WAKE FOREST UNIVERSITY

A CELEBRATION OF UNDERGRADUATE RESEARCH AND CREATIVE WORK

3 TO 5 PM
FRIDAY, SEPTEMBER 27
SUTTON CENTER

WAKE FOREST UNIVERSITY

WAKE FOREST
UNIVERSITY

Undergraduate Research and Creative Activities Center

URECA Day 2024

Friday, September 27
Sutton Center

Schedule of Events

Poster Session……..3:00-5:00pm
Sutton Center Lower Gym (2nd Floor)

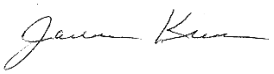
Oral Presentations……..3:30-4:55pm
Wellbeing Center Room B274

A message from Dr. Jackie Krasas, Dean of the College and the Graduate School of Arts and Sciences

Welcome to URECA Day, our annual celebration of undergraduate research and creative work! URECA Day stands out as one of the highlights of the academic year at Wake Forest. As our campus comes together to witness the vast range of projects, each one an impressive contribution to their scholarly field, I'm personally excited to see this year's projects and hear from our students who have worked hard to tackle important questions across various disciplines. The setting may vary – from the stage to the field to the lab bench, whether in Winston-Salem, or Okinawa, Japan – but the pursuit of new knowledge brings a vibrancy to our intellectual community.

Many thanks to the URECA faculty committee for their work organizing this event and to the faculty, staff, and graduate student mentors for their support of experiential learning. Students, now is your time to show off what you have learned and how you have grown as scholars yourselves. We're proud of you and look forward to hearing your stories!

Sincerely,



Dr. Jackie Krass
Dean of the College and the Graduate School of Arts & Science

Oral Presentations

3:30 – 3:40 Abby Caudill

Amsterdam: A Case Study in the Ethnomusicology of EDM

3:45 – 3:55 Adam Coil

Artistic Representation in the Age of Multiplicity: Set Theory and Self-portraits

4:00 – 4:10 Alyssa "Grace" Hernandez

Mapping Material Genre Systems: Teens Writing in/for the Community

4:15 – 4:25 Kalina Namikas

The Hands of the Maker

4:30 – 4:40 Amanda Peake

Hawking Radiation in Acoustic Black Holes

4:45 – 4:55 Lillie Sutton

To Switch or To Swap: A Retrospective Investigation of Best Treatment Options for Pediatric Patients with Refractory Uveitis

Faculty Moderator:

Dr. Cindy Gendrich

Department of Theater and Dance

Oral Presentation 1

Amsterdam: A Case Study in the Ethnomusicology of EDM

Abby Caudill
Major: Psychology

Mentor: Ali Sakkal, Education

This research project seeks to better understand the intricate relationship between Electronic Dance Music (EDM), LGBTQ culture, and political history in Amsterdam, Netherlands. Employing ethnomusicological lenses, this research explores how these seemingly disparate elements have intertwined to shape the city's vibrant EDM culture. Through a combination of archival research and field observations, this study investigates the historical and social context of Amsterdam's EDM scene (including its roots in the city's LGBTQ history and cultural resistance); the influence of traditional Dutch folk music on EDM's celebratory themes and optimistic energy; and the role of queer artists and culture in shaping the genre's aesthetics and values. By utilizing exclusive archival documents and personal experiences with Amsterdam's modern soundscape, this project seeks to bridge the gap in EDM research by highlighting the importance of historical context for understanding modern cultural trends, as well as the often-overlooked role of queer artists and culture in shaping the genre. By examining these interconnected factors, this research hopes to offer a fresh, nuanced understanding of Amsterdam's unique musical landscape. The findings contribute to broader discussions on the cultural significance of EDM, the intersection of music, history, and identity, and the enduring power of grassroots musical movements in defining culture.

Artistic Representation in the Age of Multiplicity: Set Theory and Self-portraits

Adam Coil
Major: English

Mentor: Herman Rapaport, English

Alain Badiou demonstrated in Being and Event that the logico-mathematical framework of set theory is fertile for philosophical discourse concerning ontology. This paper builds on Badiou's work and argues that set theory can be used to analyze poetry and art, particularly art that is concerned with the self and self-representation. Using the language of set theory (inclusion, belonging, containment, infinity, emptiness, etc), it argues that John Ashbery's poem "Self-Portrait in a Convex Mirror" exploits some of the tensions inherent to concepts in set theory to craft a work that constantly renews itself and resists classification

Oral Presentation 3

Mapping Material Genre Systems: Teens Writing in/for the Community

Alyssa "Grace" Hernandez
Major: Religous studies

Mentor: Keri Epps, English

"Mapping Material Genre Systems: Teens Writing in/for the Community" aims to help writing studies scholars and community arts organizations, such as Authoring Action, understand the interconnectedness of writing objects and genres and how they work together to facilitate student writers' confidence outside the classroom. We want to see how teen authors gain agency and ownership in their writing when they are the ones who need to have control and power over their voice, identity, and confidence. Relatedly, recent education trends have included declining diversity and inclusion efforts. We want Authoring Action's curriculum to be adopted into more K-12 and higher education classrooms as a way to foster inclusion for all students. Throughout the research, we have seen firsthand that confidence-building and agency are developed through invention and materiality established in the Authoring Action writing curriculum.

The Hands of the Maker

Kalina Namikas
Major: Chemistry (Biochemistry concentration) and Applied Statistics

Mentor: Morna O'Neill, Art

This summer, I explored the intersection of art and craft in order to make art as a craftsman. The first part of my project was to immerse myself in a place where craft is valued and important, and learn a new skill related to the fiber arts. This part of the project was about connecting with people who also value craft and seeing how it is a part of their life. To accomplish this, I spent a month volunteering on a farm where I could learn spinning from the woman I stayed with. I immersed myself in a traditional rural lifestyle where crafts like spinning are a normal part of life. While on the farm, I learned both wheel spinning and spinning on a drop spindle. After the time on the farm, I stayed in London to visit both museums and places of craft and observe how craft and art are exhibited. Once I returned to the US, I began creating art inspired by my experiences. My goal for the art was to use the rural lifestyle and craft I had experienced as inspiration for several pieces. I broke craft down into maker, material, and skill and I used these elements to guide my designs. I created pieces that took elements of both the rural landscape and the craft skills I had learned and I applied them in new ways. I was able to create pieces that speak to artistic expression while staying true to my craft inspiration.

Oral Presentation 5

Hawking Radiation in Acoustic Black Holes

Amanda Peake
Major: Physics

Mentor: Alessandro Fabbri, Theoretical Physics (Universitat de Valencia)
Paul Anderson, Physics

The study of Hawking Radiation (HR) around astrophysical Black Holes (BHs) sits at the intersection of three major pillars of physics: Special Relativity, General Relativity, and Quantum Field Theory. Astrophysical BHs thermally radiate at a temperature many orders of magnitude less than the ambient vacuum temperature and thus direct detection is virtually impossible. However, we can analogize the propagation of light around a BH to the propagation of sound through a subsonic/supersonic fluid in a curved 4-D 'acoustic' metric. This analogy is so good that these "Acoustic Black Holes" produce HR that can be detected and studied in a laboratory. We consider a specific sound speed profile in an acoustic BH and analytically determine exact solutions to the d'Alembert equation. We account for the back-reaction and scattering effects in 4-D by determining the relevant scattering and transmission coefficients. Ultimately, we analytically and numerically calculate peak heights of the density-density Hawking-quanta partner correlator function. These results theoretically predict the quantum effects in acoustic BHs that could be experimentally measured and then applied to astrophysical BH behavior.

To Switch or To Swap: A Retrospective Investigation of Best Treatment Options for Pediatric Patients with Refractory Uveitis

Lillian Sutton
Major: Biochemistry and Molecular Biology

Mentor: Alessandro Gonzalez Salerno, Wake Forest School of Medicine
Jackie Sheridan, Wake Forest Merit Scholars

Refractory pediatric uveitis is a condition where quick clinical action is needed to prevent potentially permanent ocular damage for patients if it is not managed properly. While many patients are controlled on either methotrexate or adalimumab monotherapy, or on the two in conjunction, there is not a consensus on the ideal course of action for patients who remain unresponsive to adalimumab treatment. While some medical guidelines recommend a "switch" within class to another TNF inhibitor, there is some evidence that a "swap" to a different biologic agent may be the preferred approach for some patients. This study sought to determine the clinical and therapeutic differences between patients who were "switched" or "swapped" for refractory uveitis. 31 patients seen at Boston Children's Hospital between 1998 and 2024 and met study criteria were included. Findings indicate that both infliximab and tocilizumab show promise as treatments following adalimumab failure. It was found that patients who "switched" to another anti-TNF medication had more severe anterior chamber cells, while those who "swapped" had longer disease duration and comparatively milder inflammation. The results of this study provide some indication for the kinds of patient cases who may benefit from a swap to an alternate biologic agent, although a greater sample size from future collaborative studies may confer greater statistical significance and more definite conclusions.

Poster Presentation 1

Examining the Relationship Between Left Ventricular Function and Exercise Capacity in Lymphoma Patients Undergoing Chemotherapy

Joshua Abrams
Major: Health and Exercise Science

Mentor: Peter Brubaker, Health and Exercise Science
Sam Norton, Health and Exercise Science

Although the efficacy of anti-cancer drugs like anthracycline based chemotherapies (Anth-bC) have increased dramatically, many patients experience exercise intolerance due to the cardio-toxic nature of these drugs. The determinant of exercise capacity can be modeled with the Fick Equation where VO2 = cardiac output x arterio-venous oxygen content difference.

To quantify the determinants of exercise capacity we compared resting and peak exercise cardiovascular hemodynamics among fourteen (5 men and 9 women) anthracycline treated survivors (ATS) that were at least 12 months post-treatment to 14 matched controls. A cardiopulmonary exercise test and cardiac magnetic resonance imaging protocol was utilized to determine peak exercise capacity (VO2 peak) as well as left ventricular (LV) function immediately post exercise (IPE).

Exercise capacity among ATS was 22% reduced compared to CON (VO2 peak; 26.9±6.4 ml/kg/min vs. 34.3±6.3 ml/kg/min; p=0.00). Immediate post cardiac output trended lower in ATS compared to CON (5.7+1.3 vs. 5.9+1.3 L/min/m 2, p=0.62) and was due to a significantly lower exercise SV in ATS (44.5±8.5 vs. 52.8±10.3 ml/m 2; p=0.04).

Linear regression analyses were used to explore the relationship between peak VO2 to changes in LV function measures. A strong significant correlation was found between peak exercise VO2 and EDV (r =0.56) in ATS while the same relationship was weak in CON (r =0.06). These results suggest that ~30% of the reduction in peak VO2 in ATS is attributable to impaired LV filling during exercise. Medical and/or lifestyle therapies to improve LV compliance and filling should be investigated in ATS.

New scaffolds for circularly polarized luminescence materials

Harrison Abromavage
Major: Chemistry with a Concnetration in Medicinal Chemistry and Drug Discovery

Mentor: Cedric Schaack, Chemistry
Jiaoyan Zhao, Chemistry

Chirality offers exciting possibilities for organic electronics, introducing functionalities beyond conventional properties. Chiral molecules' unique ability to generate CPL holds immense potential for advancements in display technologies, encryption, and quantum computing. CPL arises from the coupling of electronic transitions with molecular chirality, resulting in emitted photons with a specific polarization handedness. This phenomenon offers significant advantages in chiral recognition, spin-selective transport, and extraterrestrial material analysis.

Conventionally, CPL generation involves passing unpolarized light through polarizers, incurring substantial energy losses. Chiral luminophores provide a groundbreaking solution by directly emitting CPL, boosting display technology efficiency. Upon photon absorption, chiral molecules form excitons with a specific handedness determined by the alignment of electric and magnetic transition dipole moments. During relaxation, these chiral excitons emit CPL with a preferred polarization direction matching their handedness. This opens exciting possibilities for OLEDs, solar cells, and other optoelectronic devices.

Here, we report our recent progress on developing chiral allenes as a promising platform for such materials. We hypothesize that new organic scaffolds must be developed in order to achieve efficient CPL emission. We will develop efficient synthetic strategies and uncover new molecular scaffolds, such as chiral cyclophanes or allenes. We study these materials using UV/vis, electronic circular dichroism, photoluminescence, and circularly polarized luminescence spectroscopies. In addition, through collaborations, we study intersystem crossing rates and rotary strengths using transient absorption spectroscopy.

Poster Presentation 3

How Good is Our Undergraduate Engineering Ethics Training? A Comparative Analysis of Engineering Ethics Textbooks

Chloe Adams
Major: Engineering

Mentor: Olga Pierrakos, Engineering

Dr. Olga Pierrakos is a rotating STEM Education Program Director in the Division of Undergraduate Education at the National Science Foundation (a second stint). Olga is also the Founding Chair (2017-2022) and a Professor of Wake Forest Engineering. With a unique vision to Educate the Whole Engineer and a commitment to Human Flourishing, Olga led Wake Forest Engineering to be ranked as one of the top (14th) ”Best Undergraduate Engineering Programs” by US News Report (2023). With this unique vision, Olga has also served as the principal investigator since 2019 on a multi-year Kern Family Foundation KEEN (Kern Entrepreneurial Engineering Network) award titled ”Educating the Whole Engineer” to integrate important competencies such as virtues, character, entrepreneurial mindset, and leadership across the Wake Forest Engineering curriculum. She has led Wake Forest Engineering with a focus on inclusive innovation and excellence, curricular and pedagogical innovation, and creative partnerships across the humanities, social sciences, industry, entrepreneurs, etc. in order to rethink and reimagine engineering education. All this has led to Wake Forest Engineering achieving unprecedented student diversity (42% women, 25% racial and ethnic minorities) and faculty diversity (50% women, 25% racial and ethnic diversity). Olga is an engineering education researcher, biomedical and mechanical engineer, and national leader in transforming undergraduate engineering education. She has served as founding faculty of two brand new engineering programs (the first at James Madison University) and served on several national roles across ASEE, ABET, AAAS, NSF, KEEN, etc.

Poster Presentation 4

Examining Bias Across Genetic Association Studies of Educational Attainment and Underlying European Population Structures

Zinn Amos
Major: Biochemistry and Molecular Biology

Mentor: Josh Currie, Biology

Educational Attainment (EA) is a trait that indicates the highest level of education that an individual has completed. This phenotype is influenced by a multitude of complex socioeconomic factors, including family income, parental EA, the environment in which the individual is raised, social status, and access to equitable education and enrichment opportunities. Genome-wide association studies (GWAS) have been conducted to identify genetic factors associated with EA. We hypothesize that the genetic associations to EA are largely driven by the underlying population structure within individuals of European ancestry, rather than representing true genetic underpinnings. To test this hypothesis, we conducted a GWAS to identify single nucleotide polymorphisms (SNPs) that were associated with specific regions in Europe in the 1000 Genomes data set. We used the summary statistics from this GWAS to construct a polygenic score (PGS) in HapMAP 3 individuals of European ancestry. We plan to compare this ancestry-based PGS with the EA PGS in the HapMAP3 individuals to test whether each score is predictive of the region-based case control definition. Our study aims to demonstrate that genetic factors are a weak contributor in determining EA. These findings could lead to the reconsideration of the genetic contributions to EA, shifting focus away from PRS-based policy for improving EA and eliminating dangerous assumptions of EA genetics. We anticipate that the results of our study will emphasize the importance of instituting policy that alleviates the socioeconomic factors causing disparities in EA and provide a cautionary tale for the interpretation of genetic association findings.

Geography, Political Power, and the Presentation of Māori Identity in Heritage Institutions

Jeff Amoss
Major: Anthropology

Mentor: Paul Thacker, Anthropology

The ramifications of colonialism on the identities of indigenous Māori peoples of New Zealand are illustrated in the heritage institutions across the islands. The emergence of tribal governance systems under colonial rule in conjunction with distinct cultural practices between Iwis (Māori tribes of the Southern and Northern Islands) has led to reinforcement of cultural identity from artifact collection and public presentation in Northern institutions. Southern Māori's higher frequency of intermarriage with European colonists and the lack of portrayal of Southern Māori culture in heritage institutions has led greater significance being placed on whakapapa (lineage histories) to claim Māori descendance and subsequently political rights under Iwi governance. Moreover, the uneven distribution of political power between Northern and Southern Islands amongst the Iwis is apparent in the fact that eight Iwis are present on the North Island, while there is only one Iwi on the South Island. Thus, it is much more difficult for individuals of Southern Māori descent to acquire Māori specific government aid and funding. The South's one Iwi is recognized as the Kai Tahu, but other Southern Māori groups do not identify with them. Moreover, intra-Māori discrimination against Southern Māori further affects the presentation of their culture, as their lack of "pure" Māori lineage has resulted in further disregard for their unique cultural adaptations to the South Island of New Zealand. It is clear that heritage institutions play a dynamic component in the manifestation of these inequalities in political power and identity amongst the Māori.

Can Artifical Intelligence Inform Scale Validation?: ChatGPT-4o's Contribution to the Quantifying Construct Validity Procedure.

Kyle Austin
Major: Psychology

Mentor: Mike Furr, Psychology

Scale validation requires time and attention from experts familiar with constructs being measured. We evaluated artificial intelligence's (AI) potential as an "expert" in the Quantifying Construct Validity (QCV) procedure. If AI functions as well as (or better than) human experts, it may enhance the speed and quality of scale development. Paralleling a process used with human experts, we asked ChatGPT-4o to: a) read a conceptual definition of a focal construct (patience), b) read items from 22 scales used as convergent/discriminant validity criteria, c) hypothesize correlations between "a good measure of the focal construct" and each criterion. We did this 5 times to mimic 5 human experts. AI's hypotheses were: a) strongly consistent ($\alpha = .99$) across 5 trials (akin to inter-rater reliability), b) very similar ($r = .95$) to hypotheses from 5 human experts, c) accurately aligned with actual correlations from students ($N = 242$, $r = .89$), and d) slightly less accurate than human experts' hypotheses (which aligned with actual correlations at, $r = .96$). These initial findings suggest that AI could facilitate and enhance the QCV process of scale validation.

