITC). Unlabeled Hist-5 was synthesized using Fmoc solid-phase peptide synthesis and purified using high-performance liquid chromatography (HPLC). The identity of Hist-5 was confirmed by electrospray ionization mass spectrometry (ESI MS), then Hist-5 stock solution was quantified by UV-Vis spectroscopy. The FITC and RBITC fluorophores were successfully conjugated to Hist-5. The identity of the fluorophore Hist-5 peptides was then confirmed with ESI MS and HPLC. Finally, the peptides were characterized using the maximum absorbance wavelengths for the FITC and RBITC fluorophores. Future work includes testing the fluorophore-labeled peptides against C. albicans to ensure antifungal activity remains unchanged compared to native Hist-5. We will then use confocal fluorescence microscopy to identify how the peptide enters the cell and where it localizes following internalization.

Characterization of Mechanochemical Activity of Transition Metal Complexes

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Physical Sciences

Incorporation of mechanophores (force-reactive functional units) into the backbone architecture of a polymer chain yields constructive responses to typically destructive mechanical stimuli. Single-molecule force spectroscopy (SMFS) studies may be performed on a polymer chain loaded with multiple, nonscissile mechanophores to generate a force-extension curve. A plateau on such a curve corresponds to extension of polymer contour length upon mechanophore opening, which may be understood as the release of length stored in the mechanophore structure. SMFS offers a unique means of probing the force-coupled reactivity of transition metal complexes. To explore the potential of SMFS to reveal quantitative information on the forces involved in metal-ligand bond dissociation, we synthesized a palladium (Pd)-complexed macrocycle, consisting of a pair of N-heterocyclic carbene (NHC) moieties connected through a pyridine linker, that may be embedded within a polymer backbone via ring-opening metathesis polymerization. Force transduction along the polymer backbone leads to dissociation of Pd-ligand bonds in the mechanophore. The results of our SMFS study indicate that, at a characteristic force of 960 ± 30 piconewtons (pN), tension applied to the polymer strand is transduced into mechanophore opening. Release of length stored in the mechanophore structure results in polymer extension by 6%, in agreement with constrained geometry stimulates external force (COGEF) modeling that presumes mechanophore opening occurs via dissociation of one of the two Pd-NHC bonds and the bond of Pd to the pyridine linker. The results of this study will be extended through a series of subsequent steps, including: probing the extent of kinetic (as opposed to thermodynamic) control in the mechanophore-opening reaction based upon hysteresis in a set of SMFS-generated force-extension curves, utilizing a small-molecule thermolysis study to obtain the force-free kinetics of the reaction, and quantifying the force-dependence of the reaction rate. SMFS analysis may also be applied to a rhodium-complexed variant of the mechanophore employed in this study. This study and the experiments that follow it will advise further research aimed at using metal-complexed mechanophore-containing polymers to convert mechanical force into useful downstream applications, such as small molecule release, change in metal oxidation state, and modulation of catalyst activity.

Evaluation of Later-Generation Prochelators to Inhibit Metallo-β-Lactamase

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Physical Sciences

β-lactam antibiotics kill bacteria by binding to penicillin binding protein, an essential enzyme in cell wall synthesis. Numerous strains of pathogenic bacteria have developed a method to resist antibiotics through expression of β-lactamase enzymes, which degrade β-lactam drugs through hydrolysis. β-lactamase inhibitors can covalently bind to the active site of the enzyme, preventing β-lactam hydrolysis. This is useful against serine β-lactamases, which use a serine residue to hydrolyze β-lactam rings; however, metallo-β-lactamases, use catalytic zinc ions, which prevents covalent binding of the inhibitor. In this work, novel prodrugs, called prochelators, were tested for ability to specifically inhibit metallo-β-lactamases in drug-resistant bacteria. Inhibition of New Delhi Metallo-β-Lactamase-1 was assessed in vitro and in bacterial cells using enzyme kinetics and antimicrobial susceptibility assays.

Synthesis of N-(hetero)aryl Sulfamides Using a Nickel-Iridium Dual-Catalytic System

Georgia Scott
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Physical Sciences

The biological activity of many sulfamide-containing compounds means the synthesis of N-(hetero)aryl sulfamides has important implications in the development of pharmaceutical small molecules. Therefore, the goal of this proposed research study was to develop a method for the production of N-(hetero)aryl sulfamides through the coupling of unsubstituted sulfamides with aryl halides. The new reaction cascade employs a nickel-iridium dual-catalytic system at room temperature, a method previously used in the N-arylation of sulfamate esters. This method offers a wide variety of potential substrates, with (hetero)aryl bromides, iodides, and chlorides all acting as potential electrophiles. It is our hope that this process will be used as an alternative to traditional Buchwald-Hartwig coupling processes in the production of pharmaceutical agents.

Preparation of Later-Generation Prochelators to Inhibit Metallo-Beta-Lactamase

Christine Suh
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Physical Sciences

Antibiotic resistance is an urgent medical threat as pathogenic bacteria continue to evolve and produce new enzymes that render many current drugs ineffective. Common treatment options include beta-lactam antibiotics that bind to a key enzyme in bacterial cell wall synthesis, penicillin binding protein, resulting in bacterial cell death. However, beta-lactamases can hydrolyze these once-effective drugs, so inhibitors of beta-lactamases were developed. Metallo-beta-lactamases (MBLs) contain two catalytic zinc ions that prevent current inhibitors from remaining in the active site. We have synthesized and tested a prodrug as a strategy to selectively inhibit MBLs. This prodrug has a core that, once hydrolyzed by an MBL, removes a chemical masking group to release a metal chelating agent. This metal chelating agent can then inhibit MBLs through chelation of the zinc ions in the active site. In order to increase strain specificity, an altered core structure was synthesized to increase its affinity for resistant strains, using a modular and efficient synthetic route. The improved strain selectivity of the prodrug is a promising strategy to increase drug efficacy, avoid off-target effects, and reduce the spread of resistance.

Predicting Intrinsically Disordered Protein Conformations Using Polyampholyte Theory

Isabel Ruffin
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Physical Sciences

This work aims to develop a predictive model of intrinsically disordered protein single chain conformations using polyampholyte theory. Polyampholytes are charged polymers that contain both positive and negative charges. In particular, we apply our model to tau protein, which is implicated in Alzheimer's disease. Tau's charge sequence is overall similar to that of a diblock polyampholyte, meaning the chain can be divided into two segments, one with only positive charges and the other with only negative charges. We create a scaling model that predicts the dependence of chain conformational transitions on net charge and linear charge density. We then apply this model to a coarse-grained model of tau protein in order to predict its conformations as a function of pH.

Design, Synthesis, and Characterization of Quantum Materials

Eric Seewald
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Physical Sciences

Due to recent advances in the field of topological quantum spin liquids, there is an increasing demand for high quality single crystals of frustrated magnets that host such exotic behavior. Here we present our recent results of such efforts. Solid-state reactions are used to synthesize polycrystalline samples of quasi-2D and 3D frustrated quantum magnets, whose purity is confirmed by powder x-ray diffraction analysis. With a pure polycrystalline sample, the optical floating zone technique is used to produce high quality large single crystal samples. We use an array of thermal and magnetic measurements as well as single crystal x-ray diffraction to characterize the samples, before performing advanced neutron and synchrotron x-ray scattering experiments at national user facilities.