Surviving the Sea of Homogeneity: the Study of Ryukyuan Culture of Okinawa, Japan

Avelina Axonov
Major: Japanese Language and Culture

Mentor: Yasuko Takata Rallings, East Asian Languages and Culture

The research examines the preservation of Ryukyuan culture in Okinawa, Japan, focusing on how it is maintained by both the population and the government through cultural establishments and practices. By analyzing the treatment of Ryukyuan culture and comparing it with that of the Ainu people in Hokkaido, the study aims to highlight the challenges of cultural preservation and the levels of recognition these Indigenous groups receive within Japan. The hypothesis of the study proposes that Ryukyuan culture faces greater preservation and recognition challenges compared to Ainu culture, despite similar historical treatments like forced assimilation and discrimination. This argument is based on differences in governmental policies and the lack of legal recognition of Ryukyuans as indigenous people and their languages. To explore the state of Ryukyuan culture in today's Okinawa, a research trip was conducted in June 2024, involving a comparative analysis of parks, museums, shrines, and historical sites in Okinawa and Hokkaido, and how these establishments present and preserve the indigenous cultures. The methodology was expanded by referencing previous travel experiences in mainland Japan and a visit to Hawaii, where the focus of the analysis shifted from the initially planned comparison of Ryukyuan and Yamato Japanese immigrant cultures to analyzing Polynesian cultural preservation in Hawaii and comparing it to the preservation of indigenous cultures in Japan. This shift provided a more sophisticated comparative perspective. The research produced surprising results: contrary to initial expectations, Ryukyuan culture appears more prominently preserved in Okinawa than Ainu culture in Hokkaido.

Poster Presentation 8

Developmental Autophagy of the Golgi in *Drosophila melanogaster*

Ana Baez
Major: Biochemistry and Molecular Biology

Mentor: Eric Baehrecke, UMass Med School- Cell, Molecular, and Cancer Biology

Autophagy is a process of cellular degradation, or cellular “self eating”. Autophagy can occur under stress conditions, but can also occur developmentally. In *Drosophila melanogaster*, developmental autophagy occurs in the larval gut. In this project, autophagy levels were observed in the gut two hours after pupa formation. Selective autophagy is a process during which specific cellular substances are degraded, such as a specific organelle. This project looked at the golgi, an organelle involved in protein and lipid sorting and transport. A wide variety of genes were tested for their effects on golgiphagy, including core autophagy genes, mitophagy genes(autophagy of the mitochondria), and recently identified golgiphagy regulators. This project aimed to investigate whether golgiphagy happened and any possible regulators or mechanisms of golgiphagy.

Poster Presentation 9

Exploring the Impact of the Japanese Blue Zone Diet and Alternative Medicine Practices on Increased Longevity in Japan

Mia Barnes
Major: Health and Exercise Science

Mentor: Gary Miller, Health and Exercise Science

The purpose of this project was to explore the dietary components of the Blue Zone Diet and alternative medicine techniques practiced in Japan, exploring how they contribute to the increased longevity reported for this culture. Although my original purpose was to explore the Okinawa Blue Zone Diet, I was unable to travel to the island due to unforeseen logistics. Regardless, I soon learned that the traditional Blue Zone diet had extended to other areas of Japan and its surrounding cities. The Japanese diet has potent antioxidant, fiber, and omega-3 rich properties, consisting of more nutritionally dense foods in comparison to the average American diet. Japanese alternative medicine acknowledges that holistic health is obtained by utilizing the medicinal powers of natural substances while focusing on disease prevention. On the contrary, physicians within the American healthcare system have tendencies to over prescribe medication. I documented these observations by analyzing food content, portion sizes, availability, and nutritional value within grocery stores, restaurants, and fish markets in order to better understand how it diminishes chronic health diseases and prolongs lifespan. Within the alternative medicine realm, I conducted interviews with healthcare practitioners working in pharmacy school, acupuncture clinics, and other institutions, observing that differences in tradition and cultural values contribute to the foundation of Japanese alternative medicine. Through my data compilation, I concluded that the prolonged life expectancy in Japan can be greatly attributed to dietary practices and alternative medicine practices within the nation.

Bridging the Gap:Assessing Alignment Between Patient-Reported and Surgeon-Predicted Outcomes in Spondylolisthesis Lumbar Surgery

Deven Bhatnagar
Major: Economics, Biology and Chemistry Minors

Mentor: Celeste Abjornson, Integrated Spine Research Program Fedan Avrumova Integrated Spine Research Program

In spinal surgery, the alignment between patient expectations and surgeon-predicted outcomes is a critical yet understudied area. While lumbar surgery for spondylolisthesis generally reduces pain for patients, discrepancies between patient-reported outcomes and surgeon expectations can impact counseling.

Patients scheduled for Xtreme Lateral Interbody Fusion (XLIF) with Posterior Fusion (XLIF + PSF) in the lumbar spine by one of four spine-specialty surgeons were eligible for this study. During preoperative assessments, patients completed questionnaires: Oswestry Disability Index (ODI), Visual Analog Scale for back and leg pain, and a 20-item lumbar surgery-specific expectations survey.

For the XLIF standalone group, preoperative patient expectations had a mean score of 67.1 ± 15.8, while surgeons' expectations were of 48.1 ± 15.0. Postoperatively, patient expectations had a mean score of 46.3 ± 26.2, with 68% of patients meeting their expectations. For the XLIF + PSF group preoperative patient expectations had a mean score of 77.4 ± 18.9, while the surgeons' expectations were 53.8 ± 15.2. Postoperatively, patient expectations had a mean score of 54.0 ± 19.1, with 74% of patients meeting their expectations.

The mean XLIF patient preoperative recovery expectation for surgery was 67.1 ± 15.8, significantly different from the surgeon preoperative recovery expectation of 48.1 ± 15.0 (p > 0.05). Similarly, the mean XLIF+PFS patient preoperative recovery expectation for surgery was 77.4 ± 18.9, significantly different the surgeon preoperative recovery expectations of 53.75 ± 15.24 (p > 0.05). This underscores the need for realistic preoperative counseling to better align expectations.

(O)Mai: Living Symbol of the New Exotic for England

Bryce Biehle
Major: History

Mentor: Jake Ruddiman, History

This project explores the voyage of a Polynesian man named Mai (1753-1780) who met Captain James Cook on his Pacific explorations. When Mai traveled to England in 1774, he donned a celebrity status; the English elite and literati re-christened him “Omai.” Mai happily complied in order to receive English diplomatic aid at home. English social circles soon discovered that they needed Omai to be just exotic enough to fulfill their desire for a Pacific fantasy narrative. He was the subject of the portrait Omai (1776) by Sir Joshua Reynolds, a groundbreaking artwork that advanced the social goals of both painter and sitter. Reynolds painted a new genre of portrait to impress his peers and Omai was further inculturated into elite British circles. Similarly, naturalist Joseph Banks and playwright Fanny Burney turned Mai into their muse; Banks chaperoned Mai while keeping him within the English cultural norms that appealed to figures like Burney. The English grew weary of Omai, however, when he expressed certain elements of his native culture, particularly his non-English language. After Mai returned home, the memory of Mai persisted in England: following the death of Cook in 1779, the character of Omai appeared in a pantomime play, commemorating both men and advancing the idea of a new era of British imperialism marked by exoticizing foreign peoples in English imaginations.

Role of CLPB mutations R650P and R475Q of NBD and Y272C of ANK domain in mitochondrial function.

Jennifer Breglio
Major: Biochemistry & Molecular Biology

Mentor: Dhanendra Tomar, Atrium Health Wake Forest Baptist Cardiovascular Sciences Center, Center for Precision Medicine, and Wake Forest School of Medicine.

Human CLPB (hCLPB) encodes a chaperonin with ATPase and disaggregase activity, solubilizing proteins in the mitochondrial intermembrane space. Mitochondrial intermembrane proteins involved in calcium import, electron transport, chaperone-mediated protein transport, and more are insoluble in hCLPB knockout (KO) cells (Cupo and Shorter, 2020). Such defects in mitochondrial membrane integrity are determined to cause toxic 3-MGA accumulation during leucine metabolism, which contributes to 3 MGCA7 disease and disrupts mitochondrial homeostasis, leading to errors in respiration which is detrimental for energy-demanding organs like the heart. (Saunders et al., 2015). The CLPB mediated disease phenotype is responsible for neutropenia and cardiovascular diseases such as hypertrophic cardiomyopathy (Wachowski-Dark et al., 2022).

Mutations in the CLPB nucleotide binding domain (NBD) and ankyrin repeat (ANK) domain are linked to 3 MGCA7. R650P and R475Q within the NBD domain have decreased ATPase and disaggregation activity (Cupo and Shorter, 2020). Y272C within the ANK domain of CLPB causes impairment under oxidizing conditions due to the formation of an intramolecular disulfide bond with Cys267 (Lee et al., 2023). In this project, HEK293T CLPB KO cells were transfected with plasmids containing CLPB genes with R650P, R475Q and Y272C mutations, and R650P, R475Q and Y272C were determined to cause reduced cellular ATP levels and OCR as well as promote cellular ROS levels. R650P mutant HEK293T cells showed significantly reduced mitochondrial membrane potential. This study is an ongoing in-vitro investigation employing ATPase, OCR, ROS, and CRC assays to investigate the role of these mutations in relation to mitochondrial dysfunction.

Synthetic methodology development for the design of platinum-acridine anticancer agents as prodrug-payloads in antibody-drug conjugates

Gregory Cabezas
Major: Chemistry

Mentor: Ulrich Bierbach, Chemistry

Platinum-based agents are a specific class of cytotoxic drugs which are often components of therapeutic regimens in the treatment of aggressive solid tumors. These drugs, while effective chemotherapies, have notable limitations in their potency compared to other DNA-targeted agents. Platinum-acridine hybrid agents (PAs) kill cancer cells at concentrations 1000-fold lower than typically observed for other platinum-based treatments. Additionally, PAs overcome several forms of tumor resistance due to their unique DNA binding mode. PAs have shown promise in treating non-small cell lung tumors but have demonstrated a narrow therapeutic window. A potential solution would be the development of antibody-drug conjugates (ADCs). ADCs are a selective treatment modality in which cancer antigen-specific monoclonal antibodies (mAbs) have been modified with a cytotoxic payload. When forms of resistance arise during ADC treatment, the payloads can be exchanged for other mechanistically different drugs, which makes PAs an attractive option. A highly cytotoxic PA compound, P7A1, was synthesized and characterized to serve as a payload component. P7A1 was then modified with axial trans-hydroxo ligands via oxidative addition to Pt(IV) to install click chemistry-ready azide handles. Axial donor groups (hydroxo, carboxylato, and carbamato) were chosen based on DFT computational analysis to predict the stability and redox properties of the prodrugs . Syntheses were initially conducted as micro-scale reactions with NHS ester-modified conjugatable azides and monitored by LC-MS to determine favorable reaction conditions. Axial linkers were then extended via strain-promoted azide-alkyne cycloaddition (SPAAC) of DBCO-PEG-MAL linkers to generate the payloads for bioconjugation reactions with mAbs.

Orofacial Behaviors Differ Based On Flavor Identities

Jo Cai
Major: Biology

Mentor: Josst Maier, Department of Translational Neuroscience, Wake Forest School of Medicine

Multisensory Integration (MSI) is crucial for organisms to interpret the environment and disambiguate sensory information. Both taste and odor contribute to flavor, making it a multisensory experience. Previous consumption tasks conducted in our lab (Cai et al., 2024) provide behavioral evidence of MSI by measuring preference through overnight consumption. In this study, we employed electromyography (EMG) recordings of orofacial movements to characterize the dynamics of flavor perception within a single drop. We measured orofacial muscle contractions that reflect licking behavior as a measure of perception. We hypothesized that orofacial contractions differ across tastes and can be used as a proxy to distinguish between palatability levels and different taste identities. EMG recordings were conducted on the digastric muscles of seven rats. The EMG data were filtered, rectified, and analyzed using MATLAB. The results suggest that the contraction pattern for sour differs the most from other tastes. Previous studies have only examined high concentrations of sucrose and quinine, whereas this study explored the discriminability between different taste qualities and different exemplars within each category. Contrary to the findings of previous studies, our results indicate that mouth movements are not unique to specific palatability categories. Our study provides novel insights into the dynamics of orofacial contractions in response to different tastes, suggesting that muscle contraction frequency can distinguish between taste qualities, except for sour.

Functional Characterization of Methionyl-tRNA Synthetase Domains in *Mycoplasma penetrans*

Steven Cayea
Major: Biochemistry and Molecular Biology

Mentor: Rebecca Alexander, Chemistry

Aminoacyl tRNA synthetases (aaRSs) are a family of enzymes that covalently attach an amino acid to the correct tRNA for the process of translation. At times, these enzymes have evolved to have an added domain associated with them that expands their function beyond the attachment of the amino acid to tRNA. In *Mycoplasma penetrans*, a species of bacteria that infects the human urogenital and respiratory tracts, primarily in immunocompromised individuals, there is an additional aminotransferase domain (ATD) specifically appended to its methionyl-tRNA synthetase (MpMetRS). The ATD facilitates the synthesis of methionine within the methionine salvage pathway by adding an amino group to 2-keto-4-methylthiobutyrate (KMTB). This process is believed to prevent competition with host cell proteins by shuttling newly-synthesized methionine to the MetRS domain. In addition to the aminotransferase domain and the synthetase domain, there is also a small N-terminal domain of 166 amino acids that does not share a sequence with any known protein. Previous work has modified the MpMetRS gene to isolate specific domains for use in aminoacylation assays with radiolabeled methionine and radiolabeled tRNA and compare their relative efficiencies under different conditions and combinations. To better understand the possible shuttling process, work has shifted to *in vivo* cellular activity of MpMetRS in the context of a bacterial system that is defective for methionine biosynthesis, such as *E. coli* B834 cells. This project outlines the preliminary work completed to carry out viability assays in this auxotroph species to determine which domains are necessary to restore growth of the bacteria.

Effect of Beetroot Juice on Intraocular Pressure

Samantha Chin
Major: Health and Exercise Science

Mentor: Gary Miller, Health and Exercise Science
Atalie Thompson

Glaucoma is a leading cause of blindness worldwide and is characterized by progressive damage to the optic nerve due to loss of retinal ganglion cells and the retinal nerve fiber layer. High intraocular pressure (IOP) is currently the only modifiable risk factor for glaucoma, and can be decreased through treatment with topical eye drops, lasers, or surgeries that either limit the production of aqueous fluid or improve its outflow. Moreover, many patients with glaucoma have normal IOP. Other factors such as systemic blood pressure (BP) can also contribute to glaucoma progression though the interaction is complex. BP shows a bimodal relationship to glaucoma risk with nocturnal hypotension Currently, there are no therapies that target improving perfusion of the optic nerve. However, nitric oxide (NO) has been shown to be a potent vasodilator that improves blood flow. NO can be naturally metabolized from dietary nitrate, which is found in many vegetables, including beetroot. We hypothesize that dietary nitrate could be a viable novel treatment to decrease glaucoma risk, as the metabolized NO could increase vasodilation which could improve perfusion of the optic nerve and potentially improve the relationship between BP and OPP. Moreover, dietary nitrate could decrease IOP by improving aqueous outflow through NO-induced relaxation of smooth muscle in the trabecular meshwork and Schlemm's canal, the primary sites of obstruction to drainage in glaucoma. The purpose of this initial feasibility pilot is to evaluate the effect of dietary nitrates on IOP and systemic BP in healthy adult volunteers.

Exploring Neurobiological Mechanisms of Therapeutic Change in a Surf Therapy Program for Veterans

Hallie Clute
Major: Psychology; Minor: Neuroscience

Mentor: Sara Mendonca, Psychology

Post-Traumatic Stress Disorder (PTSD) affects many veterans. It is characterized by persistent symptoms such as re-experiencing traumatic events, disturbances in cognition and mood, and hyperarousal (Sherin et. al, 2011). These symptoms are linked to alterations in several neurobiological networks, including the salience network (SN), central executive network (CEN), and default mode network (DMN) (Akiki et. al, 2017). The neurobiological network model simplifies the brain's complex systems into three interconnected components, mapping their connectivity and functional relationships. Previous studies have shown surf therapy to be an effective intervention for veterans struggling with PTSD, yet the neurobiological mechanisms behind its efficacy are underexplored.

This study examines how cognitive behavioral therapy (CBT) combined with learning to surf contributes to post-traumatic growth (PTG) in veterans. With Richter scholarship funding, I participated in an 8-week veteran surf therapy program in Noosa, Australia, and conducted interviews with clinicians leading the program. Analysis of observational and interview data suggests that the integration of group CBT and surfing influences neurobiological networks critical for PTSD recovery. Specifically, surf therapy modulates the SN by decreasing neural activity in the subgenual prefrontal cortex (sgPFC), enhances the CEN by improving DLPFC functionality, and balances the DMN by increasing hippocampus size andconnectivity, addressing both emotional and cognitive symptoms of PTSD. The combination of top-down (CBT) and bottom-up (surfing) therapeutic processes provide a comprehensive approach to PTSD treatment. Top-down processing strengthens cognitive coping mechanisms while surfing aids in nervous system regulation and trauma processing. Repeated sessions foster self-regulation, offering veterans a holistic strategy to manage stress and trauma.

Beyond the Courtroom: Understanding the Role of Fear in Legal Systems and Its Impact on Marginalized Communities

Xochitl Contreras
Major: Sociology

Mentor: Brittany Battle, Sociology
Andrea Gomez Cervantes, Sociology

This research, part of the larger Comunidades Confined project under Dr. Battle and Dr. Gomez-Cervantes, investigates the impact of fear as a legal control mechanism on communities of color, focusing on the criminal and immigration systems. It explores how disproportionate surveillance, systemic inequality, and inadequate representation exacerbate mental and physical health disparities, leading to higher rates of incarceration and deportation. Using a multi-method approach—including transcribing interviews, volunteering at a Ministry, and conducting extensive court observations—this study provides insights into the lived experiences of individuals within these systems. Data analysis from over 300 court cases and detailed participant interactions reveals systemic flaws and advocates for necessary reforms. Findings indicate that systemic racism significantly intensifies fear and marginalization among Black and Latinx individuals, manifesting in struggles with legal challenges, basic living needs, and emotional distress. This study highlights the urgent need for comprehensive policy reforms, such as enhanced legal representation, reduced financial burdens, and integrated counseling services, to address these disparities and improve support for marginalized populations. Contributions to the Comunidades Confined project will be shared, illustrating the broader implications and potential pathways for systemic change.

Poster Presentation 19

Characterizing the antimicrobial activity of cysteine-rich peptides from legumes

Samantha Crossman
Major: Biochemistry & Molecular Biology

Mentor: Siva Sankari, Stowers Institute for Medical Research

When in conditions with low nitrogen, legumes such as *Medicago truncatula* can recruit nitrogen-fixing soil bacteria like *Sinorhizobium meliloti* and form a symbiotic relationship. Nodule-specific cysteine rich (NCR) peptides are essential for the maintenance of this symbiosis, as well as for the differentiation and manipulation of the bacteria to increase their N_2-fixation efficiency. Cationic NCR peptides have been shown to exhibit antimicrobial activity, and NCR247 specifically is known to inhibit *S. meliloti* growth. Our collaborators identified 3700 differentiation-inducing NCR peptides from 4 legume clades and about 20 species. These peptides were clustered, and I worked with 9 independently-evolved peptides representative of the clusters to determine if they also exhibit antimicrobial activity. I tested antimicrobial activity against *S. meliloti* as well as *Escherichia coli*, and found that lower concentrations of peptide were toxic to *S. meliloti* for all but one peptide, while higher concentrations of peptide were toxic to *E. coli* for all but two peptides, likely because one of these peptides is neutral, not cationic. The peptides have to be individually synthesized for these assays, so I also tested two inducible outer membrane expression systems as potential alternate ways to conduct first-pass screens. My results suggest that while both systems seem effective, it is not clear if one is better than the other. Future experiments will further characterize the representative peptides and their abilities to increase cell size or induce cellular differentiation, as well as work to identify potential suppressor mutations in bacteria allowing for resistance to the peptides.

Poster Presentation 20

Junctin's calsequestrin-binding domains have shifted charge state in birds

Olivia Delgado
Major: Biology

Mentor: James Pease, Evolution, Ecology, and Organismal Biology @ The Ohio State University
Christina Harvey, Biology

Muscle contractions and the excitation-contraction coupling reaction (E-C reaction) are essential for vertebrates. The protein calsequestrin (CASQ) stores calcium ions (Ca^{2+}) required for the E-C reaction, so the gene encoding CASQ is conserved across most vertebrates (Wang and Michalak, 2020). However, CASQ's expression in birds is different, which raises many questions about its evolution (Harvey et al., *Submitted*). This study looked at a neighboring protein, junctin: a smaller protein that binds directly to CASQ, anchoring it in place and transmitting signals (Barone et al., 2015). Binding to junctin is essential for CASQ's ability to influence (Ca^{2+}) storage (Wei et al., 2009). Since the proteins in the E-C reaction are interconnected, selection can happen in both CASQ and junctin to maintain overall function. Hence, better understanding junctin's evolution could provide insight into CASQ's story. This study found that junctin is highly conserved across all vertebrates and diverges in its final exon. Interestingly, the last exon still conserves KEKE binding motif regions used to bind CASQ, further supporting the idea that junctin strongly influences CASQ (Rossi et al., 2022). Diving deeper into these conserved KEKE motifs showed that birds have more positive motifs due to a loss of negative change, leading us to conclude that junctin's electrostatic properties may have changed to reflect changes in CASQ

Poster Presentation 21

Updating Geographic Information System Mapping for Ferrum VA Water and Sewer Assets

Reesa Devers
Major: Biology

Mentor: Erika Hoffman, Engineering and GIS

The goal of this internship was to update water and sewer mapping in GIS systems after the acquisition of a new land parcel by the Western Virginia Water Authority. GIS mapping for this area before this summer was non existent and many map records dated back to the 60's and 70's. New mapping in InfoAsset Manager and ARCPRO were needed after the acquisition in order to streamline routine maintenance and emergency response for the pipes and other assets. The goal of the GIS intern team was to survey and input into our asset managemen systems exact locations of all water and sewer assets in Ferrum, VA. Using Leica software and the InfoAsset data management system we were able to get accurate mapping for all manholes, hydrants, valves, water meters, and other assets.

Poster Presentation 22

Applying CoDA to analyze activity behaviors in older adults

Arinyah Dickerson
Major: Biochemistry

Mentor: Jason Fanning, Health and Exercise Sciences

As one ages, older adults experience a change in body composition, as lean muscle mass decreases the body fat increases. The change in body composition can result in a decline in cardiovascular health. This decline in cardiovascular health can impact cardiovascular fitness, such as a decline in aerobic capacity, a decline in mobility which can affect dainty performance and ability to live an independent lifestyle. Literature has highlighted the positive relationship between physical activity and cardiovascular fitness, but there is a lack of research demonstrating how reallocating time spent in the different physical activity behaviors- MVPA, LPA and SB have on cardiovascular fitness in older adults. The purpose of this research is to use compositional data analysis of CoDA to analyze the physical activity behaviors of older adults and demonstrating how reallocating time spent in physical activity behaviors impacts overall health. The data used was collected at baseline from the EMPOWER study, a weight loss intervention program for older adults living with obesity. The data from the EMPOWER study was used to create a Coda model to show the correlation between the various physical activity behaviors and cardiovascular fitness, measured in VO2 peak. From the CoDA model, an isotemporal substitution model was used to demonstrate how reallocating time spent in the different activity behaviors impacts VO2 peak. The greatest impact in the isotemporal substitution model was seen when time was reallocated from MVPA to LPA. Further study could analyze how the different intensities of physical activity could impact overall health.

The Health Insurance Divide: A Comparative Analysis of Dominant U.S. Industries

Millet Ding
Major: Economics

Mentor: Christina Dalton, Economics

Employer-sponsored insurance (ESI) is the primary source of health coverage for most Americans, yet participation rates vary significantly across industries. This study focuses on three of the most dominant U.S. industries—manufacturing, healthcare, and retail—each with comparable levels of employment. Using CBSA-level data from 2011 to 2019, we find that while manufacturing and healthcare sectors consistently report higher ESI participation rates (averaging 25-27%), retail lags behind, with average participation rates as low as 7-8%. Potential contributing factors are taken into account, such as geography, union presence, and socioeconomic conditions within the areas where these industries operate. By examining these factors, this presentation provides a more complete understanding of which sectors offer the best access to ESI and where significant gaps remain.

Synthesis, characterization, and time-resolved spectroscopy of CsPbI3 and CsPbBr3 nanocrystals for photovoltaic applications

Dany Doughan
Major: Chemistry

Mentor: Elham Ghadiri, Chemistry

Metal halide perovskites have emerged as a class of materials with exceptional optoelectronic properties, making them highly promising for applications in solar cells. The rapid advancements in perovskite solar cells have demonstrated potential to expand the field of photoelectronics due to their high absorption coefficients and bandgap tunability. Cesium lead iodide (CsPbI3) is the most studied perovskite because of its optimal bandgap of 1.7eV and high efficiency (> 19%). Its versatility and impressive performance make it a cornerstone in photovoltaic research. Similarly, cesium lead bromide (CsPbBr3) possesses a similar chemical composition and offers enhanced stability, but has a slightly different bandgap at 2.3 eV, establishing its importance as a candidate for photovoltaic applications.

CsPbBr3 and CsPbI3 nanocrystals were synthesized via hot injection of cesium oleate, producing high-quality nanocrystals with uniform size and composition. The structural and optical properties of the synthesized nanocrystals were characterized using various techniques, including X-ray diffraction (XRD), photoluminescence, scanning electron microscopy (SEM), and energy dispersive X-ray spectroscopy (EDX). Steady-state and transient absorption spectroscopy were also employed to investigate the photophysical properties of these nanocrystals. Using ultrafast spectroscopy, the photoexcited processes including the characteristics of excited state in CsPbI3 and CsPbBr3 were investigated. These findings could provide valuable insights into the understanding and optimization of perovskite solar cells.

Poster Presentation 25

Exploring Visitor Experiences: A Study of WFU Student Engagement with the Lam Museum of Anthropology

Chloe Edelman
Major: Anthropology

Mentor: Andrew Gurstelle, Anthropology

Conducting a visitor study at Wake Forest University's Lam Museum of Anthropology offers a chance to learn about visitor behavior and improve museum experience. The Lam Museum of Anthropology is easily accessible to a wide spectrum of people, including students, staff, and members of the larger community. The museum's engagement with WFU academic courses increases its relevance and educational effect. By researching visitor interactions in this environment, I could investigate the relationship between formal education and informal learning experiences. The on-campus location makes longitudinal studies possible, allowing researchers to monitor changes in visitor behavior in the future. Engaging teachers, students, and administrators in the research process ensured that findings are relevant and applicable to the university. I conducted a survey of WFU student perceptions of the Lam Museum of Anthropology spanning 02/02/24-05/01/24. The survey instrument was designed to be short yet widely distributed. I solicited stakeholders from a range of demographic groups such as year in school, familiarity with the museum, major, etc. The study aimed to gather insights on visitor composition, museum familiarity and visitation frequency, overall and exhibit-specific experiences, and perceptions regarding usefulness for academic and leisure purposes, quality of collections, interactions, expertise of staff, and convenience of visiting.The methodology involved in-person solicitation on campus and professor cooperation with data collection through classes. I conducted the survey using a QR code linking to a Google Form. Data was compiled into a spreadsheet for analysis, as well as additional processing with the Stata statistical software.

Material Movies with Femtosecond Time Resolution

Alexander Evju
Major: Physics

Mentor: Ajay Kandada, Physics

The pump-probe technique allows for the investigation of time-resolved dynamics, providing insight into the interactions between photo-excitations in materials. This involves exciting the material with an ultrashort optical pump pulse and measuring the change induced by it in the optical response with a time-delayed probe pulse. The overall time-resolution of the experiment is determined by the time-width of the optical pulse. In the Kandada lab, the current time resolution is at approximately 200 femtosecond but there are processes in materials that occur at even faster timescales. With a goal of pushing the time resolution into the sub-10 femtosecond regime, my project focuses on the development of sources of ultrashort optical pulses in the visible spectral range. Fourier theory demands that an optical pulse which has short pulse width must have a large spectral bandwidth. To generate such pulses, we amplify a weak, broadband white light using a parametric amplification process that manifests at extremely high light intensities. To that end, I developed a non-collinear optical parametric amplifier (NOPA) to generate pulses that have light between 600 nm and 700 nm. These pulses are further compressed using custom-designed chirped mirrors to achieve the desired ~15 femtosecond pulses. Finally, I used this optical system to perform pump-probe spectroscopy on a semiconductor microcavity to visualize the dynamics of half light-half matter quasi-particles.

Factors Influencing Chinese Students to Study as Undergraduates in the United States

Laiyi Fan
Major: Sociology

Mentor: David Yamane, Sociology

The objective of this study was to investigate the factors influencing Chinese students to study as undergraduates in the United States. Factor analysis and correlations were conducted to analyze the relations between different factors including internal factors and external factors. Internal factors indicate the motivations to get the best possible education, have more choices in subjects, and improve their career prospects. External factors include motivations influenced by parents' wish, and the desire to experience life in another country. Components including gender, years of graduation, whether taking the Chinese College Entrance Exam, and whether getting into their top choice universities were correlated with internal factors and external factors. We noticed how internal factors and external factors determine these components differently. Students who did not take the Chinese College Entrance Exam are more influenced by external factors while students who get into their top choice universities are more influenced by internal factors.

Carbon Dots Made From Serotonin as Selective Sensors for Serotonin

Mario Ficalora
Major: Health and Exercise Science

Mentor: Christa L. Colyer, Chemistry
Kelsey Morgan, Chemistry

In the aftermath of the global pandemic, the need for reliable diagnostics and rapid testing for long COVID has become increasingly urgent. Long COVID presents a complex array of persistent symptoms that extend well beyond the acute phase of the illness, underscoring the necessity for continued research and innovative strategies to address its impact. Emerging evidence suggests that lower-than-normal serotonin levels may be linked to these lingering symptoms, highlighting the importance of developing accessible and cost-effective diagnostic tools for this potential biomarker. Serotonin, a neurotransmitter involved in regulating mood, sleep, and other bodily functions, also plays a role in melatonin synthesis. Our laboratory previously synthesized carbon dots (CDs) from melatonin using a simple hydrothermal method. Building on this, the current study seeks to create CDs from serotonin, aiming to develop selective, sensitive, and non-invasive diagnostic tools for detecting serotonin. CDs are nanoscale, carbon-based materials known for their unique fluorescent properties, which can be tailored by adjusting factors such as size and surface functionalization. These properties make CDs valuable for chemical sensing. In this study, we will purify serotonin-based CDs using dialysis and characterize them with FTIR, UV-Vis absorbance, and photoluminescence spectroscopy. We aim to demonstrate that these CDs offer enhanced selectivity and sensitivity toward serotonin in aqueous samples, similar to our previous findings with melatonin-based CDs. If successful, this approach could revolutionize the detection of serotonin as a long COVID marker and inspire the development of other carbon nanomaterial-based sensors for diverse chemical analyses.

DFT Investigations of Fe-S Cluster Formations in NifU

Christopher Fivecoat
Major: Physics

Mentor: Timo Thonhauser, Physics

NifU is known to be a nitrogen fixation protein and is considered to be the scaffold for Fe-S cluster assembly. Investigations of the NifU mammalian homologue, IscU, reveals a suitable substrate binding on IscU located between six key residues. These key residues include His 105, His 106, Cys 37, Cys 63, and Cys 106. NifU is known to exist in nature within a water solution. Zinc is known in nature to be a natural inhibitor of Fe and thus investigations into the interactions between Zn, S, and Fe were investigated to bring forward evidence for either the Fe-first or S-first hypotheses surrounding Fe-S cluster formations. Charge analysis of the system can also provide insight to the effect any guest atoms will have on the electronic structure of the system. Density Functional Theory (DFT) can provide insight by providing a means to a quick but robust method of solving Schrödinger's equation for a many-body system. DFT is used to both provide relaxation energies which in turn provides evidence for either the Fe-first or S-first hypotheses and the change in electronic structure post addition of a guest atom(s).

Isotopes, Microbes, and Aliens: Determining the Optimal Growth Conditions for Bacterial Experiments to Measure Phosphate Isotope Ratios

Julia Foringer
Major: Biochemistry and Molecular Biology

Mentor: Albert Colman, Case Western Reserve University's Department of Earth, Environmental, and Planetary Sciences

My work this summer with Dr. Albert Colman revolved around the question: "How do (a) microbial uptake of phosphate during cellular growth and division, and (b) release of phosphate following cell lysis affect the isotopic composition of dissolved phosphate in the microbial habitat?". The experiments that would answer this question depend critically on optimizing growth conditions to ensure that a substantial portion of the initial phosphate in the growth medium is consumed so that the isotopic effect of phosphate uptake is maximized. Additionally, the available phosphate after uptake must be enough for isotopic analysis.

I performed experiments to define the optimal experimental conditions for two strains of bacteria: *E. coli* K-12 MG1655 and *Azotobacter vinelandii* OP. I examined the role of phosphate concentration in minimal medium for *E. coli* on final density of the cell culture and then monitored phosphate concentrations and optical densities of *E. coli* K-12 MG1655 and *Azotobacter vinelandii* OP over a full growth curve for each strain. This is relevant to the fields of astrobiology because, we want to study the cycling of nutrients in aquatic environments. The oxygen isotope ratio of phosphate can be used to determine if phosphate derived from the weathering of rocks has been cycled biologically at temperatures characteristic of planetary surfaces in the geologic past. This helps us understand the history of life on Earth and the possible detection of biomarkers elsewhere in the Universe that resemble terrestrial microbes. Essentially, this research gets us one step closer to finding aliens!

Project Saturn: High Pressure Underwater Chamber Simulator

John Gannon
Major: Engineering

Mentor: Kyle Luthy, Engineering

Underwater instrumentation is crucial for gathering data to better understand, characterize, and explore underwater ecosystems. These systems are designed to withstand harsh environmental conditions, most notably high pressures due to depth. To endure such conditions, system housings are precisely manufactured from materials capable of resisting corrosion, cracking, and implosion. However, machining such housings can be expensive with long manufacturing lead times. This can slow down or limit prototype development and may not be cost effective for low rate production. Project Saturn aims to reduce the cost and prototyping time of underwater systems by leveraging additive manufacturing techniques and materials for system development. To meet the requirements of being durable, airtight, and cost-effective, housings were 3D-printed at Wake Downtown using various resin types, while other additive manufacturing processes were outsourced. To assess the housings' ability to maintain a watertight seal at great depths, the team developed a pressure multiplication system. This system uses air pressure and water inputs to generate high water pressure within a test chamber. Control and data acquisition programs were written for the system, and hydraulics were tuned to improve its reliability and consistency. Another program was written to allow the operator to develop a pressure profile to simulate lowering a housing to depth and retrieving it after a specified period of time. By the conclusion of the URECA summer research project, the pressure chamber was operational and characterized using a custom pressure sensor and testing of the sample housings will be completed this fall.

Catalase, Azide, and Peroxide Reaction Produces Nitroxyl

Weijun Gao
Major: Biophysics

Mentor: Daniel Kim-Shapiro, Physics

Oxidative stress reduces red blood cell (RBC) deformability and increases fragility of RBCs, leading to hemolysis. RBCs have many innate protective measures for oxidative stress (catalase, glutathione, peroxiredoxin, etc.). Catalase, for example, reduces oxidants such as peroxide to water and oxygen, preventing stress put on RBC membranes due to oxidation. Many researchers use azide to block cells' catalase reactions to conduct focused studies on other anti-oxidation pathways. However, there have been some reports of a reaction between catalase and azide in the presence of peroxide. One of us has previously proposed that nitroxyl (HNO) is formed in this reaction. Using a Nitric Oxide Analyzer, we have found that instead of blocking catalase and peroxide in a traditional manner, azide actually promotes another reaction that leads to a nitrogen-based product. We hypothesize that a ferrous-heme-NO product is formed from this reaction which is consistent with the formation of nitroxyl. Using absorption spectroscopy, we confirmed production of a ferrous-heme-NO from this reaction. We found that as the concentration of catalase increases, a lower percentage of ferrous-heme-NO is detected, even with far excess azide and hydrogen peroxide. We also find that the ferrous-heme-NO product is unstable. Lastly, although previous studies suggest that ferrous-heme-NO, which is believed to be the product of (catalase) heme and nitroxyl reaction, must be conducted under anaerobic condition. Our group found the ferrous-heme-NO product can be produced by the catalase, azide, and peroxide reaction under either anaerobic or aerobic conditions.