Examining Bournonite as a Semiconductor for Energy and Optoelectronic Applications

Eric Chang
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Physical Sciences

The path towards terawatt-scale photovoltaic (PV) deployment requires both cost reduction and performance improvements. Thin-film PVs provide a means for lowering both fabrication and installation costs compared to conventional crystalline silicon by using materials that are stronger light absorbers and can be processed at lower temperatures. An ideal candidate for a thin-film single junction device has a direct bandgap in the range of 1-1.6 eV with a large absorption coefficient in the visible spectrum. Recently, thin-film lead halide perovskites have demonstrated power conversion efficiencies (PCEs) greater than 20% and can be deposited at low temperatures (~100°C). However, despite the low fabrication costs and high performance, intrinsic stability issues present a significant barrier to lead halide perovskite commercialization. Bournonite (CuPbSbS3) has recently been identified as a possible ferroelectric PV material. As a naturally occurring mineral it is expected to be significantly more stable than lead halide perovskites. Furthermore, bournonite has a bandgap of 1.3 eV (within ideal range) with absorption coefficients in the visible spectrum comparable to the commercial thin-film PV material GaAs. Additionally, the multi-element nature of bournonite allows for several chemical 'levers' of property-tuning capability through atomic substitutions and alloying. This combination of desirable attributes and robust tunability makes bournonite an ideal candidate for both PV and photoelectrochemical (PEC) device integration. However, there are currently few reports of investigating bournonite as a PV material. The long-term goal of this project is to characterize the optoelectronic properties of bournonite (completed), find ways to tailor bournonite's bandgap to an even more favorable level via solid-state reactions (in progress), and fabricate thin-film photovoltaic devices, processing films using a simple, environmentally benign ball-milling approach (in progress). Preliminary results show an exciting ability to lower bournonite's bandgap via doping, and film processing questions regarding slurry preparation, annealing conditions, and phase stability have been investigated. In continuing these studies, future work may involve collaboration with IBM for use of their photo Hall measurement technique, as well as computational materials researchers at Duke to compare theoretical band structure calculations with experimental results.

HybriD^3 and MatD^3: Curated Materials Data for Hybrid Organic-Inorganic Semiconductors and a General Software Stack for Materials Data

Xiaochen Du
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Physical Sciences

Materials research is generating a wealth of data across a vast community. Specifically, the volume of available data on hybrid organic-inorganic perovskites (HOIPs) and related growth in this area is now immense. Keeping track of data of different origins, sample types or levels of theory, with a diverse set of different relevant observables and discoveries, is a challenging task at best. We here present an open database, "HybriD^3" (Design, discovery and dissemination (D^3) of data related to hybrid materials, https://materials.hybrid3.duke.edu), aiming to collect, curate, and make available materials data related to HOIP. The database is designed to provide a broad set of data, i.e., experimental and computational, related to in principle any materials property of relevance to the community: structure, optical or electronic properties, and more. A key goal is to provide the ability to curate data, that is, identify property information closest to the actual properties of a real material prepared in a specific way (bulk crystalline, powder, thin film, nanocrystalline, ...). Importantly, the database is open to the community and designed to accept community input. While the "HybriD^3" database is focused on a particular materials class, the problem of making materials data of all kinds available in a structured, reproducible way is general. The software underlying the HybriD^3 database is thus available as a separate open-source project "MatD^3" (https://github.com/HybriD3-database/MatD3). We also describe this software stack, which can enable materials data at any scale, from small workgroups via focused projects all the way to large and general, open and reproducible materials data collections.

Adaptive AR Visual Output Security using Reinforcement Learning Trained Policies

Joseph DeChicchis
Faculty Mentor: Maria Gorlatova
Quantitative Sciences

Augmented reality (AR) technologies have seen significant improvement in recent years with several consumer and commercial solutions being developed. New security challenges arise as AR becomes increasingly ubiquitous. Previous work has proposed techniques for securing the output of AR devices and used reinforcement learning (RL) to train security policies which can be difficult to define manually. However, whether such systems and policies can be deployed on a physical AR device without degrading performance was left an open question. We develop a visual output security application using a RL trained policy and deploy it on a Magic Leap One head-mounted AR device. The demonstration illustrates that RL based visual output security systems are feasible.

A Case for Compute Reuse in Future Edge Systems: An Empirical Study

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Quantitative Sciences

Edge computing has been proposed as a solution to the ultra-low latency requirements of novel compute-intensive applications and systems such as autonomous driving, smart cities, etc. However, the scale of such compute-intensive systems coupled with stricter application requirements causes the computation load to exceed the current rate at which we provision the resources at the edge. In this paper, we advocate that reusing (partly or fully) the results of already executed computational tasks among multiple users to calculate new results, which we call "compute reuse", has the potential to significantly reduce resource utilization and lessen the time needed for the completion (i.e., execution) of new tasks. We conduct an experimental study to quantify the performance gain and improved utilization of resources that stem from systems being able to reuse previous computations. Our results demonstrate that such systems can result in up to 50 times lower completion times and substantially lower utilization of computing resources. We also discuss alternative design options and tradeoffs of building systems aware of compute reuse semantics.

Answering Summation Queries for Numerical Attributes under Differential Privacy

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Quantitative Sciences

In this work we explore the problem of answering a set of sum queries under Differential Privacy. This is a little understood, non-trivial problem especially in the case of numerical domains. We show that traditional techniques from the literature are not always the best choice and a more rigorous approach is necessary to develop low error algorithms.

Clustering Drug Synergy Surfaces with Siamese Convolutional Autoencoders Reveals Associated Mechanisms of Action

Barbara Xiong
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Quantitative Sciences

Combinatorial approaches to anti-cancer drug discovery can provide more effective alternatives to monotherapy with fewer side effects, lower toxicity, and reduced drug resistance. Drug synergy occurs when the combined effect of the simultaneous treatment of two drugs is greater than the sum of the effects of the individual treatments for each of the two drugs. In this project, we explored a multifaceted notion of synergy. Rather than limiting to a single numerical metric of synergy, we focused on examining synergy surfaces, or two-dimensional representations of synergy in which each drug is treated at multiple concentrations. We hypothesized that certain visual motifs in the drug synergy surfaces could be correlated with certain mechanisms of action used by the drugs in the treatment. To investigate this, we built a siamese convolutional autoencoder that condensed these synergy surfaces to represent their most essential features. In constructing our model, we took advantage of transpositional invariants by implementing pairwise constraints. We then used K-means clustering to arrange these condensed outputs into visually similar clusters and used Fisher testing to identify which clusters were most associated with which mechanisms of action. In our analysis, we found that our cluster with the highest overall synergy was enriched with Venetoclax, which targets the BCL2 gene, in combination with a kinase ($p = 0.000000204$), especially when treated in the SUDHL-4 cell line. Another interesting cluster that was characterized by a single-agent driver was enriched with a DNA-AKT/MEK pathway combination ($p = 0.000162$, $p = 0.00116$). We also found that 16 of 25 samples involving Defactinib with one of the five RTK-pathway drugs tested displayed a distinct motif with synergy only at high concentrations for both drugs.

Edge-based Provisioning of Holographic Content for Contextual and Personalized Augmented Reality

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Quantitative Sciences

The project examines how current Augmented Reality experiences can be improved by utilizing edge-computing. This project proposes edge-based holographic loading frameworks for popular AR frameworks. The project discusses two case studies, one using Google ARCore, one of the top AR platforms for mobile phones, and the other using Magic Leap One, one of the most popular AR headsets in the market. The Google ARCore case study proposes an API that can be used for the creation of code-free AR experiences. Google ARCore case study also examines the runtime load and processing times for both cloud and edge infrastructures, as well as SFB and GLB file formats. The Magic Leap One case study proposes runtime model loading as a solution to the current limitations of AR headsets. Magic Leap One case study provides metrics of the load and decompression times for models of various sizes and suggests mechanisms such as proactive hologram loading to reduce user-facing latencies. Finally the project outlines possible research directions that will help overcome challenges faced in the case studies.