Analysis of Drug Diffusivity Due to Vascular Motion to Improve Treatment Outcomes for Peripheral Artery Disease

Amogh Gorantla
Major: Engineering

Mentor: Saami Yazdani, Engineering

The preferred treatment of peripheral artery disease (PAD) includes the use of drug-eluting stents (DES) to prevent neointimal hyperplasia and maintain long-term patency. However, arteries in the lower extremities are prone to movement, making it challenging to treat using intravascular drug delivery devices and leaving the impact of such movement on drug uptake and device retention unknown. This study uses explanted pig arteries in a newly fabricated peripheral-simulating bioreactor system to examine two distinct stents, the Zilver PTX and ELUVIA systems. This system, redesigned via 3D printing techniques with Fusion 360 and Ultimaker Cura, aims to standardize variables affecting testing outcomes. Employing pulsatile flow conditions, we assess the effects of polymer inclusion on drug release and tissue absorption at 1 and 24 hours (n=3) (per stent for each time) post-deployment. Preliminary research suggests that the ELUVIA stent has a controlled, sustained release of paclitaxel over 24 hours, compared to the rapid release observed with Zilver PTX, and that, for both stents at 24 hours, the porcine arterial tissue absorbs a larger concentration of paclitaxel. These observations highlight potential differences in efficacy and safety profiles between the stents, attributed to their polymer components. As data collection is ongoing, final analyses will further elucidate the impact of vascular movement on pharmacokinetic profiles. This research not only advances our understanding of the differences in efficacy between the Zilver PTX and ELUVIA stents in dynamic vascular environments but also validates the functionality of the bioreactor system, promoting reliable and replicable future studies.

Characterization of Class II Cysteine Desulfurase Protein Interactions as a Target for Antimicrobial Protein Synthesis

Brystol Habermacher
Major: Classical Studies, Chemistry and Biology Minors

Mentor: Patricia Dos Santos, Chemistry

Sulfur is a required element for all biological systems. Often, sulfur is complexed into iron-sulfur clusters which can serve as a point of electron transfer in catalysis among other functions. Iron-sulfur cluster containing proteins comprise a diverse domain needed for proper cell function including lipoic acid, molybdenum cofactor, biotin, thiamine, and thionucleoside biogenesis.

Cysteine desulfurase (CD) proteins are responsible for shuttling sulfur down metabolic pathways including the synthesis of Fe-S clusters. CD proteins interact specifically with a sulfur acceptor (SA) co-enzyme which cleaves a persulfide (-SSH) group from a catalytic cysteine residue. The sulfur is sequentially brought to the next protein in the pathway. The SUF pathway is highly conserved in pathogenic Gram-positive bacteria such as *S. aureus*, *M. tuberculosis*, and *S. faecium*, providing significance for mechanistic studies of the Suf system. In *Bacillus subtilis*, a non-pathogenic Gram-positive model, the sulfur formation pathway (SUF) utilizes a zinc-ligand-swapping mechanism to achieve the persulfide transfer between the CD protein, BsSufS, and the SA, BsSufU.

Certain non-catalytic residues near the active site of both BsSufS and BsSufU form ionic salt bridges that stabilize the complexation of the two enzymes. Through systematic mutagenesis, growth, purification, and protein inhibition assays, we can determine the significance of these interactions on sulfur transfer. By extensively mapping the BsSufS-U interactions, a small antimicrobial peptide (AMP) may be formulated to hinder sulfur transfer down the SUF pathway. By slowing sulfur transfer in the SUF pathway, the AMP may act as a bacteriostatic that would stagnate bacterial growth.

The effects of exercise on aerobic fitness and cognition in patients with cognitive impairment

Hannah Haukos
Major: Health and Exercise Science

Mentor: Jeffrey Katula, Health and Exercise Science

Alzheimer's Disease (AD) is a neurodegenerative disease that currently impacts 6.5 million Americans, is the most common cause of dementia, is the 6th leading cause of death, and costs the public health system more than $300 billion annually. Evidence suggests that exercise has the potential to meaningfully improve brain function and structure in older adults through improvements in aerobic fitness, but findings are equivocal. The purpose of this study is to test the impact of two different types of exercise, aerobic (AX) vs. stretching/balance (SBR) on aerobic fitness and cognition in older adults with Mild Cognitive Impairment (MCI). The EXERT study randomly allocated volunteers (n=289) into either AX or SBR for a 12-month intervention. All participants exercised at a local YMCA 4 times/week with a personal trainer. The AX involved moderate/high intensity training (70-80% heart rate reserve [HRR]) and SBR low intensity (less than 35% HRR). Aerobic fitness (AF) was estimated from variables obtained during a 400-meter walk test and included performance time, sex, and systolic blood pressure. An analysis of covariance in which change in AF was the dependent variable with baseline AF and age as covariates revealed that the AX group experienced significantly different changes in AF as compared to the SBR group (Mean AF change: AX=0.53 ml/kg/min; SBR=-1.04 ml/kg/min; $p < .05$; ES=0.35). Additionally, AF was associated with measures of cognitive functioning at baseline and 12-month follow-up. The study's results will be useful in elucidating the relationship between AF and cognition within a population of individuals with MCI.

Impact of IRE1α-XBP1 Pathway in Co-Cultures of Cancer Cells and ERAI-reporter Mouse Derived Macrophages and Sensory Neurons to Study CIPN Mechanisms

Jenna Hauser
Major: Biology

Mentor: Dr. E. Alfonso Romero-Sandoval, WFU School of Medicine

Chemotherapy-induced Peripheral Neuropathy (CIPN) is a common side effect of chemotherapy drugs like Paclitaxel (PTX), causing neuronal damage and symptoms such as numbness, tingling, and pain. Our lab previously showed that PTX activates the IRE1α-XBP1 signaling pathway in immune cells, contributing to neurotoxicity. To study this, we developed an ex vivo co-culture system with sensory neurons, macrophages, and cancer cells, mimicking key aspects of CIPN. We hypothesize that inhibiting IRE1α-XBP1 can provide neuroprotection while enhancing PTX's anti-tumor effects.

Using Endoplasmic-Reticulum Stress-Activated Indicator (ERAI) mice, which express green fluorescent protein upon IRE1α-XBP1 activation, we harvested bone marrow-derived macrophages (BMDMs) and dorsal root ganglion (DRG) neurons. We co-cultured BMDMs with MDA-MB-231 breast cancer cells to observe their effects on DRG neurons. Cultures were treated with the IRE1α inhibitor MKC8866 or a vehicle in the presence or absence of PTX. Cells were then fixed, stained, and imaged.

Our results show that cells from ERAI mice are useful for visualizing IRE1α-XBP1 activation. Tumor cells increased IRE1α-XBP1 activity, which MKC8866 suppressed. PTX-induced neurotoxicity was evident in co-cultures with macrophages and cancer cells, but MKC8866 partially reduced this damage. These preliminary findings suggest that inhibiting IRE1α-XBP1 may reduce PTX-induced neuropathy. Future steps include quantifying the neuroprotective effects of IRE1α inhibition, analyzing IRE1α-XBP1 status in macrophages and cancer cells, and evaluating how IRE1α inhibition affects their viability.

Dramaturgical Research for William Shakespeare's "The Tempest"

Eleanor Howell
Major: Theatre

Mentor: Michael Kamtman, Theatre

In the spring of 2025, Assistant Teaching Professor Michael Kamtman will be directing a production of William Shakespeare's "The Tempest" as part of the Wake Forest Theatre Department's 24-25 season. I worked with Professor Kamtman on preliminary research regarding the play. We looked into the original production, Shakespearean theatre, and influential past performances. We also examined gender roles and analyzed different methods of producing the magical elements of the show. In addition, we dove into the Chinese Theatre technique; I researched puppetry, masks, dances, staging, the Peking Opera, the history of theatre in China, and more. All of this information will likely be implemented in next spring's production of "The Tempest." As a whole, it was an exciting process through which I learned how directors and designers will investigate first-hand essential elements for a large-scale theatre production.

Thiol-Activated Hydrogen Sulfide Donors with Self-Reporting Fluorescence Properties and Highly Tunable Rates of Delivery

Katrina Hu
Major: Medicinal Chemistry

Mentor: John Lukesh, Chemistry

Hydrogen sulfide (H_2S) is a critical gasotransmitter in the human body, involved in various physiological and pathological processes such as neurotransmission, vasodilation, and cancer modulation. The concentration and release rate of H_2S are crucial in determining its biological effects, with low concentrations promoting cancer and higher, sustained levels offering potential therapeutic benefits. Previously, our lab established an intramolecular thiol-assisted mechanism that mimics the sustained release of H_2S observed in cells. The aim of this project is to synthesize a library of these H_2S donors with varied protecting groups to offer precise control over H_2S release rates. Additionally, the donors are self-reporting, utilizing a pyridine-based fluorophore that allows for real-time tracking of H_2S release. This dual functionality provides the opportunity to study the spatiotemporal dynamics of H_2S in biological systems. The synthesized donors will be tested for stability, H_2S release rates, and *in vitro* biological activity, with the goal of developing a deeper understanding of H_2S's nuanced role in various diseases and advancing novel therapeutic strategies.

Calcium Signaling in Tomato Pollen Tube Heat Stress Responses

Keyi Huang
Major: Biochemistry and Molecular Biology

Mentor: Gloria Muday, Biochemistry and Molecular Biology

The production of food by crops relies on successful fertilization of the ovary resulting in fruit and seed development. For the fertilization process to occur, the pollen grain lands onto the stigma and elongates until it reaches the ovary. Experiments using *Arabidopsis thaliana* pollen tubes (PT) showed that PT growth is mediated by calcium oscillation at the tip and is associated with a small localized increase in Reactive Oxygen Species (ROS). However high temperatures associated with climate change cause elevated ROS levels in pollen that halts the growth of the PT and leads to PT bursting resulting in reproductive failure. These results highlight the necessity to understand how the signaling processes that regulate PT growth in response to heat stress. This project studies how the calcium signal is altered in tomato PTs in response to heat. To quantify the [Ca2+]cyt in real-time, a reporter gene CGf was transformed into several thermosensitive and thermotolerant tomato strains. Pollen was collected from successfully transformed plants and imaged under a confocal microscope. Time-lapse videos of PT elongation under normal and heat stress conditions were captured to measure heat-triggering changes in [Ca2+]cyt at the PT tip. Kymographs were generated from the videos, and the fluorescence intensity data were analyzed by R-script. This study will also examine the balance of calcium and ROS under heat stress to provide a better understanding of the signaling mechanisms that control pollen heat responses and provide insight into the mechanism of thermotolerance in the PT.

Metal-Organic Frameworks (MOFs) for Hydrogen Storage

Michael Huang
Major: Chemistry with Concentration in Materials Chemistry, Environmental Science

Mentor: Abdessadek Lachgar, Chemistry

The need for sustainable energy sources and storage is a worldwide issue, particularly scarce in developing countries like Namibia. The Richter Scholarship Program supported my research and engagement with these issues during a six-week stay in Windhoek, Namibia. The involvement consisted of writing a tutorial review, interviewing Namibia Green Hydrogen Research Institute (NGHRI) experts about the potential of the Green Hydrogen Initiative in Namibia, and teaching others about hydrogen production and utilization by way of hands-on experimentation. The tutorial review focuses on the synthesis, characterization, and applications of Metal-Organic Frameworks (MOFs) for hydrogen storage. Hydrogen, with its high energy content and zero carbon emissions, is seen as a key clean energy carrier, though it remains difficult to store as a gas due to gas's large volume. MOFs, with their large surface areas and tunable structures, offer a potential solution for efficient gas adsorption. Interviews held with NGHRI's experts revealed the opportunities in Namibian green hydrogen projects, showcasing Namibia's outstanding solar and wind resources, government support, and career prospects. Additionally, this project allowed hands-on teaching experiences of green hydrogen production and utilization for undergraduate and graduate students in Namibia. This was accomplished by lectures with a green hydrogen "toolkit," enabling real-world demonstrations and applications for educational purposes. The growing interest in MOF technology and its potential role in advancing the hydrogen economy, particularly in smaller countries like Namibia, serves as a case study for global energy strategies, and this Richter Scholarship project aimed to inform and promote such strategies.

Investigating the accuracy of Garmin PPG sensors on differing skin types based on the Fitzpatrick scale: Cross-Sectional Comparison Study

Annie Icenhower
Major: Health and Exercise Science

Mentor: Jason Fanning, Health and Exercise Science

Researchers have previously investigated whether the accuracy of photoplethysmography (PPG)-measured heart rate varies based on skin pigmentation, focusing on accuracy of such devices among users with darker skin tones. It is imperative that studies exploring the impact of pigmentation on PPG accuracy are replicated.

This study aimed to contrast heart rate readings collected via PPG using the Garmin Forerunner 45 in comparison with electrocardiogram (ECG) during various levels of physical activity across participants representing a range of skin tones.

Heart rate data were collected from adult participants (18-64 years of age) at a single study session using the Garmin Forerunner 45 PPG-equipped smartwatch and the Polar H10 ECG chest strap. Skin tone was self-reported via the Fitzpatrick scale. Each participant completed two 10-minute bouts of moderate intensity walking or jogging separated by a 10-minute bout of light walking.

A series of mixed ANOVAs indicated no significant interaction between Fitzpatrick score and phase of the activity bout (i.e., rest at start, first intensity ramp-up phase, first steady-state phase, active rest, second ramp-up phase, second steady-state phase). Likewise, there was no significant main effect for Fitzpatrick score, though there was a significant main effect for phase, which was driven by greater ECG-recorded heart rate relative to PPG during the first ramp-up phase.

Our findings support prior research demonstrating no significant impact of skin tone on PPG-measured heart rate, with significant differences between PPG- and ECG-measured heart rate emerging during dynamic changes in activity intensity.

Exploring How the Integrity of the α-helix in E4orf6 Impacts Nuclear Localization at 32°C, 37°C, and 39.5°C

Safa Jan
Major: Biochemistry and Molecular Biology

Mentor: David Ornelles, Immunology and Virology

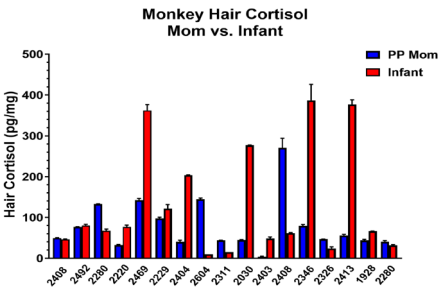
E4orf6 plays a pivotal role in the biology of adenovirus and adeno-associated viruses (AAV). Adenovirus is a family of DNA viruses associated with mild illnesses like respiratory, gastrointestinal, and ocular infections. AAV is a nonenveloped icosahedral virus that encapsulates a linear, 4.7 kb single-stranded DNA genome. Both adenovirus and AAV require the E4orf6 and E1B-55K proteins for efficient replication. E4orf6 contains an arginine-faced amphipathic α-helix critical for its function during an infection. Many of the activities of E4orf6 occur as a physical complex with E1B-55K. This project studied how changes to the α-helix in E4orf6 affected its interaction with E1B-55K by evaluating nuclear localization of the proteins at three different temperatures: 32°C, 37°C, and 39.5°C. Building on the discovery that the α-helix in E4orf6 is essential for its function, arginine and glutamic acid pairs were introduced into the α-helix with the potential to form ionic salt bridges that stabilize the α-helix. This work tested the hypothesis that salt bridges can impact the folding kinetics of the protein. Because the association of hydrophobic residues is greater at high temperatures and weaker at low temperatures, we predicted the structure of E4orf6 is driven by temperature-dependent folding of the α-helix. By looking at eight α-helix variations we were able to determine that at 32°C and 39.5°C, temperature does affect the nuclear localization of the proteins and that, variants with a greater number of potential salt bridges localize into the nucleus more readily at the lower and more restrictive temperature.

Correlation of Hair Cortisol Levels Between Postpartum Mother and Infant Vervet Monkeys

Emma Johnson
Major: Biology

Mentor: Dr. Sarah Cilvik, Molecular Biology and Neonatology

Cortisol is a hormone produced by the adrenal glands that plays several key roles in the body. Known as the body's "stress hormone," cortisol is released in response to the sympathetic nervous system ("fight or flight" response). This study aimed to investigate the correlation between hair cortisol levels in the Vervet Monkey (*Chlorocebus aethiops sabaeus*) in postpartum mothers and infants. We collected at least 10 grams of hair from the thorax region of both mother and infant within 3 days of birth and prepared each sample according to the instructions in the Salimetrics Salivary Cortisol ELISA Kit procedure prior to ELISA analysis. We then measured cortisol absorbance levels for each standard and sample. We used a four-parameter fit curve for the standards and conducted a non-parametric Spearman correlation for the statistical analysis of the samples. The r value for mother-infant pairs was 0.1225. There is no correlation between postpartum maternal hair cortisol concentration and infant hair cortisol concentration at birth suggesting that infant cortisol is independently regulated from the mother. The average cortisol concentration for postpartum mothers was 79.17 pg/mg, and the average cortisol concentration for infants was 132.73 pg/mg. After performing a non-parametric Mann-Whitney t-test, we obtained a p-value of 0.4332, indicating no significant discrepancy between postpartum maternal and infant hair cortisol concentration at birth. Future studies will investigate the relationship between infant anthropomorphic measures, postnatal growth, and survival outcomes.



Characterizing a Conditional Knockout for PKCε In Rodent Models

Alisha Kamath
Major: Biochemistry & Molecular Biology

Mentor: Dwayne Godwin, Department of Translational Neuroscience

The National Institute on Alcohol Abuse and Alcoholism (NIAAA) estimates around 15.1 million adults in the United States suffer from alcohol use disorders. Chronic alcohol use resulting in alcohol withdrawal (WD) has been shown to produce a variety of serious clinical symptoms, including seizures, due to the detrimental effects of alcohol on neural systems. Current treatments for WD syndrome include benzodiazepines, which are harmful and carry abuse potential. Thus, gaining a deeper understanding of the mechanisms underlying WD-mediated neuronal hyperexcitability is vital for improving targeted therapies and enhancing patient quality of life. Preliminary research by the Godwin lab has identified the protein kinase C (PKC) pathway as highly sensitive to ethanol. Data have implicated PKCε, an isoform of PKC with established roles in alcohol dependency, in the gain of function of T-type Ca^{2+} channels, leading to increased excitability in the midline thalamus during withdrawal. Researchers have also proposed PKCε knockout animals may serve as a good model for humans with a decreased risk of developing alcohol dependencies. This project aimed to characterize a conditional knockout for PKCε in mouse models by administering stereotaxic virus microinjections to the midline thalamus and dentate gyrus. Western blotting and tissue immunohistochemistry at various time points post-injection confirmed a significant visual reduction in PKCε expression two weeks following viral injections. These findings provide a foundation for future in-vitro electrophysiological studies. Our research underscores the importance of characterizing a conditional PKCε knockout model in rodents for the discovery of therapeutic treatments for alcohol WD.