Classifying Short-finned Pilot Whale Acoustics with Deep Learning

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Quantitative Sciences

Short-finned pilot whales are deep diving cetaceans that use sound for navigation, hunting, and communication. Scientists use digital acoustic recording tags (DTAGs) to collect depth, movement, and audio data that provide insight on their behavior. However, it is time consuming to conduct manual reviews of DTAG audio and these reviews require a trained ear. This study is the first to use deep learning to differentiate amongst short-finned pilot whale buzz and minibuzz vocalizations in DTAG recordings. A total of 2,784 buzz and minibuzz sound samples were identified from tag deployments on 25 different short-finned pilot whales offshore Cape Hatteras, NC during 2008, 2010, and 2011. Audit files of events were manually created and used to extract clips that contained either buzzes or minibuzzes. These snippets were high-pass filtered to eliminate low frequency noise, and then a short-time Fourier transform was performed on each sample, which served as the input form. Alternating convolution and rectified linear unit activation layers were applied to group sounds. A global max pooling layer was applied to check for the presence of a sound sequence in the whole audio clip, which resolved the challenge of working with differing length audio segments. Lastly, a fully connected layer, in which each cell from the max pooled layer "cast a vote", was used to determine whether the clip was a buzz or minibuzz. The model was trained with 532 examples, including an equal number of buzzes and minibuzzes, and then was tested with 768 examples; it achieved 97.633% accuracy.

Preprocessing the data was performed locally and deep learning was preformed using Amazon Web Services (AWS) with Keras backed by TensorFlow. Future work includes expanding the deep learning model to classify other types of acoustic events, such as calls, and pairing the classifier with a detection scheme to find and isolate events as input for the classifier. The completed workflow will enable scientists to more quickly analyze DTAG audio without having to aurally review entire records.

Stability and Dynamics of Tensegrity

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Quantitative Sciences

This project addressed scaling relationships for tensegrity structures. The effect of (a) simple geometric scaling and (b) geometric and mass scaling on the stability and dynamics of tensegrity towers was quantified through simulations of nonlinear, mathematical models. One method involved minimizing potential energy using optimization techniques such as the Nelder-Mead method, Sequential Quadratic Programming, and Optimized Step Size Randomized Search to find the equilibrium configuration. Another method used was Gauss' Principle of Least Constraint (GPLC). GPLC allows for the inclusion of the natural dynamics of the system into a solution for its equilibrium point, adding realistic complexity. It says the true accelerations of a constrained dynamic system minimize the sum of the squares of the difference between the true accelerations and the unconstrained accelerations, weighted by the mass matrix. To develop this concept, the computer models were compared to physical models built out of chopsticks and straws. These small structures can and will be used to predict the stability of large-scale models. Additionally, several conceptual designs were created for a large-scale sculpture to be installed next year, and the beginnings of a proposal were sketched out. This project will be developed further next year. Specifically, pre-tensioning the cables will affect the structure's behavior. Then, using the acoustical frequency to determine the tension forces in the cables, GPLC can be utilized once again. Since the equilibrium configuration does not need to be predetermined to use GPLC, there is great opportunity for further development. Additionally, applications for a low cost, deployable structure will be explored. Some ideas have included modular housing, water collection system, and deployable bridge.

Prospects for Long-Term Agriculture in Southern Africa: A joint, multisensor analysis of land-atmosphere dynamics in the Miombo ecosystem using AI algorithms

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Quantitative Sciences

Land-use and land cover (LULC) dynamics are crucial factors for modeling climate change, and areas with population growth present challenges for sustainable food and water resource management. The miombo ecosystem in Southern Africa supports diverse land uses, covers a wide areal extent, and contains extensive woodlands. These characteristics give the region globally significant potential as either a carbon source or sink, which is contingent upon which land-use management strategies are implemented. However, the complex interactions between LULC and climate change in this ecosystem are not well quantified, and a dynamic approach focusing on the region's land-atmosphere interactions needs to be developed. The portion of total solar radiation reflected by Earth's surface, or surface albedo, is a critical parameter for determining radiative energy fluxes on land. Increases in albedo can lead to decreases in precipitation, and small changes in albedo (tenths) can produce temperature changes of 10 degrees Celsius. Since albedo calculations present a major radiative uncertainty in climate modeling, high resolution (1 km) remotely sensed aerosol optical depths and Ross-Thick Li-Sparse Reciprocal kernel parameters were obtained to estimate surface albedo. These data were developed with the Multi-Angle Implementation of Atmospheric Correction algorithm, which uses the time series of data from the Moderate Resolution Imaging Spectroradiometer (MODIS) to collect aerosol optical thickness and surface bi-directional reflection factor retrievals simultaneously. Along with MODIS land surface temperature data, GTOPO30 digital elevation data, and FLDAS surface pressure products, the aerosol optical depths and kernel parameters were used to calculate hourly shortwave broadband albedo data sets over the span of 10 years (2009-2018). To evaluate changes in plant photosynthetic rates, data such as the MODIS leaf area index, vegetation fraction, and global "OCO-2" solar-induced chlorophyll fluorescence (GOSIF) are jointly analyzed with albedo to understand the long-term subgrid-scale variability and diurnal land-atmosphere dynamics of the miombo ecosystem. Further, we characterize the relationship between albedo, LULC types, and precipitation fluctuations at multiple spatial resolutions. With machine learning, we assess this joint behavior with current climate model simulations to predict agricultural productivity and uncertainty in regional climate change projections.

Learning Fitness Landscapes for Protein Design

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Quantitative Sciences

There have been exciting recent advancements in the ability for statistical models to predict desirable protein functions from sequence data alone. However, even provided with a perfect model to predict protein function, there remains a problem in being able to extract from the model those sequences that are not only predicted to have the highest functionality but also represent diverse parts of sequence space. This paper proposes a novel approach using variational inference and invertible neural networks to discover protein sequences that maximize the function and diversity of sequences corresponding to any given protein function predictor. The generated sequences can then either be directly assayed or used to seed directed evolution experiments across diverse parts of sequence space.

Corrupted Data and the Illicit Arms Trade

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Quantitative Sciences

With the ever-increasing advancements in weapons technology, the illicit arms trade has steadily become a greater threat to international security. The small arms trade, consisting of portable weapons and their parts, is not only a profitable good, but also a method of gaining power through violent and threatening means. Being able to identify when and what countries are engaging in illicit arms trade is essential in order to make informed policy decisions. The driving question behind this project is: how do we recognize corrupted network data and how does corrupted network data impact our statistical analyses? The arms trade takes the form of network data consisting of actors (nodes) and the relationship between them (edges). This analysis of methods initially looks at simulated data. We show that if data is sampled from a pre-specified model then increasing the proportion of corrupt data present impacts posterior statistics such as the intercept and row and column coefficients, as well as posterior predictive descriptive statistics such as degree distributions, triangle counts, betweenness, and eigen vector centrality. This analysis demonstrates if data is corrupt, then by replacing the corrupted values with NAs these missing values will be imputed from the true pre-specified model and thus will not drastically alter the inference but rather increase uncertainty around the inference. These methods are then applied to actual small arms trade data, to see what nations may be engaging in illicit arms trading.

A Finance-Driven Gaussian Process Model Learning Model for American Option Pricing

Chiwan Kim
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Quantitative Sciences

It is widely known that, with assumptions held, the theoretical price for European options can be priced through the Black-Scholes formula by Fischer Black and Myron Scholes (Black and Scholes, 1973). Pricing American options, however, remains to be a fundamental unsolved problem in finance regardless of its countless applications in our current markets. There have been many attempts to model the prices for American options and there is a dichotomy of purely "principle-based" modeling and purely "data-based" modeling, both short-reaching the goals of accurate and timely pricing.

Purely principle-based modeling refers to the different stochastic differential equation models that try to explain the price behavior of American options. However, such methods suffer from both precision and computations. These stochastic models not only carry strong assumptions that are not necessarily held in practice but also fail to capture the un-parametrized variables that affect the prices of American options. Computational inefficiency is also problematic as the prices will constantly change. On the other hand, there is another group of methods that utilize a purely "data-based" approach for predicting American option prices. However, the most obvious limitations of these models are that there is no economic principle that supports the interpretations of the models. Lacking encoded economic principles, the models often completely ignores crucial economic principles and delivers poor predictions especially for limited or unbalanced data.

Understanding the strengths and weaknesses of the methods above, we propose a new economics-driven machine learning model that combines the strengths of both approaches while eliminating the limitations of each as well. This model, which we will call the GP-pricing model, entails guiding economic principles within a Gaussian process, a widely used non-parametric machine learning model. This new model allows us to combine the virtues and concepts from "principle-based" pricing, which encodes well-established pricing principles, with "data-based" pricing, which captures real market discrepancies. Incorporation of economic principles within the learning mode additionally allows data fusion of market information from different types of options. The method, therefore, targets for practical accuracy that can perform under a short execution time that proves to be better than existing methods in practical trading strategies.

Algorithmic Trading of an Alternative Cryptocurrency Using Sentiment and Volume Based Predictors

Daniel Spottiswood
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Quantitative Sciences

Social Media and search engines are two of the largest platforms for the dissemination of information. I use Twitter sentiment and Google search volume to predict price fluctuations in the alternative cryptocurrency Zcash. I compare strategies built upon the predictions of two prominent supervised machine learning algorithms: Extreme Gradient Boosted Trees and Long Short-Term Memory. Walk-forward testing demonstrates triple-digit returns in less than four months of hourly trading. These results provide novel academic proof of concept that the combination of social media and search volume can be utilized to build profitable trading strategies in the altcoin market.

Pretrial Detention in the Wake of Criminal Justice and Bail Reform in Union County, New Jersey

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In 2017, New Jersey shifted from a resource-based to a risk-based system of pretrial release, which included virtually eliminating cash bail. Instead of setting cash bail as the condition for release, judges now use the defendant's prior criminal history and risk factors to determine whether the defendant should be released before their trial begins. These "detention hearings" take place 5-7 days after an arrest and only occur if the prosecutor indicates they want to detain the defendant until their trial at a "first appearance" which occurs 24 hours after arrest. Prosecutors and judges are aided by a "Public Safety Assessment" (PSA) that gives recommendations based on 9 risk factors. This project looked at whether prosecutors were following the recommendation guidelines when considering pretrial detention and how often prosecutors' judgements at first appearances match judges' rulings at detention hearings. We analyzed 331 cases from the Union County, NJ Public Defender Office. Overall, prosecutors moved to detain the defendant in 73.414% of cases but judges granted detention motions only 35% of the time. For those who are recommended to be released by the guidelines, judges granted detention motions only about 20% of the time. Even among those who were recommended not to be released, judges granted those motions only 50% of the time. We then calculated the "distance" between the decision the prosecutor made at 1st appearance, and what the PSA recommended. Positive distances mean the prosecutor gave the client a harsher decision than the PSA recommended, while negative distances mean the client got a better deal than the PSA recommended. The average distance for 1st appearances was 1.04. This means that at first appearance, prosecutors gave defendants an average of 1 grade higher than the PSA recommended. However, the average distance the judges gave was only 0.175. Judges are not granting prosecutors the increased level of monitoring or detention that they are asking for, but rather reverting back to what the PSA guidelines are. This data demonstrates how prosecutors must be thoughtful when deciding what pretrial route to take for defendants and not rely on judges to make that decision for them at detention hearings. Prosecutors must also recognize that they have a somewhat contradictory mandate by being tasked with representing the state while simultaneously being asked to make decisions on defendants' detention status.

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Challenges and Supports to Aging in Place in a Gentrifying Context

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Social Sciences

Neighborhoods play a critical role in the health and well-being of older adults, through both the provision of physical amenities and opportunities to build social capital. They are particularly important as older adults continue to age within their neighborhoods, a phenomenon referred to as "aging in place." As such, changes to neighborhoods can have a profound impact on the health and well-being of older adults. One such change occurs through gentrification, a process generally characterized in literature as the redevelopment of neighborhoods to accommodate higher standards of living. However, despite extensive research on gentrification, there is a limited focus on the impact of such environmental and place-based changes on aging. Using both a qualitative approach and a sample of low-income older adults in a gentrifying area of Washington DC, this study examines perceptions of gentrification, aging in place, and challenges and supports to aging in place within a gentrifying context. In addition, this study examines two affordable housing interventions, for-profit and non-profit housing, evaluating the role they play amidst gentrifying processes. A total of 32 older adults (16 in non-profit and 16 in for-profit affordable housing) aged 55 and older answered questions pertaining to gentrification, aging in place, and challenges and supports to aging in place. The majority of participants reported experiencing gentrification in their neighborhood, conceptualized primarily through increased housing construction, neighborhood racial changes, and increased costs of living. Major themes included a reliance on an age-friendly built environment, a lack of social capital, housing as an important determinant of health, and feelings of uncertainty for the future. No major distinctions were observed for individuals across both types of housing. This data adds to existing literature on gentrification and aging in place, suggesting that while gentrification may improve certain aspects of the physical environment, it erodes the social capital of older adults. While affordable housing enables older adults to age in place within this context, additional interventions must increase accessibility of physical amenities provided by gentrification and focus on preserving community cohesion.

Taxing Marijuana and the Road to Reparations

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After the year of the War on Drugs, cannabis can now be found on the shelves of recreational dispensaries across thirty-three U.S states. While still living in the age of pre-federal legalization, we are witnessing the rampant growth of the legal cannabis market. This unique market dynamic, with states regulating cannabis independently, calls for a cross-state approach. Throughout data layering, this research combined cannabis and non-cannabis variables to understand the incidence of a single tax increase on the Colorado market. The results, which outline the luxury nature of cannabis, are used to analyze Illinois' market and its cannabis-funded reparations programs.

Determinants of bidders' valuation in Spectrum auctions

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In order to operate in a particular region, spectrum service providers need to obtain licenses through auctions hosted by the Federal Communications Commission. The significance of this activity to the state's revenue and interests call for an understanding of the participants' bidding behavior. In this research project, I investigate the factors that influence the bidders' valuation of the spectrum licenses using mathematical modeling and regression analysis on the Broadband Personal Communications Services (PCS) auctions. My results show that the licenses with larger bandwidths and covering larger, wealthier market areas tend to be valued more highly. Additionally, license valuation is positively correlated with the size of an auction and whether or not a bidder possesses bidding credits.

Special thanks to the Spectrum lab for their tremendous support!