In Pursuit of Happiness: Exploring Life in the World's Happiest Countries

Kathrine Kiersted
Major: Critical and Creative Media

Mentor: Cagney Gentry, Communication

The World Happiness Report was first published in 2012 and ranks countries around the world on well-being and happiness. But can happiness really be defined, let alone ranked? For the last six years, Finland has been ranked number one in the World Happiness Report. Other Nordic countries have ranked similarly highly: in 2023, Iceland came in second place, and Denmark third. Being half Danish myself, I was aware of this report, but I was curious as to what life in these countries really looked like. I wanted to figure out what it is that makes these countries happier than others: was it something about the culture or the traditions in those countries, was it due to the forms of government, or was it something else? With funding from the Richter Committee, I traveled to various cities throughout Finland, Iceland, and Denmark. Taking a journalistic approach, I interviewed locals in order to gain their perspective and more insight into my questions. In addition to these interviews, I captured my travels and surroundings on film. I was able to capture a glimpse into everyday life in these so-called happy countries, both visually and from first hand accounts of residents. I compiled my findings into a short film, which combines my findings with my personal observations and reflections throughout my travels.

High Dimensional Immune Profiles and Machine Learning May Predict AML Relapse Early Following Transplant

Neesha Kuntamukkala
Major: Biology

Mentor: Jason Grayson, Microbiology & Immunology

Identifying early immune signatures associated with Acute Myeloid Leukemia (AML) relapse following hematopoietic stem cell transplantation (HSCT) is critical for patient outcomes. In this study, we analyzed peripheral blood mononuclear cells (PBMCs) from 10 AML patients undergoing HSCT, focusing on T cell subsets and functional profiles. High-dimensional flow cytometry, combined with Uniform Manifold Approximation Projection (UMAP) dimensionality reduction and PhenoGraph clustering, revealed distinct changes in CD4+ and CD8+ T cell populations. In our previous studies, we developed a supervised machine learning algorithm that predicted AML relapse with a 90.2% accuracy at 30 days post-HSCT in a training cohort. In this study, we applied the same algorithm to a validation cohort of 10 AML patients who received cyclophosphamide (Cytoxan) as part of their treatment. This study aims to evaluate the algorithm's broader applicability in clinical settings and assess the impact of Cytoxan treatment on the algorithm's accuracy, as HSCT patients now receive this therapy as part of standard clinical practice. Our model predicted relapse in 6 out of 9 patients who have passed the 30-day post-transplant milestone. However, the model's accuracy remains difficult to evaluate due to the absence of relapses in our validation cohort thus far. In our prior cohort, 16 out of 59 patients relapsed, thus, the model may be highly influenced by prophylaxis with Cytoxan. The potential influence of Cytoxan on prediction accuracy remains an area for further investigation.

Combating Summer Reading Loss: The Role of Culturally Sustaining Pedagogy in CDF Freedom Schools

Campbell Lambeth
Major: Psychology major, Schools, Education, and Society minor, Statistics minor

Mentor: Dani Parker Moore, Education

Research has shown that the summer months are a period of reading loss for students, specifically those from low socioeconomic status (SES) backgrounds and racial and ethnic minorities. The Children's Defense Fund (CDF) Freedom Schools seek to eliminate summer learning loss through a six-week summer reading program employing college-aged servant leader interns (SLIs) to provide culturally sustaining pedagogy. By utilizing diverse materials and exploring themes relevant to scholars' lives, students are able to connect to the books and feel seen in a classroom setting, which has been shown to mediate reading performance. This study sought to determine the degree to which first through eighth grade students gained in literacy through attending CDF Freedom School, and how this relates to instructors' culturally responsive teaching self-efficacy. We administered the Basic Reading Inventory (BRI) to 74 students across two Freedom School sites, and assessed 11 instructors' attitudes toward delivering multicultural education. Scholars' instructional reading scores significantly improved over the summer, $t(59) = 3.162$, $p < .002$, with an average growth of about eight months ($M = 0.667$, $SD = 1.633$) in reading comprehension skill. Instructors' retrospective self-assessments of their delivery of culturally sustaining pedagogy suggest initial overconfidence, and a change in self-perception, $t(10) = 4.752$, $p < .001$. These findings suggest that training confident, culturally aware educators and providing diverse materials in the classroom are crucial to improving educational outcomes for all students.

Understanding Latinos' Racial Identity and Attitudes

Catarina Laufer Salazar
Major: Politics & International Affairs

Mentor: Betina Wilkinson, Politics & International Affairs

Race is a taboo topic in many Latin American countries with pervasive prejudice negatively affecting dark-skinned individuals and citizens seldom acknowledging their indigenous or African roots. A potential reason for this is the long history of massacring Indigenous groups and those with African roots and then whitewashing the country's history, social and political culture, as seen in Argentina and Brazil (see Hooker 2017; Moraes et al. 2020; Pineda 2021). While research on racism and indigenous politics in Latin America has addressed some of the topics noted above, there is little to no research examining the extent that Latin Americans carry their views on issues of race when migrating to the US and becoming a racialized minority group. Building on research in Latino politics, indigenous politics, political psychology and Latin American politics, we rely upon survey data of Latino immigrants in Winston-Salem, NC to answer the following questions: How do Latin American immigrants in the US identify racially? To what extent do Latin American countries' racist past translate to US Latinos' racial identity and racial justice attitudes? To what extent do Latino immigrants carry their views of race issues from their native countries and adopt them in the US? To what extent does skin tone, time in the US, national origin and experiencing discrimination relate to Latinos' racial identity and political perspectives?

How the brain reframes emotion: dynamic functional connectivity insights into cognitive reappraisal

Brody Leo
Major: Psychology

Mentor: Christian Waugh, Psychology

Reappraisal is an emotional regulation strategy which involves altering the meaning of an emotional event to change its emotional impact. Previous research has separated reappraisal into the distinct sub-processes of generation and implementation, which each have different impacts on emotional change. It is unclear, however, the extent to which the neural mechanisms involved with these two subprocesses are shared or unique. The present study aims to investigate the neural networks associated with reappraisal generation dynamic functional connectivity (dFC) analyses. This study also aims to determine whether successful emotional change from reappraisal can be predicted by certain network activations. 45 participants underwent blood-oxygen level dependent (BOLD) functional MRI (fMRI) scanning while completing reappraisal generation and implementation tasks and self-reporting emotional ratings throughout the scan. The data analysis yielded five potential networks from the group BOLD data. The network that was found to be mostly uniquely associated with reappraisal generation included connectivity between posterior cingulate cortex, dorsal prefrontal cortex, and visual receiving areas in the occipital lobe. The network most strongly predicted by reappraisal implementation included strong connectivity between the inferior temporal gyrus and superior parietal lobe through the parahippocampal gyrus area. Participant loading of this network were associated lower emotional ratings after positive reappraisal generation and use. These findings demonstrate the unique neural underpinnings of reappraisal generation and implementation in large-scale networks, as well as the notion that individual difference in positive emotional change following reappraisal can be predicted by usage of these networks.

The impact of brain angiotensin II on cognitive decline in aged animal

Wanxin (Corrine) Li
Major: Biochemistry and Molecular Biology

Mentor: Rong Chen, Wake School of Medicine, Department of Translational Neuroscience

Aging is associated with elevated levels of angiotensinogen and its active peptide, angiotensin II, in the brain. This contributes to increased oxidative stress and cognitive decline, as well as disruption of memory consolidation and retrieval.The elevated angiotensin II is also associated with dysregulation of the prefrontal cortex, which is crucial for key executive processes such as problem-solving, adaptability, and decision-making. This study examines the impact of angiotensin II on cognitive flexibility by investigating the cognitive performance of transgenic rat models with hypertension (PH) and hypotension (Aogen). We hypothesized that rats with higher angiotensin II levels, classified as PH, would demonstrate impaired cognitive performance, while rats with lower levels, classified as Aogen, would perform better. Cognitive assessments were conducted using pairwise discrimination (PD) and reversal learning tasks, with key metrics such as accuracy, latency, and error correction evaluated. However, our results show that Aogen rats with low angiotensin levels demonstrated inferior performance in both PD and reversal learning tasks, despite prior research indicating superior cognitive abilities in non-operant tasks such as novel-object recognition. PH rats exhibited deficits in cognitive flexibility, particularly in reversal learning, a process that is associated with the prefrontal cortex.

Single Dose Epinephrine Protocol Improves Survival of Older Adults with Out-of-Hospital Cardiac Arrest

Ethan Lilien
Major: Biology

Mentor: Nicklaus Ashburn, Department of Emergency Medicine Wake Forest University School of Medicine

Background: A single dose epinephrine protocol (SDEP) for out-of-hospital cardiac arrest (OHCA) is associated with similar survival to hospital discharge (SHD) rates compared to the traditional multi-dose epinephrine protocol (MDEP). It remains unknown if SHD varies by age. This study aims to determine if a SDEP protocol improves SHD in distinct age groups.

Methods: We conducted a pre-post implementation study (MDEP vs. SDEP) in 5 NC EMS systems from 11/01/2016-10/29/2019 among patients ≥18 years old with non-traumatic OHCA. Demographics and EMS response interval were determined by prehospital records and the primary outcome of SHD was sourced from the Cardiac Arrest Registry to Enhance Survival. Patients were categorized as young (18-45years), middle-aged (46-64years), and older adults (≥65years). SHD rates were compared pre vs. post SDEP implementation between age groups using Generalized Estimating Equations to account for clustering within EMS systems and to adjust for sex, race, witnessed arrest, AED availability, rhythm type, bystander CPR, and EMS response time. The interaction of SDEP implementation with age group was evaluated.

Results: Among 1690 patients (899 MDEP, 791 SDEP), SDEP was associated with improved SHD in older adults and similar SHD among middle-aged and young adults. The interaction between SDEP and age was not significant for SHD. After adjusting, SDEP remained associated with improved SHD among older adults and similar SHD among middle-aged and young patients.

Conclusion: SDEP was associated with improved SHD rates among older adults. SHD rates were similar between SDEP and MDEP among middle-aged and young patients.

Are all types of corruption created equal? How corruption type, gender, and win likelihood impact voter preferences

Margaret Linker
Major: Political Science and International Affairs

Mentor: Justin Esarey, Political Science and International Affairs

Under what conditions do voters choose to support a political candidate they suspect is corrupt? Existing research is complex and somewhat contradictory, particularly when considering whether women candidates face electoral advantage or disadvantage for engaging in corruption (Le Foulon and Reyes-Householder 2021; Eggers, Vivyan, and Wagner 2018; Klavsnja, Lupu, and Tucker 2021). This study uses a conjoint survey experiment to study the link between candidate gender and voter support for corrupt candidates. Respondents choose between two biographical vignettes with randomly selected characteristics who they would prefer as their party's presidential candidate. Our experiment differs from previous investigations by varying the type of corruption a candidate is accused of, as well as varying a candidate's probability of success in the general election. These measures were taken so we could determine whether respondents react differently to various kinds of corruption, as well as how they weigh the benefits of potential party success versus the collective action problem of corruption. We found that different types of corruption were treated differently by voters, but that there was not a significant difference in how voters treat male and female candidates. The probability of winning also did not have a significant impact.

Elucidating chemical cues driving cellular aggregation in the marine mixoplankton *Ochromonas* sp.

Elise Lipezker
Major: Biology

Mentor: Sheri Floge, Biology

Marine microbial interactions regulate oceanic carbon cycling throughout the ocean and affect the earth's climate. Marine mixoplankton - organisms that use both photoautotrophy and phagotrophy to satisfy nutritional needs - are ubiquitous in marine systems and enhance trophic transfer efficiency and vertical carbon flux. We observed that *Ochromonas*, a model marine mixoplankton, form aggregates when grown in culture with and without zooplankton predators. The factors controlling aggregate formation are currently unknown and could impact predator-prey dynamics and carbon flux. The objective of this project was to determine if dissolved chemical cues derived from predators cause *Ochromonas* to aggregate. Preliminary analyses suggest that dissolved chemical compounds from zooplankton predators do not stimulate aggregate formation in the time scales tested (24h exposure). Understanding mechanisms underlying marine microbial aggregate formation is key to predicting plankton responses in a changing global ocean.

Modeling Solvent Effects on Au(I)-catalyzed Cyclization of N-propargyl Benzamide: A DFT Computational Analysis

Leo Liu
Major: Chemistry

Mentor: Wendu Ding, Chemistry

Gold catalysis has emerged as a forefront candidate for the development of new organometallic systems in the past two decades. Since its first report in 2004, Au(I)-catalyzed cyclization of N-propargyl benzamide into its corresponding oxazole has become a widely used benchmark reaction for the evaluation of catalytic activity, selectivity, and stability across various reaction conditions (ligands, counterions, & solvents). Current mechanistic and computational models suggest a two-step process: an initial nucleophilic attack on the gold-alkyne π-complex, followed by protodeauration—the rate-limiting step—of the resulting vinyl gold species. However, recent experimental studies vary in agreement; different solvents could change the rate-determining step (RDS) of the reaction—cyclization in methanol (MeOH) and protodeauration in dichloromethane (DCM). In this study, a catalytic pair of triphenylphosphine Au-ligand coupled with a NTf2 counterion was modeled using Density Functional Theory (DFT), a computational quantum mechanical modeling method. Potential energy surface profiles derived from the simulations reveal that, indeed, cyclization and protodeauration have greater activation barriers in MeOH and DCM, respectively. Yet, computational results produced a less pronounced difference than its experimental counterparts, whose cyclic step in DCM exhibited a rate of 17 times faster than that of MeOH. DFT simulations conducted also revealed two possible coordination—one with NTf2's nitrogen, and another with its oxygen—between the counterion and the amide proton. These latest findings expand on the current protodeauration framework, introduce nuances in evaluating the counterion's role in cyclization & protodeauration, and strongly corroborates recent experimental and computational trends.

Youth Football Athletes' Perceptions of Concussions and Head Kinematics

Grace Loftin
Major: Engineering

Mentor: Jillian Urban, Biomedical Engineering Department of the Wake Forest School of Medicine Madison Marks, Biomedical Engineering Department of the Wake Forest School of Medicine

Football has one of the highest rates of concussions and repetitive subconcussive head acceleration events (i.e., collisions not associated with acute signs and symptoms of concussions; HAEs) among youth team sports. To better understand factors influencing exposure to HAEs, this study evaluated the relationship between athlete beliefs surrounding concussions, concussion reporting, and resulting exposure to HAEs. Two teams competing at the 13U (n=13) and 12U (n=12) levels of play were equipped with instrumented mouthpieces for a single football season. Video data were captured to characterize the events. A survey evaluating constructs within the Health Belief Model (concussion knowledge, perceived susceptibility, perceived severity, perceived benefits, perceived barriers, cues to action, symptom reporting intentions, and concussion reporting intentions) was adapted for middle-school-aged athletes and completed by athletes at pre- and post-season timepoints. Composite scores of each survey construct and summary statistics were calculated for HAE frequency metrics using JMP Prostatistical analysis software. A total of 2,138 HAEs were identified as "real events" after film review. Athletes experienced between 17 and 205 HAEs during the season.

Athletes experienced mean [95% CI] HAEs per athlete per session of 3.1 [2.6, 3.6] and 3.6 [3.0, 4.1] for the 12U and 13U teams, respectively. The 12U team reported greater mean cues to action (12U: 5.7, 13U: 5.2), while the 13U team had greater means for concussion knowledge (12U: 4.2, 13U: 4.4) and perceived benefits of concussion reporting (12U: 3.5, 13U: 4.3). Future work will explore the relationship between survey composite scores and HAE magnitude.

Optimization of DNMT3Ac Enzyme-Coupled Assay

Lydia Grace Logan
Major: Biochemistry and Molecular Biology

Mentor: Lindsay Comstock, Chemistry

DNA methyltransferases are classes of enzymes that facilitate the methylation of DNA via the universal methyl donor, S-adenosyl-L-methionine (SAM). DNA methylation is essential for regulation of gene expression, which is the process of protein production that is fundamental to cellular life. In Dr. Comstock's lab, experiments have been conducted that examine the inhibition of a specific catalytic subunit of DNA methyltransferase 3A, DNMT3Ac, via an N-mustard analog of SAM. This project therefore set out to optimize the function and results of the enzyme-coupled assay, in order to quantitate DNA methylation through detection of adenine, one of the constituent nucleotides in DNA.

Liquid chromatography-tandem mass spectrometry using the triple quadrupole mass spectrometer (TQMS) was initially employed. The instrument is designed to perform precise and selective molecular analysis. However, despite method adjustment and type of enzyme used, confidence in the quantification of DNA methylation data was low on the TQMS, due to poor reproducibility of the adenine standard peak areas and variability in manual peak integration. Thus, a fluorescence magnetic bead assay was utilized moving forward. Streptavidin coated magnetic beads are used to isolate methylated DNA, where DNA methylation can be quantified according to the fluorescence counts produced on a well plate reader. Optimization of the assay included adjusting reaction components such as DNA type, DNA concentration, enzyme type, and enzyme concentration. Although the assay improved with optimization, reproducibility was still poor with the bead assay. It was concluded that usage of a different enzyme construct should be explored moving forward.

Developing a Novel Method of Production for Recombinant Fibrinogen

Lourdes Lopez
Major: Biophysics

Mentor: Martin Guthold, Biophysics
Caela Flake, Physics

Fibrinogen plays a crucial role in blood clot formation by forming fibrin fibers in response to vascular injury. While the activation and initial stages of fibrinogen conversion to fibrin are well-studied, the role of the αC region, particularly the αC connector, in fibrin fiber assembly remains poorly understood. This study seeks to elucidate the influence of the αC connector on fibrin fiber assembly, aiming to fill a critical knowledge gap and potentially inform therapeutic interventions for bleeding disorders and cardiovascular diseases.

We are working to establish a cell-based system to express fibrinogen variants by deleting parts of the αC connector, beginning with the entire connector. The plasmid DNA encoding these variants was amplified in *E. coli* bacterial cells, followed by plasmid purification, gel electrophoresis, and sequence confirmation. Chinese hamster ovary (CHO) cells will be transfected with the purified DNA plasmids to express the fibrinogen variants, which will be subsequently purified and characterized using SDS-PAGE, Western blotting, and ELISA. Structural analyses of the clots formed from the variant fibrinogen will determine the impact of the αC connector deletions on fibrin fiber assembly.

This summer, the plasmid amplification phase of the experiment was successfully started. We developed a method for replicating, purifying, and verifying the presence of the fibrinogen Aalpha plasmid and the pUC19 plasmid as a model. Our results show the plasmids can be amplified and purified yielding about 400 nanograms of DNA per prep.

We successfully established a robust method for the initial stages of the experiment, plasmid amplification.