The Führer of All Maladies: Cancer and the Utility of Metaphors for Its "Independence," under the Nazi Regime

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Work in science studies has demonstrated that metaphors construct a cognitive framework for making sense both of diseases and of new scientific research. In her 1978 book, "Illness as Metaphor," Susan Sontag argued that the dominant metaphor for cancer has ultimately become one of war; cancer cells do not just “multiply,” they are invasive – cancer patients do not just “heal,” they “fight a battle.” However, this “war metaphor” for cancer was not always and everywhere so ubiquitous. In the Third Reich, for example, Nazi scientists discussed cancer in terms of independent agency; cancer cells were viewed not on equal footing with their researchers or even the patients they plagued, but as independent degenerates or revolutionaries that threatened the unity of Nazi society – which the Nazis defined as their own "Aryan nation." Importantly, the metaphors that any society adopts are informative of aspects of their culture, and the Nazis were no exception. After a twelve-week examination of Nazi advertisements, books, and research publications in Fall 2019, I came to understand how metaphors for cancer in Nazi Germany ultimately reflected the lens through which Nazi professionals saw their own “diseased” world. This poster (and the paper on which it is based), entitled "The Führer of All Maladies: Cancer and the Utility of Metaphors for Its 'Independence,' under the Nazi Regime," draws on literature from several prominent Nazi cancer scientists (originally analyzed in German) to explain the origins and utility of independence metaphors for cancer in the Third Reich – and how the greater importance of such analysis lies in its capacity to help us understand the paranoia driving (and embedded in) Nazi perceptions of society in general.

Understanding Male Involvement in Antenatal Care in the Kilimanjaro Region of Tanzania: Barriers, Facilitators, and Opportunities for Engagement

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Social Sciences

Male involvement in antenatal care (ANC) has been recommended by the World Health Organization to improve pregnancy and birth outcomes, but challenges to male engagement exist. This study explored male perceptions and experiences of their roles in ANC in order to identify opportunities to improve male engagement. In-depth interviews were conducted with pregnant women and their partners attending first ANC at two public health centers in Moshi, Tanzania. Participants included 13 pregnant women and 6 men. Among women, 7 presented with a male partner and 6 presented without a male partner. Interviews explored barriers and facilitators to male ANC attendance and male experiences during the clinic visit. Data were coded thematically in NVivo; memos were written to synthesize findings and identify representative quotes. The primary barriers to male involvement in ANC were a fear of HIV testing and time constraints. Additionally, some men noted discomfort attending ANC and pressure from male peers not to attend, because ANC was perceived as a female space. The primary facilitator to male involvement was the preferential care given in ANC to women who presented with their male partners. Some men stated that they desired to learn about pregnancy care, and that male attendance at ANC was becoming normalized in the community.

Men who attended ANC felt that their role was limited to HIV testing and counselling, as opportunities to ask questions or directly interact with healthcare providers were limited. Women who attended with male partners felt the impact was positive, as they appreciated HIV testing and counselling with their partners. Overall, male presence provided women with psychosocial and emotional support that improved their quality of care. Opportunities exist to improve male involvement in ANC, including by addressing clinic time and access restrictions and allowing men to interact with ANC services beyond HIV testing. Peer programs that promote responsible fatherhood and ANC involvement could prove useful to dispelling conceptions of ANC as only a women's healthcare space. Future studies should develop and test interventions to promote ANC involvement among men, taking into account the perspectives of men that do not present to ANC.

Increasing Descriptive Representation within the Senate Judiciary Committee's Expert Witness Selection and Testimony Process

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The United States Senate Judiciary Committee frequently calls witnesses to testify during the bill-drafting process. These witnesses provide expert testimony in specific issue areas and allow senators who may have limited in-depth understanding of that policy area to ask questions and request recommendations. These witnesses can be university faculty, government officials, corporate employees, etc., and are selected and invited by senators and their committee staff. A review of the Senate Judiciary Committee's expert witness selection for the first 7 months of the 116th Congress (January through July) showed that nearly 70% of all of the committee's expert witnesses are white men, with less than 3% being women of color. This project uses quantitative data and transcripts with 11 of the Judiciary Committee senators' chief counsels to detail the factors which cause homogenous testimony as well as recommend solutions for Senators and their staff to increase the descriptive representation of women and people of color throughout the expert witness selection and testimony process.

"Do /ay/ sound Southern?": A preliminary analysis of the status of the /ay/ monophthong in native Charlottean speech

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This study examines 33 native Charlottean speakers, ages 10-86, 16 males 17 females, to assess the decline of a salient feature of Southern dialects: the /ay/ monophthong. The data was obtained via semi-structured interview with a word list, word pairs, and interview, and it was subsequently parsed through digital transcription and vowel extraction software. Average speaker formant measurements across the duration of the vowel were compared in SPSS. Aspects of speakers' backgrounds such as age, gender, education level, affinity for the South, and Southern familial connections were examined for their effects on the production of the /ay/ monophthong. The findings suggest that age is the most reliable predictor of whether a speaker produces the Southern monophthong or the standard diphthong; older speakers more frequently use the former. The results also point to a complex interplay between gender, age, and monophthong production. A less reliable predictor of the feature is whether one's family and primary social network also reside in the South. Affinity for the region and education level were seen to have no main effect. From this study, preliminary conclusions show that according to the apparent-time hypothesis, at least some Southern varieties in Charlotte are on the decline, trending with other major cosmopolitan areas in the South.

Less Compliance with the International Human Rights Law in the Post-World War II Era is Associated with Worse Modern State Security

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Since the establishment of the United Nations in the early post-WWII era, states, one after another, have signed and ratified the international human rights treaties. By 2019, all 193 UN member states have ratified at least one core international human rights treaty. Under the UN, these states have a legal obligation to respect, protect, and fulfill the relevant human rights standards. However, not all states comply with the treaties they have ratified. In this paper, we ask, is there an association between less compliance with the international human rights law in the post-WWII era and worse modern state fragility? Drawing on previous studies, we employ post-WWII trends in human rights scores as our proxy for compliance. We find a significant association between a decline in post-WWII human rights scores and worse modern state security, an indicator for state fragility. Thus, our findings suggest that less compliance with the international human rights law in the post-WWII era is associated with worse modern state security, thus greater fragility.

Perfectionism and Friendship: How Do Interpersonal and Intrapersonal Facets of Perfectionism Relate to College Students' Closest Friendships?

Caroline Armstrong
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Social Sciences

Friendships that are rich in positive features (e.g., mutual self-disclosure and provision of emotional support) fulfill human needs for connection, buffer against mental health problems, and serve vital additional roles. Research on factors that contribute to difficulty forming and maintaining such positive friendships has focused little on the role of perfectionism. The perfectionism social disconnection model posits that both intrapersonal and interpersonal facets of perfectionism generate social disconnection, suggesting that certain facets of perfectionism may adversely affect people's friendships. The present study examined the associations between college students' closest friendships and interpersonal facets of perfectionism (believing that one should not disclose their imperfections to others, setting very high standards for one's friend, and experiencing a negative emotional reaction when one's friend fails to meet one's standards) and intrapersonal facets of perfectionism (setting very high standards for oneself, perceiving a discrepancy between one's ideal and actual performance). Undergraduate students (n = 268) responded to an online survey assessing perfectionism and the quality of one's closest friendship (to what degree one's friendship is characterized by various positive features). The belief that one should not disclose their imperfections negatively predicted level of self-disclosure in and overall quality of one's closest friendship as well as several additional individual positive friendship features. Findings were mixed regarding setting very high standards for one's friend. Experiencing a negative emotional reaction when one's friend fails to meet one's standards negatively predicted overall friendship quality and almost all individual positive friendship features. Unexpectedly, setting very high standards for oneself was a strong positive predictor of overall friendship quality and all individual positive friendship features. Perceiving a discrepancy between one's ideal and actual performance negatively predicted only time spent with one's friend and positively predicted level of conflict in one's friendship. Our findings may inform interventions to promote building and fostering positive friendships.