Inkjet-Printed Hydrogen Peroxide Sensors for Neural Interfaces

Jacob Louie
Major: Engineering

Mentor: Allison Hess-Dunning, Department of Biomedical Engineering, Case School of Engineering

Intracortical probes can record signals from individual neurons, providing research and clinical opportunities for restoring function to people with limb loss or motor dysfunction. Yet, neuroinflammation and oxidative stress around the implant still commonly lead to signal degradation. Sensing hydrogen peroxide as a marker of oxidative stress could serve as a feedback signal for tuning anti-inflammatory or anti-oxidative therapeutic agent delivery. In this project, inkjet printing was used to fabricate silver-based hydrogen peroxide sensors. Compared to typical microelectrode fabrication processes like micromachining laser-cut foils or thin film deposition, this process provided better control over material selection and morphology of the sensors, increasing sensitivity for eventual miniaturization.

With an inkjet printer, novel silver-based monoethylene glycol (Ag-MonoEG) or triethylene glycol (Ag-TriEG) inks were deposited on plasma pre-treated liquid crystal polymer before they were reduced to silver in an argon plasma chamber. Using Ag-MonoEG ink, a smooth and continuous sensor base layer was printed. Using Ag-TriEG ink, a second rough layer with high surface area was printed over the sensing area. Platen temperature, droplet spacing, and nozzle voltage were adjusted to improve print fidelity.

Sensors with Ag-TriEG layered over Ag-MonoEG were amperometrically tested against single layer Ag-MonoEG in a phosphate buffered saline solution with hydrogen peroxide concentrations of 1mM - 10mM. Initial testing of the layered sensors revealed a higher average sensitivity of -1.61μA/mM, about 2.2 times that of single layer Ag-MonoEG. This process could translate to printing materials like platinum or graphene oxide to increase utility in neural interfaces.

To Ban, Or Not To Ban, Physician-Assisted Suicide in the United States

Qianyu Lu
Major: Philosophy

Mentor: Adam Kadlac, Philosophy

This research starts with a philosophical question of "Is there a difference between killing and letting someone die?" while trying to look into the history of legalizing/banning Physician-Assisted Suicide in America. Particular focus is paid to the state of Washington, as it has shifted from banning PAS in its statutes to both the District Court and the Ninth Circuit agreeing that banning PAS is unconstitutional, to the Supreme Court overturning the former conclusion, and to eventually passing The Death with Dignity Act in 2008.

The research aims to find the reason behind those 3 shifts by examining the following court cases:

In re Joseph G.(1983),
Cruzan v. Director,Missouri Dept. of Health (1990);
Roe v. Wade (1973);
Planned Parenthood v. Casey(1992);
People v. Kevorkian(1994);
Washington v. Glucksberg(1997);
Vacco v. Quill (1997); and
Gonzales v. Oregon(2006).

The Due Process Clause of the Fourteenth Amendment is also analyzed with an emphasis on the definition of "dignity" to help analyze the issue. Finally, the research answers the philosophical question by legally distinguishing between "killing" and "letting die" and expands to discuss the legal trade-off between physicians' rights and patient autonomy by distinguishing between "refusing life-sustaining medical treatments" and "seeking assistance in suicide."

Is the TilS function essential in *E. coli*: A CRISPR analysis

Zhongyi Lyu
Major: Biochemistry and Molecular Biology

Mentor: Rebecca Alexander, Department of Chemistry

We are interested in the importance of the bacterial-specific modifying enzyme tRNA isoleucine lysidine synthetase (TilS). This study investigates the role of specific gene-coded amino acid residues at positions 118 (Aspartic acid) and 119 (Aspartic acid) in the survival of *E. coli*. These conserved residues are located on the N-terminal catalytic domain of TilS and are thought to be crucial for its activity. We employed PCR to generate mutations D118A and D119A, followed by *in vitro* lysidinylation assays to assess the impact of these mutations on TilS function. Additionally, CRISPR-Cas9 techniques were used to introduce these mutations *in vivo*. Preliminary results indicate that the D118A mutation is likely lethal to *E. coli*, as evidenced by the lack of growth on multiple experimental plates. The D119A mutation was successfully generated and verified by sequencing. gRNA for the D119A mutation was programmed with SnapGene for use in the CRISPR-Cas9 system and constructed with PCR and Gibson Assembly. Future work will involve sequencing, assessing the enzymatic activity of the mutated protein through lysidinylation assays, generating gRNA for the D118A mutation, and evaluating cell growth following *in vivo* mutations using the CRISPR-Cas9 system.

Preserving Historical Costumes

Sadie MacDonald
Major: Studio Art

Mentor: Mary Wayne-Thomas, Theatre

Over the summer, I worked with Professor Mary Wayne-Thomas to catalog and store the historical garments that the WFU Theatre and Dance department has come to access. Most of the clothing items were donated from patrons such as Harold C. Tedford, after whom our theater mainstage is named, and others have been gathered throughout the years to be used as costumes in theatrical productions. With Mary's aid, I was able to assist in the production of an online database, which is soon to be open to the public, that retains this information. Once the electronic processing of this information has been completed, our catalog will be accessible through JSTOR. We hope that this database will allow the public - both our WFU community and beyond - the ability to view the extant garments in an educational way, as well as provide a means to understand the impact that costumes have left on our knowledge of history, the economy, and society.

Identity and Relationships: How Discrimination Shapes Multiracial Asian-White Experiences

Sarah MacDougald
Major: Psychology

Mentor: Lisa Kiang, Psychology

In an increasingly diverse society, the importance of understanding multiracial individuals is crucial. The present study aimed to investigate the impact of perceived ethnic-racial discrimination and ethnic-racial identity on relationship quality with multiracial Asian-White individuals (M_{Age} = 20, 64.7% female). Participants completed a survey assessing self-identification, perceived discrimination, and relationship quality among White, Asian, Wasian, and Other non-Asian minority individuals. Results indicated that discrimination from a specific racial group may negatively impact relationships with members of that group, but contrary to the hypothesis, ethnic-racial identity did not buffer this effect. Instead, qualitative data suggested that peer perceptions and an individuals' public or private regard for one's race might play a more significant role in shaping these relationships. The findings highlight the intricate relationships between identity, discrimination, and social dynamics in the lived experiences of multiracial individuals.

Exploring the Structure-Property Relationships of Organic Semiconductors at Princeton University

Edith MacKenzie
Major: Physics

Mentor: Lynn Loo, Princeton University Chemical and Biological Engineering
Oana Jurchescu, Wake Forest Physics

Organic electronics, or carbon-based electronics, represent a rapidly developing field of materials science aimed at investigating the unique properties of organic materials for electronic device applications. Organic electronics have potential advantages over their inorganic counterparts, including lower costs and enhanced processability. The resulting flexible devices yield powerful commercial, societal, and medical applications. This research encompasses the synthesis and study of small-molecule organic semiconductors processed in Dr. Lynn Loo's Organic and Polymer Electronics Laboratory at Princeton University. The materials under study include both established organic molecules such as TIPS-Pentacene, as well as two newly synthesized compounds labeled TIPS-PhPn and TES-PhPn. Focusing on these materials, the goal of this project is to analyze the relationship between an organic device's structure and its resulting electrical properties. This correlation was studied through repeated experimentation and the use of innovative technology, including an x-ray diffractometer, to effectively relate changes in a material's characterization to trends in its electrical efficiency, measured through field-effect mobility and current-voltage (IV) relationships.

Assessing enjoyment and intensity of virtual physical activity

Ella Maffi
Major: Health and Exercise Science

Mentor: Jason Fanning, Health and Exercise Science

Most Americans engage in too little physical activity, often due to low enjoyment. This has led to the rise of "gamified" exercise programs, especially virtual reality-based ones, where users report increased enjoyment and a greater tolerance for higher intensity compared to conventional exercise. To date, limited data exist contrasting objective and subjective measures of exertion during conventional and gamified exercise.

This study will compare perceived vs actual exertion (measured by heart rate reserve) during treadmill exercise and virtual reality activity, examining if either leads to greater discrepancies between perceived and actual intensity. It will also assess whether these relationships are influenced by physical activity experience, enjoyment, and preference or tolerance for intensity. The hypothesis is that virtual reality activity will result in a greater discrepancy between perceived and actual intensity, especially in individuals with less experience and lower tolerance for intensity.

Participants will complete baseline questionnaires on physical activity, preference, tolerance, stress, and other factors, and will be fitted with a Polar H10 heart rate monitor. After measuring resting heart rate, they will complete one 10-minute treadmill block and one 10-minute virtual reality exercise block, each targeting the same perceived exertion. Participants will rate their exertion and affective state throughout, adjusting intensity as needed. They will rate enjoyment and exertion immediately after completing each activity. During a second and third session the participant will repeat the activity blocks, and the order of activities will be randomized across sessions.

Participant recruitment is currently underway as data collection is ongoing.

TREX1 Regulates the Inflammatory Response to Oxidatively Damaged Cytosolic DNA

Rylie McAllister
Major: Biochemistry and Molecular Biology

Mentor: Thomas Hollis, Biochemistry

TREX1 is the primary enzyme responsible for degrading cytosolic DNA and is the master regulator of the cGAS-STING pathway. However, an overproduction of reactive oxygen species (ROS) during mitochondrial metabolism can lead to oxidative stress and damage to the mitochondrial genome. This causes oxidized DNA fragments to accumulate in the cytosol, activating the cGAS-STING pathway, which drives a sustained immune response and inflammation, leading to disease. Therefore, this study is investigating how TREX1 regulates the inflammatory response to oxidatively damaged cytosolic DNA.

We measured the rate of TREX1 degradative activity on a control and a FAM-labeled 31-mer with an 8-oxo-G modification, which is the most common form of oxidative damage. We found that the 8-oxo-G modification inhibits TREX1 activity. We investigated where 8-oxo-G modified DNA accumulates in human retinal capillary endothelial cells (HRCECs) and found oxidized DNA in the mitochondria and cytosol of HRCECs using an 8-oxo-G antibody in a dot blot array. Lastly, we measured inflammatory biomarkers using the expression of key cGAS-STING proteins on a Western blot. We found that the accumulation of DNA in the cytosol leads to an increased immune response through the upregulation of pTBK1, a cGAS-STING biomarker. These results suggest that TREX1 degradative activity is decreased when oxidatively damaged DNA is present, which is caused by oxidative stress and leads to cellular inflammation.

Women's Perceptions of Health, Healthcare Utilization, and Education in Rural and Urban El Salvador: A Critical Narrative Inquiry

Heavyn McDaniels
Major: Health and Exercise Science

Mentor: Megan Irby, Health and Exercise Science

El Salvador is characterized by some of the most profound health disparities in Central America, linked to the country's tumultuous political climate and absence of a stable education system. Relatedly, women in rural and urban areas of El Salvador face significant disparities in education and healthcare, and these disparities are rooted in a complex interplay of socioeconomic, cultural, and systemic factors that have limited access to educational opportunities and healthcare utilization.

To explore the relationship between education and health outcomes among rural and urban women in El Salvador, we conducted a mixed-methods narrative inquiry study to better understand barriers that shape knowledge and utilization of healthcare services among women, alongside perceptions of education access.

Semi-structured interview guides were developed and tested before the study and administered in person among rural and urban-dwelling women in El Salvador. An *a priori* codebook guided data analysis. Interviews were digitally recorded, translated into English, and analyzed following a grounded-theory approach.

17 women completed consent procedures and qualitative interviews: 8 residing in urban areas and 9 in rural areas of El Salvador. Results supported the hypothesis that obstacles such as cost, distance, and lack of resources were major drivers of disparities, but also indicated home life and family factors as key drivers of access to education and health.

Lessons from this study inform our understanding of factors shaping women's education and health outcomes in various locations within El Salvador and serve as a foundation for future research to support the empowerment of women.

Using Compositional Data Analysis to Measure the Effect of Time Substitutions of Different Activity Behaviors on Pain Intensity and Interference

Victoria McGuirt
Major: Health and Exercise Science

Mentor: Jason Fanning, Health and Exercise Science

Previous research has demonstrated that a greater amount of light physical activity (LPA) and moderate to vigorous physical activity (MVPA) are associated with lower levels of pain. However, to date, this relationship has not been investigated leveraging compositional data analysis. This study aims to assess how time substitutions of physical activity behaviors such as, LPA, MVPA, sleep and sedentary time affect pain intensity and pain interference, using compositional data analysis techniques. Participants were 55-85 years of age, had a body mass index of 30-40 kg/m2, were self-reported to be low active and weight stable and had to have chronic pain in at least one of the following areas in the previous 12 weeks: back, hip or knee. Physical activity was assessed using an ActivPAL 4 triaxial accelerometer over 7 days. The PROMIS pain intensity scale and PROMIS pain interference scale were used to measure pain intensity and interference. Results indicated that daily time use compositions were not related to pain intensity but were related to pain interference. Substitutions involving increased MVPA were associated with greater pain interference, and lower MVPA were associated with greater magnitude decreases in interference relative to increases in MVPA. Increasing MVPA, but not LPA, for those with chronic pain results in more pain interference, suggesting future research should explore the health benefits of increasing LPA among those with chronic pain.

Effect of extracellular matrix material incorporation into alginate hydrogel microbead on its porosity

Jake Miller
Major: Biology

Mentor: Emmanuel Opara, Wake Forest Institute for Regenerative Medicine
Joshua Bowlby, Wake Forest Institute for Regenerative Medicine

We previously reported that the incorporation of ECM into alginate matrix hydrogel enhances its mechanical properties. In the present study, we will examine the effect of ECM incorporation on the porosity of the hydrogel. We will determine alginate hydrogel porosity by ethanol solvent replacement model and scanning electron microscopy.

The ethanol solvent replacement method has been validated for porosity measurements *in vitro*. This method determines the percent porosity of the hydrogels by placing pre-weighed dry hydrogel samples (Wh) into ethanol and weighing the total weight of hydrogels and ethanol (W2). The samples are then removed after 24 hours and the weight of the remaining components of the hydrogel is collected (W3). The calculation of the porosity is done with the following formula using the density of absolute ethanol (ρe). Porosity (%) = (W2 – W3 –Wh) / (W1 – W3 + 20ρe) x 100.

By utilizing a combination of optical microscopy and Scanning Electron microscopy, we will be able to determine a qualitative and quantitative method of measuring porosity through an analog of pore size. Hydrogel scaffolds can be imaged and in conjunction with accompanying computer software, it will be possible to accurately replicate measurements across samples and different experimental groups.

The Evolution of Carceral Technologies in the Philippines

Alex Mojica
Major: Sociology

Mentor: Catherine Harnois, Sociology

The Philippines is facing an intensifying and ever-evolving human caging crisis. As the drug war formulated by Rodrigo Duterte has evolved into Bong Bong Marcos's administration, prison overcrowding is ballooning, and human rights abuses have persisted. While excellent reporting has focused on the Philippines' contemporary carceral crisis, this research report asks: where did these carceral technologies come from?

This report refers to carceral technologies as the methods by which harm is inflicted on people by a state's policing and prison systems. While carceral technologies can take ideological or discursive forms, this report focuses on technologies used to impose physical violence, such as prison building.
While prior research has understood the Philippines as a branch of the United States, whereby carceral technologies are more-or-less exported from the United States abroad, this report takes a different approach. I argue that carceral technologies don't move from country to country like a pipeline, but evolve co-constitutively and seem to ignore borders. In other words, this paper argues that the way violence changes depends less on what country it develops in, and more on what its purpose is.

Fluorescent Turn-on Aptasensor of Δ9-THC Based on the FRET Between Melamine Carbon Quantum Dots and Gold Nanoparticles

Caroline Nett
Major: Medicinal Chemistry

Mentor: Christa Colyer, Chemistry

This study investigated the detection of Δ9-tetrahydrocannabinol (Δ9-THC), a key active compound in cannabis, using a fluorescence turn-on aptasensor based on fluorescence resonance energy transfer (FRET) between melamine carbon dots (M-CDs) and gold nanoparticles (GNPs). FRET involves energy transfer from an excited molecular fluorophore (M-CDs), to another acceptor fluorophore (GNPs). M-CDs were synthesized via a hydrothermal method and combined with GNPs, produced by reducing chloroauric acid. The GNPs significantly quenched the fluorescence of the M-CDs, as determined by fluorescence spectrophotometry. Additionally, the sensor design involved an aptamer (or short, single-stranded DNA molecule known to bind the target molecule). The aptamer was initially bonded to the M-CD and was anticipated to preferentially bind to the analyte Δ9-THC upon its introduction to the system. The anticipated impact of this would be to liberate the M-CDs from the GNPs, thus restoring the fluorescence of the M-CDs to an extent that correlates to the Δ9-THC concentration and signaling the presence of the drug. However, the aptamers didn't have a significant effect on the fluorescent signal. Ethanolamine was then added, blocking unreacted carboxyl groups on the M-CD's surface and caused a slight decrease in the signal intensity. However, when Δ9-THC was added to the system with CDs, GNPs, ethanolamine, and aptamer, the expected fluorescence restoration was still not seen. Further research will focus on using fluorescently labeled aptamers to study the binding interactions between aptamers and M-CDs. Additionally, optimizing the GNPs synthesis and investigating the particle aggregation effects will be important in examining this system.

Structure in word embeddings

Jiacheng Ni
Major: Statistics

Mentor: Kenneth Berenhaut

In this poster we consider structure and locality in word embeddings. There are several extant methods for embedding words from a vocabulary into a relatively high-dimensional vector space, so that relative word positioning reflects contextual similarity. It has been found that while positioning can at times communicate accessible information regarding complex word relationships, Euclidean distance (which incorporates vector magnitudes) is outperformed by cosine similarity (which restricts attention to angle comparisons) in many applications. Here we consider how accounting for varying density in the space can allow for incorporating of vector magnitudes in important applications. We employ the measure of cohesion introduced by Berenhaut, Moore and Melvin [*Proceedings of the National Academy of Sciences*, **119** (4) (2022)] in conjunction with Euclidean distance to shed new light on structure in pre-trained word embeddings.

The Effects of Remote Online Learning on Self-Reported Sleep Quality in High School Students

Mayank Nihalani
Major: Health and Exercise Science

Mentor: Dr. Nancy Dawson, Department of Internal Medicine, Mayo Clinic, Jacksonville, Florida

Background: During the COVID-19 pandemic, academic institutions nationwide changed from in person learning (IPL) to remote online learning (ROL). Subsequently, many students spent prolonged periods exposed to blue light. As it has been proposed that increased blue light exposure may disturb natural circadian rhythm and sleeping patterns, it remains unclear whether ROL is a safe option for adolescent students. This study aims to assess the effects of ROL during the COVID-19 pandemic on sleep quality in high school students.