Understanding Risks of Biologic Drugs

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Social Sciences

Biologic drugs are made from living organisms or contain components of living organisms and are used to treat a variety of health conditions, such as rheumatoid arthritis and various cancers. They are widely prescribed, but doctors and patients may not fully understand their risks. For example, a major risk is "infection" since biologics weaken the immune system. The main infection given in official documents is tuberculosis, while common infections such as influenza are often not mentioned as a risk at all. Therefore doctors might not warn patients about getting the flu while taking a biologic. Also, patients might not know the appropriate action to take if an infection occurs during treatment, leading to potentially serious complications or even death. This research examined comprehension of information about biologic risks and whether it can be improved by enhanced risk displays. The cognitive accessibility of FDA approval documents for biologics used to treat rheumatoid arthritis was assessed based on cognitive principles such as chunking, coding, and linguistic complexity. Features that violated these principles were identified and used to develop an Enhanced version of the risk information. In Experiment 1, participants read either the Original or Enhanced display and were tested in cognitive tasks such as free recall, cued recall, and recognition. The Enhanced group had higher free recall scores for certain risks, especially those involving infection. The results also suggested additional information enhancements, as examined in Experiment 2. Experiment 2 introduced a new type of display, a patient-action table. It listed each serious side effect, its typical symptoms, and what actions to take in adjacent columns. Participants read either the Original version of side effects or the Enhanced display. The same cognitive tasks were tested as in Experiment 1. Better performance is predicted for the Enhanced group. The results will also be compared to those of Experiment 1 to determine the relative effectiveness of general cognitive enhancements versus the patient-action table. This project holds implications for both public health and cognitive science. Cognitively enhanced information may improve both doctor and patient understanding of biologic risks and help prevent complications from serious side effects. The results may also provide insight about cognitive principles for medical information and suggest optimal presentation standards.

Mindsets Through Language

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Social Sciences

Everyone holds certain implicit beliefs, also called “mindsets”, about the nature and malleability of intelligence. These mindsets powerfully influence students’ academic experience by shaping how they set classroom goals and approach challenges. Although the relationship between intelligence mindsets and classroom grades had been widely explored, the present work investigates a novel way of measuring intelligence mindsets through language and examines the effects of mindset on other domains crucial for student experience. In this study, we collected data from a sample of 775 students enrolled in introductory STEM classes across two semesters. In addition to using established intelligence mindset scales (Dweck, 2006), we coded students’ free response answers to questions about the nature of intelligence to identify their inferred or “coded” mindset. To establish the validity of this novel coded mindset measure, we examined how this coded mindset measure predicts students’ conceptualization of effort, their overall well-being, and their grade satisfaction. Our results indicated that language is a reliable indicator of intelligence mindsets, and these mindsets are consistent with students’ experiences in a course. We discuss our findings’ implications for teaching and psychology.

Keywords: intelligence mindsets, implicit theories, language, well-being, grade satisfaction

That's the Way Life Goes, You Know: What Narrative Psychology Can Learn from Sociolinguistics and Literary Theory

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Social Sciences

We love stories—from pop culture gossip and nightly news updates to books and award-winning movies, we are constantly telling, watching and listening to stories. They help us understand ourselves, others, and the world. The field of narrative psychology, focused on studying stories, has grown in the last four decades, expanding on and informing how the stories we tell about our lives are understood and applied in clinical and non-clinical settings. However, there is a lack of communication between narrative psychology and other disciplines—particularly sociolinguistics and literary theory—about how narratives can be understood on the level of both theory and data analysis. This project is aimed at providing literature reviews of how psychology, sociolinguistics, and literary theory study narrative. By putting the literature of these fields in conversation with each other, a more collaborative narrative lens will be crafted. Through this lens, a dataset of life stories (n=106), collected by Dr. Rubin and colleagues nearly a decade ago, will be analyzed, highlighting ways the field of narrative psychology can continue to grow.

Teaching with Toys: How mothers communicate messages about race and gender during playtime

Grace Gutierrez
Faculty Mentors: Makeba Wilbourn, Dr. Michael Gaffrey, and Dr. Sarah Gaither
Social Sciences

This study examines how Black and White mothers may communicate differently with their sons versus their daughters during playtime. It is known that mothers are key influencers in their infants' language development. Although it is not often thought about as an educational experience, playtime is an important time in which infants are introduced to new words and phrases by their caregivers. Perhaps the content of what caregivers talk about during playtime should be more closely examined since it can be used as a learning opportunity. It would be especially interesting to determine if there are any differences in playtime talk when mothers are speaking to their sons in comparison to their daughters. In this study specifically, coding was done to determine the different themes presented by mothers in the toy task. The prevalence of different themes was then compared to Black and White mothers with sons and Black and White mothers with daughters to see if there are any significant differences in topic. Furthermore, this was analyzed in comparison to the infant's score on the MacArthur Short Form to determine the possible influence of what mothers discuss with their infants during playtime on their infant's language comprehension and production. It was predicted that there would be some differences in themes depending on infant gender and race, based on traditional gender stereotypes and past literature.

Together We Can: Establishing Collaboration and Promoting Prosocial Behavior in Preschoolers

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Social Sciences

This study investigates how the presence of we-framing and/or minimal groups potentially affects prosocial behavior in preschoolers, such as helping, sharing, and sense of commitment. Conditions differed in a combination of whether the coloring task was described with a “We” or “You” and whether the participant received a matching or non-matching color bracelet as the experimenter. 96 3.5-4.5-year-old children engage in a coloring task with an experimenter, during which we measured whether they helped retrieve an out-of-reach box, potentially shared up to 6 erasers, and left the coloring task to play with a fun toy when the option became available. Results showed that there was no effect on children's helping and very little effect on children's sense of commitment. However, there is significant evidence that children in the outgroup more often engaged in "fair or generous sharing", sharing half or more of their erasers, while children in the ingroup often chose not to share at all.

Developmental Trajectories of Hostile Attributions Across Cultures

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Hostile attribution bias informs many areas of social cognition, and has been found to be stable across middle childhood. A child's demonstrated hostile attribution bias is often correlated with increased aggressive behavior, but depending on social norms, what qualifies as aggressive behavior in one culture may be perceived as benign in another. The present study sought to investigate whether these differing attitudes toward aggression were reflected in trajectories of hostile attribution bias in a sample of 1,298 children (51% girls). Participants were recruited from 11 distinct cultural groups in eight countries (Colombia, Italy, Jordan, Kenya, the Philippines, Sweden, Thailand, and the United States) and followed from the time children were 10 to 13 years of age, on average. At each of three time points, children were presented with ten vignettes depicting ambiguous provocations and asked to determine the intent of the person who caused the incident. Children's responses were averaged across the ten vignettes to create a composite hostile attribution bias score. Latent growth curve modeling suggested that all cultural groups with significant slopes demonstrated small decreases but overall stability in hostile attribution bias over the three time points assessed, which is consistent with previous research about hostile attribution bias. These patterns were similar across all 11 cultural groups. ANOVA testing also found many significant differences between cultural groups in initial and final mean-levels of hostile attributions. Findings are discussed in relation to the development of hostile attribution biases from childhood to early adolescence and in terms of possible explanations for cultural consistencies in the development of hostile attributions.

Who gets the job? Examining the relationship between automatic expungement policies and racial discrimination in NC

Leah Abrams
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Social Sciences

"Unmarking" processes are among those policies intended to facilitate a reduction in the barriers to employment for justice-involved1 American residents. Widely proposed unmarking policies include "Ban the Box," or policies that remove questions about criminal history from initial applications; expungement policies that automatically clear certain convictions or arrests; and targeted jobs-guarantees for justice-involved populations.

The following thesis isolates one specific unmarking policy—an automatic expungement policy—and investigates its implications for white and black men. Through an experimental survey distributed to 300 North Carolina adults via Amazon's Mechanical Turk, the data provide preliminary answers to the guiding research question: "Would the implementation of an automatic expungement policy for non-violent charges at the state level influence disparities in job prospects for white and black male applicants in North Carolina?"

By comparing differences in willingness to give candidate callbacks "before" and "after" the implementation of an expungement policy, the thesis will draw conclusions about the effectiveness of such policies in reintegrating—or "unmarking"—justice-involved North Carolinians. In the final section, this paper offers a series of policy recommendations for lawmakers interested in "unmarking.

Building An Equitable Movement: Observing Class and Racial Diversity in the Sunrise Movement

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Social Sciences

Amidst the climate crisis, the Sunrise Movement has emerged as a powerful protector of people and the places they call home. Sunrise strives to build a cross-class multiracial coalition to pass the Green New Deal. However the historic racist and classist legacy of the environmental movement paints a backdrop that makes this not so simple. Over 8 weeks, I attended meetings and events, conducted interviews, and attended the Sunrise summer Bootcamp in 8 different cities. From my observations and interviews, I compiled a report on the state of equity and diversity in the growing Sunrise Movement supporter base. The Sunrise Movement does not yet have a base that represents the frontline communities that need to be leading the fight against climate change. I found this to be the most prevalent in local chapters but also manifested in national support staff. I found the core issue to be organizers viewing diversity and base building as separate goals, and not at their core the same. Most chapters worked to build a base of support and then moved to address equity. This made equity a second priority. It is for that reason that as Sunrise moves building diverse bases should be seen as a cohesive goal that encompasses the recruitment of people from all walks of life. The report outlines specific ways this can be purposed as well as a more in-depth analysis of the current situation.

Structural Inequality and Reproductive Health for Puerto Rican Women in the Twenty-First Century

Corinne Mayle
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In 1965, a study showed that over one third of Puerto Rican women of childbearing age had been sterilized. Widespread sterilization had become so common that women simply called the sterilization procedure "la operacíon," or "the operation." Although the history of widespread Puerto Rican sterilization and the ideology it exposed received much scholarly attention in the 1980s-1990s, relatively little scholarship connects that history to modern reproductive health outcomes and access to care for Puerto Rican women. While the incidence of Hurricane Maria drew attention to the structural implications of colonialism, few scholars have examined how and why structural inequality is still upheld. Furthermore, research on the modern health delivery system's influence on women's reproductive health status in Puerto Rico is limited. This study uses open-ended qualitative interviews, both over the phone and in person, of twenty-nine individuals consisting of health professionals, patients, scholars and activists to understand the role of majority-minority identity construction, social determinants of health, and colonial-driven structural inequality in modern reproductive health of Puerto Rican women. Without minimizing Puerto Rican agency, I find that Puerto Rico's subordinate colonial position left it vulnerable to institutionalization of mainland-imposed policies that valued efficiency over the dignity of women, and the effects of those policies linger. Accordingly, key recommendations include: (1) a transition from Medicaid block grants to the need-based funding states receive, (2) increased oversight of the Centers for Disease Control and Prevention's recent contraception intervention, (3) cost reduction and deregulation of access to contraception, and (4) investment in a comprehensive study of the status of Puerto Rican reproductive health and health systems

Swedish Counterterrorism Policy on the Reintegration of Former Terrorist Fighters

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Social Sciences

Sweden, like other nations around across the world, currently faces a national security challenge of re-integrating former terrorist fighters (FTFs) who left the country to join terrorist organizations or engage in armed conflict (such as the Syrian Civil War). This research examines how Sweden's current re-integration laws have affected its counterterrorism strategy. Interviews with Swedish counterterrorism scholars, police and security personnel, government officials, and politicians were conducted and used to collect information about the goals, challenges, and current situation of re-integrating FTFs into Swedish society. Since Sweden is also a member state of the European Union, interviews also explored how the nation's re-integration policies affect the security of the intergovernmental organization. Data analysis of the interviews indicate that Swedish reintegration policies are provide some benefits, but also conflict with the nation's counterterrorism strategy and domestic security. Interviews revealed that Sweden's local disengagement programs and initiatives engage FTFs to challenge radical ideologies and provide social services (such as housing, education, employment aid, and welfare benefits). These programs and social benefits contribute to the national effort to re-integrate former fighters and prevent them from participating in violent extremism. On the contrary, these reintegration policies pose a challenge to Swedish counterterrorism policy. This includes concerns about insufficient surveillance on former fighters and the effectiveness of mitigating radical ideology in individuals. Therefore, FTFs may pose a security risk to themselves or others in Swedish society. Furthermore, Swedish counterterrorism policies for reintegration FTFs could undermine the security of the European Union due to insufficient surveillance on recent movement and activities. The results of this study provide insight on ways Swedish reintegration policies contribute to or challenge the nation's counterterrorism polices.

Needs Assessment for High Quality Early Learning in the Gainesville Empowerment Zone

Lenae Ryan
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Social Sciences

During the summer of 2019, I partnered with Gainesville for All, a community organization in Alachua County, Florida, working to end local racial and economic inequities through systemic policy change. We specifically focused our efforts on a low-income area in East Gainesville designated as the Gainesville Empowerment Zone (GEZ). My research centered around education policies to mitigate the achievement gap between Black and white students at local public schools. The achievement gap problem was clearly demonstrated in the 2018 Alachua County Equity Report, showing that reading proficiency for Black third graders in our community is only one-third of the reading proficiency for non-Hispanic white students. One of the many reasons for this is the lack of equality in early learning opportunities. In my preliminary research, I found that public high-quality early learning is one of the best policy tools to diminish the achievement gap which is already so prominent by the time a child reaches third grade. To analyze the current state of high-quality early learning locally, I compiled a database of all early learning opportunities, eligibility requirements, hours, and costs, finding that there was no early learning center in the GEZ that operates for more than half the day and serves kids 0-3 while families in wealthier, whiter parts of Gainesville have an abundance of centers to choose from. This disproportionately affects families in the GEZ trying to work and provide quality care for their young children. My community partner and I then carried out a needs assessment of service providers for an early learning center in the GEZ. After conducting interviews with local elementary school teachers, families, and city commissioners, we found support for a full-day, publicly funded early learning center for kids 0-3 being placed at Metcalfe Elementary School in the GEZ.

Enforcement as Community Trauma in the Arizona Borderlands

Olivia Simpson
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Social Sciences

Since critical shifts in border enforcement strategy during the 1990s, over 3000 migrant fatalities have been recorded in the borderlands of southern Arizona. At the same time, the region continues to be a popular destination for recreation and retirement as people are drawn to the climate, relatively low cost of living, and protected wilderness areas. My project is situated in the tension between these two realities. Drawing on 15 semi-structured interviews with year-round and seasonal residents of the Arizona borderlands, I investigate the impact of changes in border enforcement strategy over the last 30 years. How do these residents experience border enforcement strategies? To what extent are they impacted by the lethal consequences of border enforcement in the region? What might the experiences of community members indicate about the indirect effects of enforcement activities?

In answering these questions, I frame border enforcement as a violent form of state power and argue that, for these residents, their experience of it constitutes a collective, communal form of trauma.