Methods: Data was collected cross sectionally through a self-reported survey in which mode of schooling, duration of screen time, and sleep scores were reported. Sleep scores were calculated using the Pittsburgh Sleep Quality Index (PSQI). Low sleep quality was classified as a global PSQI score over 5 whereas high sleep quality was classified as a PSQI score of greater than 5.

Results: Of 54 collected responses, 34 (63%) attended IPL and 20 (37%) attended ROL. Mean global PSQI scores for IPL and ROL were 8.03 and 8.6, respectively. 27 (79%) IPL students reported low sleep quality whereas 13 (65%) ROL students reported low sleep quality. No significant differences in sleep quality were found between groups ($p=0.337$).

Conclusion: Our findings suggest that sleep quality does not differ between ROL and IPL students, indicating that ROL is a safe and viable alternative that does not interfere with sleep in adolescent students. Possible explanations for these findings include more flexibility in schedule and decreased commute time.

Investigating the role of glia-neuron communication in the walking behavior of *Drosophila melanogaster*.

Hope Nitsche
Major: Biology

Mentor: Richard Mann, Department of Biochemistry and Molecular Biophysics, Mortimer B. Zuckerman Institute, Columbia University
Himanshu Gupta, Department of Biochemistry and Molecular Biophysics, Mortimer B. Zuckerman Institute, Columbia University

Proper development and maintenance of leg motor neurons, and their targeting to the correct target muscles, are essential for locomotion to occur. These leg motor neurons require tightly regulated signals to initiate and maintain voluntary movements. Many genes expressed in motor neurons have been identified as important to this process. Prior studies have examined the importance of genes expressed in glial cells in neuronal development and activity regulation. However, the impact of genes specifically expressed within astrocytes or ensheathing glial, two of the seven subtypes of glia within *Drosophila melanogaster*, on walking behavior has not yet been studied. In this study, we screened candidate genes expressed within astrocytes or ensheathing glia based on literature and our scRNA-seq glial dataset. The expression of these target genes was validated using a genetic tool that allows us to visualize them within the astrocytes or glia in the ventral nerve cord (VNC). The target genes were then knocked down using a pan-glial GAL4, repo, or an astrocyte-specific GAL4, alrm. Our data shows that downregulation of Nrg or BeatIIIc, specifically in astrocytes using alrm-GAL4, causes multiple alterations in locomotor behavior over a ten-minute recording period. Not all of these alterations were present in flies when these genes were knocked down with repo. The future adaptation of this tool may allow targeted knockdown of candidate genes only within the VNC, and allow for their role in walking behavior to be accessed.

Remote Anemometer Fault Detection Using Machine Learning

Aidan Norris
Major: Engineering

Mentor: Hussein Abdeltawab, Engineering

Wind energy is one of the most prominent forms of renewable energy currently being implemented to decrease our reliance on fossil fuels and curb the emission rates of greenhouse gasses. The growth of wind energy is slowed by the unpredictability of the wind and the power fluctuations that accompany variable resources. To account for the different wind speeds, wind farms apply control systems to optimise the power generated by each turbine. These controls are dependent on accurate measurements of the wind speed, usually made by devices called anemometers. Faults in anemometers can lead to suboptimal turbine performance and additional mechanical strain on the turbine. There are a wide range of methods employed towards the fault detection of anemometers, including data driven approaches, machine learning techniques, set value observations, and parameter estimation models. The goal of these methods is to remotely assess the performance of these sensors and alert maintenance teams to faults as soon as they occur. This project proposes using knowledge of wind speeds at an entire wind farm to detect faults in anemometers by applying machine learning to simulated wake fields of wind farms. In this project, 8000 wind profiles of a 3x3 wind farm were generated using WFSim. This data was modified to introduce faults of 5-15% and noise of 0-2% before applying machine learning models to detect the faults on unseen data. This approach was able to detect errors in wind speed readings with an accuracy of 94.2%.

Curve Shortening Flow Simulation Under Spherical Geometry

Boyuan Pan
Major: Mathematics

Mentor: Leandro Lichtenfelz, Mathematics

Curve Shortening Flow (CSF) is a geometric evolution process that is characterized by the progressive movement of a curve in the direction of its normal vector. The speed of this process is proportional to the curvature of the curve, which means the areas of the curve experiencing the most significant bending will undergo the fastest evolution. Despite its geometric appeal, to the best of our knowledge no interactive graphical simulations of curve shortening flow on non-Euclidean geometries — such as spheres, tori, cones, and beyond — have been created so far. In this project, a computer simulation program was developed, offering an interactive interface that allows users to input any curve they want on a 2-dimensional plane or a sphere in 3-space. The program will display an animation of the evolution of CSF. Thus, this scholarly project fills a gap in the visualization of curve shortening flow. The outcome of this project could be used for various purposes, particularly in education, where visual animations can make the concept of CSF more accessible to students. By offering clear, dynamic visualizations, it can enhance understanding of this abstract geometry process. Additionally, it could also be a tool for scholars engaged in CSF research, allowing them to conduct simulations under specific and unique conditions to gain insight into the process.

Differentiation of induced Pluripotent Stem Cells to Lung Organoids and characterization of stages of development

Sriram Patnaik
Major: Biochemistry and Molecular Biology

Mentor: Geetaram Sahu, Molecular Biology

In my project, I aimed to develop a sophisticated model for studying lung infections by differentiating human induced pluripotent stem cells (iPSCs) into mature lung organoids, providing a more accurate 3D representation of lung tissues compared to traditional 2D cultures. The process involved expanding Cellartis hiPS cell lines through multiple passages, followed by differentiation into Definitive Endoderm (DE) using the Cellartis DE Differentiation Kit over 7 days, then into Anterior Foregut Endoderm (AFE) over 3-4 days, and subsequently into Lung Bud Organoids (LBO) using the STEMdiff Branching Lung Organoid Kit over 7-14 days, eventually developing Branching Lung Organoids (BLO), though full maturation was not achieved by the end of the project. The cells and tissue were characterized using Immunofluorescence (IF) to visualize marker expression patterns and quantitative PCR (qPCR) to quantify gene expression relative to β-actin, employing the 2^-ΔCt method for relative fold changes. Key findings included a progressive increase in lung-specific markers such as *SFTPB*, *SFTPC*, and *NKX2*.1, alongside a decrease in DE markers like *EPCAM*, indicating successful differentiation. This work not only demonstrates the feasibility of generating LBOs from iPSCs but also provides a robust model for studying pathogenic infections and testing therapeutic interventions, although further maturation of the organoids is needed for complete functional applications.

Repentance, Atonement, Forgiveness, and “Cancel Culture”

Jack Peterson
Major: Philosophy

Mentor: Christian Miller, Philosophy

In this paper I will outline a philosophical framework of atonement, with key components of repentance and forgiveness. I will give examples of the phenomenon of cancel culture and show how the atonement framework fits with cancel culture. Finally I will argue that cancel culture is flawed and needs to be remodeled. It has some benefits in how it seeks to pursue justice and punish wrongdoers. But I will also argue that it ends up promoting a culture that condemns people without hope for achieving forgiveness or reconciliation.

Investigating the functional links of stress response pathways via Mbf1 in *Schizosaccharomyces pombe*

Nathan Philip
Major: Biochemistry & Molecular Biology

Mentor: Ke Zhang Reid, Biology
Summer Adams-Brown, Biology

Multiprotein Bridging Factor 1 (Mbf1) is a protein that maintains ribosome stability by preventing frameshifting in the event of ribosomal collisions caused by cellular stress. This research investigates the functional dynamics of Mbf1 within the context of No-Go Decay (NGD), Ribosome Quality Control (RQC), and the Integrated Stress Response (ISR) in *Schizosaccharomyces pombe* (fission yeast). Not much is known about *S. pombe'*s Mbf1, however in budding yeast, Mbf1 has been shown to interact with the ribosomal subunit Rps3 and its subsequent recruitment of the E3 ubiquitin ligase Hel2, which marks Rps3 for degradation – a process fundamental to NGD. Through dilution assays conducted at YEA 30°C, and with the translation elongation inhibitor cycloheximide (CHX) at concentrations of 1 ug/mL and 10 ug/mL, we assessed the genetic interplays between Mbf1, Gcn1, Cue2, and Elf1 – proteins essential for translational regulation and stress response. This study explores the hypothesis that Mbf1 is the bridge between these highly conserved stress-mediated signaling pathways, with preliminary findings suggesting that deletion of Mbf1 partially rescues the severe genomic instability phenotype observed in *elf1*Δ mutants. Additionally, the generation of triple mutants (*elf1*Δ*cue2*Δ*mbf1*Δ and *elf1*Δ*gcn1*Δ*mbf1*Δ) highlights a complex network of interactions, positioning Mbf1 as a pivotal linker in maintaining the efficiency and accuracy of the cellular translational machinery under stress conditions. This investigation is part of a broader research project aimed at elucidating the roles of Elf1 and Cue2 in translation and the ISR, providing insights into how translational control mechanisms interlink cellular adaptation and survival during stress.

Synthetic Studies of Alternative Biological Thiols

Jose Luis Policarpio
Major: Chemistry

Mentor: S. Bruce King, Chemistry

Glutathione (GSH) is an important low molecular weight (LMW) thiol/antioxidant found in many organisms and buffers against oxidative stress by alternating between several oxidation states. Alternative LMW thiols include ergothioneine (ERG), biologically synthesized in certain bacteria and fungi, and bacillithiol (BSH), which naturally occurs in Gram-positive bacteria. ERG and its amino acid analog 2-thiohistidine most commonly exist in the thione oxidation state. Due to the scarcity of these molecules, further studies on their redox activity is limited, creating a necessity to synthesize them. This research is based on previous procedures defined for the synthesis of these molecules proceeding from histidine (for 2-thiohistidine) and hercynine (for ergothioneine). These preparations rely on imidazole bromination followed by sulfur introduction with L-cysteine and elimination using 3-mercaptopropionic acid. Successful studies in the organic synthesis of ERG and this analogue will help to clarify the biological roles of these redox buffers and define pathways for the generation of analogs. Other research includes investigating thiiranes, 3-membered ring molecules containing one sulfur atom that are capable of converting thiols to persulfides. Our goal is to use these reagents to prepare the persulfides of BSH, as it may be relevant in the redox activity of Gram-positive bacteria. Thiirane synthesis proceeds through a rhodium catalyzed addition of dimethyl 2-diazomalonate and a thioketone, 9-fluorenethione. By studying thione analogues of these molecules, we can better understand the activity of thiiranes.

Poster Presentation 80

Understanding the culture of flamenco in Cádiz, Spain

Shaila Prasad
Major: Minor: Journalism

Mentor: Phoebe Zerwick, Journalism

Through the eyes of professional flamenco dancer Ana Gonzalez, I spent two weeks understanding the culture of flamenco in Cádiz, Spain. From the stigma and pressure that comes with pursuing a dance form as your career, pressure and support from loved ones, working to support yourself and your family to teaching other young kids to pursue their passion of dance as well. As someone who danced my whole childhood, and chose the academic path instead, I wanted to understand what that path was like for someone in a different country who did pick dance.

The use of dialectal sources in the study of Spanish etymologies

Meredith Prince
Major: Spanish

Mentor: César Gutiérrez, Spanish

Research in etymology draws upon three main data sources: written records, lexicographic works, and dialectal studies. Linguistic atlases are among the most relevant sources of dialectal information, namely because they provide precise details about the location of known and unknown linguistic variants. For the Spanish language, there are both linguistic atlases and etymological dictionaries; nevertheless, neither one of the two major etymological dictionaries available take into consideration the data collected by the linguistic atlases of the Iberian Peninsula published up to the 1990's. The purpose of this project is to apply the geolinguistic information contained in the regional linguistic atlases of Spain published so far to account for the etymology of the word hollín 'soot' and its variants in Spanish. The etymon of hollín is still controversial; in Modern Spanish the word itself shows a great deal of variation, with multiple alternative forms across the Iberian Peninsula (e.g. hollín, holguín, holingre). In this project, the data collected from the atlases will be introduced in a digital database that will allow the generation of one map with information from all of the hard-copy atlases. By determining the geographic areas in which each linguistic variant is used, we will be able to establish the genetic relations among these variants applying linguistic principles, which in turn will allow us to propose the etymology for this word. On a larger scale, this project will contribute to highlighting how large sets of dialectal data can help in the study of etymology and historical lexicology.

Cysteine-Activated Hydrogen Sulfide Donors

Jalaa Qays-Grier
Major: Chemistry

Mentor: John Lukesh, Chemistry

H2S is an important biological signaling molecule that is enzymatically expressed in mammalian systems. To further uncover its chemical biology and therapeutic utility, refined donor compounds that release H2S in a controlled and sustained fashion are needed. Herein, we describe a novel chemical framework that we propose will fit this description by supplying H2S in a controlled manner when exposed to biologically relevant levels of cysteine. The synthesis of key intermediates en route to these donors will be presented along with future directions of study once these compounds are in hand.

Adventure, Esotericism, and the Buddha: the Nepali Art Market under Neocolonial Mechanisms

Zhanyi Qi
Major: Anthropology

Mentor: Andrew Gurstelle, Anthropology
Steve Folmar, Anthropology

This project analyzes how tourist art consumption practices influence the Nepali art market, specifically the Thangka Paintings. These are paintings that depict Buddhist gods and goddesses and are often considered to embody the same sacred energy, Buddhist Dharma, as Buddhist statues. My research explores the interactions among artists, dealers, and tourists, mediated through galleries, museums, and Thangka academies, to study t the complexities of local cultural heritage preservation under global pressures. Through participant observation and informational interviews, I developed a unique understanding of how generational conflict, (over)commercialization, and globalization collectively modify the landscape of this market. Hence, my central theoretical focus is the neo-colonial mechanisms through which entities influence local art practices and the preservation and transformation of artistic expression in cultural heritage practices.

Too Good to Belong

Emma Schaad
Major: Psychology

Mentor: Shannon Brady, Psychology

Who feels like they don't belong in school? Past research on belonging has largely focused on students at risk of feeling inferior due to negative stereotypes, histories of exclusion, or perceived poor performance. Here, we consider the possibility that in some cases, students who feel superior to their peers might also experience lower belonging--essentially feeling that they are "too good" to belong. In Study 1, we asked four-year college students (N=495) recruited from the Prolific research platform, "How often, if ever, do you feel that you are 'too good' for your school?" (1=never, 5=always). Just over a fifth of students said that they sometimes (15.7%), often (5.8%), or always (1.0%) feel this way. Moreover, students' ratings of these feelings negatively predicted their belonging. In Study 2, we recruited a second, larger sample of college students from Prolific (N=1,832). We asked more explicitly, "How often, if ever, do you feel you don't belong at your school because you are 'too good'?" Still, one-eighth of students reported that they sometimes (8.3%), often (2.2%), or always (0.5%) experience this feeling. Again, students' ratings of these feelings negatively predicted their belonging. Thus, across two studies, we find that--although not common--some students do report feeling "too good to belong." These findings suggest a compelling aspect of belonging that warrants deeper exploration to enrich our understanding of this fundamental aspect of the human experience.

Analyzing Built and Natural Environments Utilizing Photogrammetry

Maxwell Schellhammer
Major: Engineering

Mentor: Tricia Clayton, Engineering

Photogrammetry is the process of digitizing real-world objects using photographs to build a dimensionally-accurate 3D model. Unlike alternatives like LiDAR, photogrammetry's power lies in its ability to precisely render objects as seen by the naked eye. Modern processing power enables unforeseen versatility and application of photogrammetry in a wide range of fields. One such application of photogrammetry is archaeology with the Lam Museum of Anthropology at Wake Forest University, housing 138 unique terracotta artifacts originating from the Bura-Asinda-Sikka region of Niger. Dr. Andrew Gurstelle is leading an international effort to repatriate these artifacts back to Niger to address the risks associated with artifact repatriation while supporting the shift of research authority to local archaeologists and communities.

With repatriation comes the risk of predation, thus this project utilized photogrammetry to create digital replicas that be embedded in blockchain for cross-referencing with the originals to ward off illicit antiquities trafficking. To capture these vulnerable objects, a studio was built with specialized lighting, a backdrop, a turntable, and a high-resolution camera, and the artifacts were photographed from multiple angles. Photogrammetry software was used to generate 22 lifelike digital models, supporting cultural preservation in the digital age. Additionally, practical photogrammetry techniques were compiled into a comprehensive handbook to increase accessibility for the Wake Forest community. Moving forward, alongside completion of all 138 artifacts through photogrammetrical training of museum employees, photogrammetry will be combined with UAVs/drones to track rapid erosion on campus with Wake Forest Facilities.

Ex Vivo Analysis of Balloon-Expandable Stent Fracture within a Peripheral-Simulating Bioreactor System

Aleyna Schuett
Meera Doran
Major: Biomedical Engineering

Mentor: Saami Yazdani, Engineering

Balloon-expandable stents are used to treat cardiovascular diseases including Peripheral Arterial Disease (PAD). Stents are susceptible to fractures due to motion in peripheral arteries. Overlapping coronary stents can treat long plaque lesions in below-the-knee disease. To date, minimal studies have focused on overlapping balloon-expandable stent fracture undergoing peripheral arterial motion. The study objective was to evaluate fractures in overlapping coronary bare metal balloon-expandable stents undergoing cyclical movement using a peripheral simulating bioreactor system.

A novel peripheral-simulating bioreactor system of 3D-printed parts and servo motors was utilized. Feasibility of the bioreactor system was evaluated using both Sylgard 184 and porcine carotid arteries. Inner diameters ranged 4.5-6mm, with average thickness of 1mm. Balloon-expandable stents (4-5mmx12-24mm) were deployed and overlapped 5mm. Tests underwent 90° twist, 120° bend, and 30mm compression in a CO_2 incubator, 6 times per minute. Fractures were analyzed using high-powered digital images and scanning electron microscopy.

In both silicone and porcine models, overlapping stents fractured under 60 hours. Stents displayed crushing and fractures near the proximal end. Further analysis showed single and multiple strut fractures, and incomplete transverse “v” gap fractures. The overlap region had no fractures.

This study shows fracture potential of overlapping balloon-expandable stainless steel stents in conditions mimicking peripheral arteries. These studies are warranted to ensure longevity of balloon-expandable stainless-steel stents in non-coronary environments. These results validate our mock arteries for fracture testing on a broad scale. This unique study provides a novel platform to determine susceptibility of implants designed to be deployed within peripheral vasculature.