Investigating Underpricing in Venture-Backed IPOs Using Statistical Techniques

Michael Tan
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Social Sciences

This paper concerns applying statistical methods to investigate underpricing in VC-backed technology Initial Public Offerings (IPOs) since the great recession. In particular, firm, market, and IPO-specific variables were explored to determine if there were any signifi- cant relationships to underpricing. The paper focused on the Bank Preference theory of underpricing, where underpricing is said to occur because investment banks running IPO processes are incentivized to underprice to decrease the risk that they will not be able to allocate all the issuance to price-sensitive public markets investors.

MEETING OF THE MINDS

This year's ACC Meeting of the Minds was set to take place from March 20-22, 2020 hosted by the University of North Carolina at Chapel Hill, but was canceled due to public health concerns about the spread of COVID-19. Below you will find more information about the conference and its participants, as well as the abstracts for the 5 Duke undergraduates selected to present at the conference:

- **Benjamin Nativi**
- **Gino Nuzzolillo**
- **Isabel Shepard**
- **D'amy N. Steward**
- **Carter Zenke**

The Atlantic Coast Conference (ACC) Meeting of the Minds conference is held each spring and is hosted by one of the 15 ACC member schools. It is funded in part by revenue from athletic events. The conference celebrates undergraduate research and provides an opportunity for sharing ideas and collaboration. Every spring, outstanding undergraduate researchers and a faculty mentor from all ACC universities are invited to present their original research.

ACC member schools include:

- Boston College
- Clemson University
- Duke University
- Florida State University
- Georgia Tech
- NC State University
- Syracuse University
- University of Louisville

An Analogue of Gauss Composition for Binary Cubic Forms

Benjamin Nativi

Consider primitive binary quadratic forms, i.e. p(x, y) =ax2+bxy+cy2where a, b, c are integers such that gcd(a, b, c) = 1. Gauss showed that one can compose two such binary quadratic forms p1(x1, y1) and p2(x2, y2) of the same discriminant and choose appropriate new variables X and Y as integral bilinear combinations of x1, y1, x2, y2 to get a new form P(X, Y) of the same discriminant. This composition is well defined on SL2(Z)-equivalence classes and although Gauss's proof of this composition is tediously computational, more recent proofs such as that by Dirichlet are less cumbersome and more intuitive. One benefit of the study of binary quadratic forms is their relation to the class group. For a ring RD=Z[D+√D2], its class group is the set of fractional ideals quotiented by the principle fractional ideals. It turns out the elements of the class group correspond to SL2(Z)-equivalence classes of primitive BQF's and that the composition of ideals gives the same ideal class as that from composing the corresponding BQF's. This allows the study of class groups by studying BQF's. In my work, under the supervision of Professor Aaron Pollack, I have expanded on results of Bhargava to show that there is a similar composition of projective binary cubic forms. The SL2(Z)-equivalence classes of BCF's correspond to elements of the 3-torsion of the class group of certain rings. I was able to prove that, as in the quadratic case, the composition of BCF equivalence classes is equivalent to the composition of ideals. My result is intriguing for two reasons. First, although it was clear from the work of others that some composition law existed on classes of BCF's, I was able to explicitly demonstrate this law in a form analogous to Gauss composition. Second, my result furthers the connection between classes of forms and the ideal class group and may inspire similar results in related settings.

Black Community Organizing & Urban Change in early 20th Century Atlanta

Gino Nuzzolillo

At the turn of the 20th century, the city of Atlanta flaunted its status as capital of the New South —filled with civic pride, focused on commerce, and devoid of racial conflict. W.E.B. Du Bois commented that the nation "talked of [Atlanta's] striving," an image effectively projected by the city's elite Black and white communities. For all of its New South aspirations, however, stark inequality along lines of race, class, gender, geography, and access to the Atlanta's many resources defined daily life. In September 1906, a violent massacre —which left dozens of Black Atlantans dead at the hands of a white mob —tarnished Atlanta's New South veneer and made clear the ways in which competing visions of a "New South city" were playing out in Atlanta's streets, saloons, and neighborhoods. This thesis focuses on these many visions, primarily from the perspective of diverse Black community organizers, social workers, educators, and preachers who articulated their worldviews and put them into action. Using personal papers, maps, city ordinances, conference proceedings, and newspaper archives, this thesis tells the story of how Black Atlantans made claims upon, and asserted a right to, a rapidly changing Atlanta from 1890 to 1930.

No Place Like Home: Dorm Room Culture on a College Campus

Isabel Shepard

This project explores placemaking in the college bedroom through a lens of materiality and aesthetics. The dormitory has become central to higher education in the United States and serves as an institutional hotbed of cultural codes structured around a 'normative' student. Localized to Duke University and the digital platforms of Dormify and Instagram, my research investigates the construction, exhibition, and fixity of identity concealed by and achieved through the dorm room's presentation. This project traces how Dormify embeds itself in Instagram and assumes some of its (anti)social qualities as it manufactures a trope of the dorm space. Amplified by Instagram's sociality, this material and aesthetic culture defines a perceived norm and, therefore, necessity for girls eager and insecure to go to college. The brand allows for the normalization of a hyper-commodified and hyper-curated dorm space on Duke's campus. In the complicated dialogue between freshman girls and their bedrooms, their bedrooms become contested spaces that can be both a "girly" façade and an affective home. My project acts to expose the negotiations of institutionalized norms on the level of the individual—the level of the undergraduate student and the dorm occupant. To do so, I navigate the conflicting discourse around private/public, girlhood, and human to non-human relations. My work draws upon interviews, 'room tours,' photographs, sketches, and descriptions grounded in the sensory to re-experience the college bedroom space.

Quantifying spatial distributions and benthic footprints of artificial reefs on the southeastern USA continental shelf

D'amy N. Steward

Artificial reefs are commonly deployed to enhance fish habitat and provide fishing and diving opportunities. Despite the widespread occurrence of artificial reefs, relatively little is understood about their spatial distributions and how much area of the seafloor these reefs cover. To help fill these knowledge gaps, we quantified the spatial distribution and benthic coverage ('footprint')of artificial reefs along the continental shelf of the southeastern United States (Florida, Georgia, South Carolina, North Carolina)using data from the respective state agencies. Specifically, we examined the distribution of artificial reefs by geography, depth, material, and structure type. We then estimated the minimum, mean, and maximum coverage of artificial reefs across the southeastern USA using multiple quantitative approaches. By increasing knowledge and understanding of the distribution and associated attributes of artificial reefs, this research may help inform future designs, deployments, regulation, and restoration along US coastlines.

Cultivating Computing Identity: How Children Come to Be, Know, and Do in Computer Science

Carter Zenke

As states begin to mandate computer science (CS) instruction for ever earlier ages, it is critical to establish a shared language—among teachers, policymakers, and researchers—regarding how students come to learn computer science. This language should equip policymakers to remove systemic barriers, help teachers to humanize their students, and encourage researchers to establish best practices. This presentation argues that the concept of a "computing identity," coupled with an understanding of how children come to develop this construct, will best unify educational stakeholders across these goals. To propose a useful model of computing identity, this presentation will first draw from literature on established disciplinary identities, such as math identity and STEM identity. Then, it will delve into two ethnographic portraits of high-school students who participated in a computer science curriculum designed to help the students see themselves as, and be recognized as, computer scientists. In merging the literature on disciplinary identity with this rich ethnography of student experiences, this presentation opens a space for conceptualizing computing identity and the conditions that cultivate it. As a test-case for the construct's usefulness, the presentation will conclude by discussing how computing identity has been used to frame the development of North Carolina's first elementary CS curriculum, to be implemented in all classrooms by 2021.

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