Simplified Pelvimetry Score as a Predictor of the Second Stage of Labor

Sophia Sethi
Major: Psychology

Mentor: James Greenberg
Shannon Brady, Psychology

Pelvimetry assesses the size and dimensions of a woman's pelvis to help determine whether a woman can give birth vaginally. Simplified Pelvimetry Score aims to examine the coccyx, ischial spine, and pelvic arch; more simply, to determine whether a woman can give birth vaginally by assigning a score to the bones. This study examines the Simplified Pelvimetry Score (SPS) as a predictor of the second stage of labor. It also aims to investigate whether SPS becomes an alternative method to normal pelvimetry exams for OB providers, specifically in predicting second-stage labor. The participant pool was comprised of women who were more than 36 weeks pregnant and scheduled for an induction of labor. Once consented, the providers performed a routine cervical exam and assessed and measured the coccyx, ischial spine, and pubic bone to determine the Simplified Pelivimetry Score. The results for SPS have yet to be analyzed. However, the data will be used to analyze three hypotheses: SPS significantly and positively correlates to the patient's ability to reach the second stage of labor, SPS significantly and positively predicts the length of time a patient is in the second stage of labor, and SPS significantly and positively predicts the mode of delivery in the second stage of labor. This study aims to understand that the higher the SPS score, the likelihood of a more time-consuming and non-vaginal mode of delivery. Whereas the lower the SPS score, the patient is to have a quicker second stage of labor and delivery vaginally.

Do Standardized Test or High School GPA Matter More for College Success

Hongwen (Andy) Shen
Major: Economics

Mentor: Erik Nesson, Economics

Examinations, including both standardized tests and HSGPA, play a crucial role for higher education institutions in assessing applicants and identifying individuals with potential for further development. However, standardized tests are not the only criterion used by colleges for admission, and there is a lack of comprehensive studies to determine the relative importance and interactive effects between HSGPA and standardized tests. This study aims to explore the significance and relative importance of two major academic performance indicators—standardized test scores (SAT and ACT percentile ranks) and credit weighted high school GPA (HSGPA) percentile ranks—in predicting students' college GPA rankings. The findings indicate that HSGPA consistently serves as a significant predictor of college performance, while standardized test scores become equally important only when students score above the 75th percentile. These two indicators amplify each other's impact on college GPA. Additionally, regardless of whether the 50th percentile or 75th percentile is used as the cut-off, students with an above-threshold HSGPA and below-threshold test scores tend to achieve higher college GPAs than those with above-threshold test scores and below-threshold HSGPAs. The implications of these findings suggest that urgent reform is needed in the use of standardized tests, particularly due to their limited effectiveness in assessing students who score below the 75th percentile. For non-elite colleges, where students may have discrepancies on their performances on standardized tests and HSGPA, the admission should value standardized test scores only when the score exceeds 75th percentile, otherwise this criterion provides limited information without decent performance on HSGPA.

Valuing Humanity: A Study in Supported Housing, Affordable Housing, Cooperative Housing, and Social Housing Techniques for Prospective Adoption in Winston-Salem, NC

Noah Sibbett
Major: Engineering

Mentor: Tricia Clayton, Engineering
Dan Rose, Sociology (WSSU)

The City of Winston-Salem estimates that nearly 400 of its residents experience homelessness on any given night, something it has largely sought to address by allocating around 2 million dollars for housing-focused community organizations in its past two budgets. This research seeks to better optimize the City's efforts by studying how successful strategies have been implemented abroad. This was primarily accomplished by conducting institution-level interviews and housing walkthroughs with subject-matter experts (researchers, NGOs, government officials) in Finland, Denmark, and Austria. While state-level legislation limits the capacity in which local governments in NC can effect change in housing policy, several potential workarounds have been identified. After a preliminary review of the services offered locally, a need is identified for supported housing units with no sobriety requirement. It is additionally recommended that the City actively invest in cooperative housing opportunities and adopt a target for new housing developments to consist of 25% affordable units. This research also identified a need for greater cooperation between community organizations. The money provided to the city and county as part of the NC Opioid Settlement disbursement is recommended as a short-term funding mechanism for the proposed changes, but long-term sustainability will hinge upon the City's ability to transition away from emergency services. This research is ongoing as each of my contacts continues to connect me with other experts. I will be seeking to enact these recommendations over the next three years as a member of the City's Affordable Housing Coalition.

Using analytical chemistry to better understand nuclear waste after the Fukushima Daiichi disaster: An investigation of factors controlling the kinetic inertness of actinyl-phenanthroline dicarboxylate complexes

Dani Simon
Major: Chemistry with a concentration in Medicinal Chemistry and Drug Discovery

Mentor: Christa Colyer, Chemistry

The nuclear accident at the Fukushima Daiichi nuclear power plant in Japan on March 11, 2011 was devastating to the area. In order to make the land habitable, identification of contaminants and determination of amounts of radioactive ions present in the area are required. The Saito laboratory at Saitama University in Japan is particularly invested in addressing this problem and is currently working on using phenanthroline dicarboxylate to bind the heavy radioactive ions, making them kinetically inert. I was able to join the Saito lab for six weeks over the summer as a Richter Scholar, with the goal of contributing to their research mission. As a part of the Saito lab, I focused on using polyacrylamide gel electrophoresis (PAGE) to study reaction kinetics using nonradioactive lanthanides as models of radioactive actinyl ions for safety purposes. However, the data from these experiments were inconclusive because the PAGE band intensities were inconsistent with the analytes' concentrations and incubation times. An energy decomposition analysis (EDA) was also performed in order to model the mechanism of the release of the radioactive actinyl ions from a phenanthroline dicarboxylate complex. It was proposed that the rotation of a carboxyl group by 90° would trigger the release of the actinyl ion. Further studies are needed to determine if the electrostatic energy was substantial enough to cause the release of the ion. In the longer term, this research aims to improve environmental and human health in the region of Japan near my research location.

The Role of Perineuronal Nets in Opioid Addiction Susceptibility

Louisa Simpson
Major: Psychology

Mentor: Brittany Kuhn, Medical University of South Carolina Department of Neuroscience

Understanding the physiological mechanisms behind opioid use disorder (OUD) may aid in establishing better treatments. In addition, developing new models that account for the diversity in OUD criteria may create better representations of the variation within human addiction. Though many regions are implicated in addiction, prelimbic cortex (PrL) signaling to the nucleus accumbens (NAc), and in turn the ventral pallidum (VP), are among the most important. Maladaptive changes in these regions by opioids require more research. Opioid-induced plasticity of extracellular matrix components (ECM) has been implicated in relapse, but the role of perineuronal nets (PNNs) in mediating opioid relapse is not known. Heterogenous stock rats (NMcwiWFsm:HS; n=46) underwent heroin (Females, n=20; Males, n=18) or saline (Females, n=4; Males, n=4) self-administration training for three weeks, followed by tests of motivation, primed and cued reinstatement, and extinction. Animals were sacrificed either 24 hours after the last extinction session or immediately following the 15-minute cued reinstatement test to accurately measure transient synaptic plasticity. Using a non-linear network-based clustering analysis, rats were separated into clusters: vulnerable, intermediate, and resilient. Immunohistochemistry staining with Wisteria floribunda Agglutinin (WFA) 488 identified PNN prevalence. Regions of interest for PrL and VP were imaged via 10x tile scans with a Lecia Stellaris SP5 Confocal Microscope. Imaris was used to automatically quantify PNNs. General trends in the data were consistent with our hypothesis; PNNs appeared less prevalent for vulnerable reinstated animals, but similar for cued and extinction groups in resilient subpopulations, implying that PNNs may be protective against addiction.

A comparison between indoor air quality of high-traffic mosques in the United Arab Emirates and Egypt

Mai Soliman
Major: Biochemistry and Molecular Biology

Mentor: Debbie French, Department of Education

While air quality is a significant public health issue in the United Arab Emirates (UAE) and Egypt, the contributing factors vary. The use of incense, air conditioning, vehicle emissions, and outdoor air quality may influence indoor air quality. The UAE and Egypt are Islamic countries, with mosques being visited multiple times daily. Therefore, this project acts as a preliminary study to examine three comparisons: the indoor air quality of mosques in Dubai, UAE, and Cairo, Egypt; each city's mosques to the World Health Organization (WHO) standard of poor indoor air quality; and the relationship between the indoor air quality level with the outdoor air quality in each city. Measurements of particulate matter (PM), volatile organic compounds (VOC), and overall air quality levels are the basis of the comparison. Data was collected from 16 mosques in Cairo and Dubai using the ATMO Tube Pro monitor during prayer. Outdoor air quality measurements were also taken outside the mosques using the same device. Cairo had a higher PM and VOC level than Dubai and the WHO limit. There was a statistical difference between indoor and outdoor air quality in Dubai but not in Cairo. There were no significant differences in air quality between men's and women's prayer sections in both cities. Dubai’s reliance on air conditioning and Cairo’s infrastructure may impact indoor air quality. However, limitations such as the small sample size suggest further research is necessary to fully understand the factors affecting mosque air quality and their potential health impacts.

Insights into Age-Dependent T Cell Response to Respiratory Syncytial Virus using a T cell receptor (TCR) Transgenic Mouse Model

Sophie Staugaitis
Major: Health and Exercise Science

Mentor: Allison Malloy, Department of Pediatrics

Respiratory syncytial virus (RSV) poses a significant health threat to infants and the elderly. While CD8 T-cells are crucial for clearing RSV, the age-related activation and memory formation of these cells are not fully understood. CD8 T-cell activation and proliferation are regulated by the interaction between the T-cell receptor (TCR) and major histocompatibility complex I (MHC-I) on T-cells and antigen-presenting cells (APCs). To explore this dynamic, a TCR transgenic mouse model was engineered to recognize an epitope in the RSV matrix protein (DbM187-195). These transgenic T-cells proliferate in response to the M-peptide, providing a measurable indicator of antigen availability.

To quantify the DbM187-195 epitope presented, various doses of the M187-195 peptide were titrated *in vitro* using lung cell suspensions, followed by the introduction of TCR transgenic T-cells labeled with a proliferation dye. Flow cytometry was used to track T-cell proliferation through the dilution of the dye as cells divided. A peptide dose curve was generated to analyze the proliferation of M-specific TCR transgenic T-cells in lung homogenates at 4, 6, and 8 days post-RSV infection in neonatal and adult mice. This comparison allowed us to measure antigen specificity in CD8 T-cells co-cultured with APCs.

Our findings suggest that antigen availability from APCs significantly impacts the proliferation of M-specific CD8 T-cells. These insights enhance our understanding of T-cell sensitivity and specificity, which are critical for developing vaccines and improving immune responses against respiratory pathogens.

Event Related Potential Markers of Attentional Flexibility

Yiwei Tang
Major: Psychology

Mentor: Anthony Sali, Psychology

Attention is the process through which task-relevant or physically-salient stimuli are prioritized while irrelevant stimuli are suppressed. To maximize performance, individuals must be able to selectively suppress prepotent irrelevant stimuli and redirect their attention according to task requirements. Attentional flexibility, the capacity to shift attention among spatial locations, varies over time in response to changes in the demands of the environment. Understanding the learned adjustment of attentional flexibility is crucial for understanding both normal and disordered behavior. Anxiety impairs attentional control by weighing more on stimulus-driven attentional system and less on goal-directed attentional system. Moreover, individuals with anxiety preferentially attend to or are slower to disengage from threat-associated contexts. The worry caused by anxiety also preempts the processing and storage capacity of working memory, which also impedes attentional flexibility. By employing EEG, this study aims to identify the neurological mechanisms for impaired attentional flexibility in individuals with high trait anxiety. In an initial training phase, participants were shown streams of neutral images with embedded threat-associated images. For each participant, the threat-associated images were most likely to appear at a particular time interval. Participants indicated the direction of rotation of embedded rotated neutral images. In the testing phase, participants were shown continuous streams of numbers. Participants were cued to shift or hold their attention at time intervals that were previously associated with threat and neutral stimuli. It was hypothesized that participants with higher anxiety would learn to be more attentionally stable (slower to shift attention) at the previous threat-associated time interval.

Immigrants in the South: A Healthcare View

Brithany Teran-Boza
Major: Health and Exercise Science

Mentor: Andera Gomez-Cervantes, Latin American Studies

The purpose of this study is to analyze the role that immigration status plays in the health of Latino immigrants in the United States. It aims to answer the question, How does immigration status affect the health of Latino Immigrants in the United States? The goal is to analyze the impact of immigration policies, health disparities, health care access and the impact of legal status on health. Social and institutional contexts, such as employment, housing, healthcare access, and food insecurity, deeply influence the well-being of an immigrant. It aims to examine how immigration policies in the United States have historically criminalized and racialized immigrants which in turn affect immigrant health. Immigration Customs Enforcement (ICE) raids, detentions, and deportations create significant stress, fear, and anxiety, leading to negative health outcomes. The fear of deportation, especially those undocumented, avoid seeking healthcare due to fears of deportation and mistrust of authorities, exacerbated by programs like 287(g) that link local law enforcement with ICE. Finally, in an attempt to address these gaps, a “Third Net” of free or low-cost care, including mobile and pop-up clinics, provides essential services to those excluded from the formal healthcare systems. These factors combine to create stark inequalities and vulnerabilities for Latino immigrants, especially the undocumented. The research focuses on North Carolina, where over half of the foreign-born population are noncitizens, about half of noncitizens lack health insurance, nearly half live below the 200% poverty line, have low homeownership rates and report low rates of English proficiency.

Poster Presentation 96

A Comparative Analysis of Clinical, Regulatory, and Engineering Performance Metrics for Prosthetic Heart Valves

Katherina Tsai
Major: French Studies

Mentor: Olga Pierrakos, Engineering

Prosthetic heart valve (PHV) designs have evolved considerably over the past decades with the emergence of percutaneous and transcatheter valves. Hemodynamic performance metrics have also evolved during the past decades and we can gain considerable insights comparing performance metrics across clinical practice, engineering testing standards, and recent research. In fact, heart valve performance metrics have transcended beyond transvalvular metrics and now include a more holistic evaluation of ventricular performance in the presence of PHVs.

This investigation comparing clinical, engineering, regulatory, and research performance metrics pertinent to assessing both heart valve performance and ventricular performance in the presence of a PHV has revealed opportunities for future research and implications for clinical and regulatory practice. One such opportunity is to identify and understand performance metrics that can bridge clinical metrics and regulatory metrics. Another opportunity is the inclusion of new performance metrics to evaluate the efficacy of PHVs in the heart.

Examining ADHD Diagnosis and Cannabis Use Frequency: The Role of Family Environment in a Nationally-Representative Sample

Holland Tyson
Major: Psychology

Mentor: Mason Garrison, Psychology

The relationship between cannabis use and Attention-Deficit/Hyperactivity Disorder (ADHD) involves complex genetic and environmental factors. Research indicates parenting characteristics and the home environment influence cannabis use (Mulligan et al., 2013). However, measures like the Home Observation for Measurement of the Environment (HOME) capture more than just the "shared environment", absorbing other between-family variance. Extending our prior work (Tyson, Webster, & Garrison, 2024), we incorporated the HOME measure to examine the ADHD-cannabis use relationship. Using the nationally-representative Children of the National Longitudinal Survey of Youth (NLSYC), we explored associations at both between- and within-family levels utilizing siblings and cousins. Without accounting for family structure, the classic approach found an association between ADHD and higher cannabis use, even after controlling for the HOME. At the between-family level, only dyads where at least one sibling had ADHD were associated with higher cannabis use. No significant associations were found at the within-family level. Using the HOME across childhood, we lost a lot of nuance which could be reflected by no significant associations. Regardless, our results show that cannabis use is not caused by an ADHD diagnosis or the home environment.

References:
Mulligan, A, Anney, R, Butler, L, O'Regan, M, Richardson, T, Tulewicz, EM, Fitzgerald, M, & Gill, M (2013). Home environment: Association with hyperactivity/impulsivity in children with ADHD and their non-ADHD siblings. *Child: Care, Health and Development, 39*(2)
Tyson KH, Webster EE, Garrison SM (2023) Unpacking The Link Between ADHD and Cannabis Use: A Sibling Comparison Approach. *Behav Genet 53* (6)

Optimization of Collection Methods for Local Mosquito Surveillance

Erica Vazquez
Major: Biology

Mentor: Regina Cordy, Biology

Three primary mosquito genera are found in North Carolina: *Aedes*, *Anopheles*, and *Culex*. These mosquitoes can carry parasites that can transmit diseases like Malaria. This study aims to explore the relationships between mosquito genera, climate, parasitic prevalence, and trapping methods. There are three trap styles, including the sentinel style trap which involves setting up a trap on the ground. There is also the encephalitis vector survey trap (EVS) style trap, where dry ice is used in conjunction with a mosquito trap that is hung in the air. Lastly, the Center of Disease Control (CDC) style trap involves the use of a carbon dioxide (CO2) gas tank, light emitting diode (LED) light strip, a battery pack, and a sweetscent package. Out of all of these methods, the CDC-style trap emerged as the most effective, utilizing the Biogents-Pro Trap without the LED strip. Six collections occurred over the span of 3–4 days between July 15 and August 5. On the last catch day for each collection, specimens were freeze-killed and identified on the genus level based on morphological traits. The CDC style trap yielded the highest percentage of mosquitoes to total caught insects. Additionally, the percentage of *Culex* mosquitoes to total caught seemingly increased over time relative to the yield of *Aedes*. Future research will employ metagenomic sequencing to determine precise species and identify the parasites carried by the mosquitoes. To further analyze the relationship between climate and mosquito diversity, traps will be set up within the Pilot Mountain State Park.

Data-Centric Artificial Intelligence for Environmental Toxicology

Yimin Wang
Major: Computer Science

Mentor: Natalia Khuri, Computer Science

The main objective of this project was to investigate the performance of data-centric artificial intelligence for the prediction of endocrine disrupting chemicals. Data about environmental chemicals, which were tested for toxicity as part of the US EPA EDCS program, were downloaded, cleaned and preprocessed. Next, several predictors were trained with the state-of-the art machine learning algorithms. While holding the parameters of the best classification models fixed, data-centric approaches were tested to derive the best performing subset of the training data. These small, weighted subsets of training data that approximately preserve the properties of the entire dataset are called coresets. To derive coresets, we used an optimization algorithm inspired by the principles of natural selection and genetics, called “Genetic algorithm”. It is an optimization technique. Finally, we investigated how optimization parameters influenced the quality and size of coresets and the accuracy of predictors. Our results indicate that models trained with coresets perform similarly to the models trained with all of the available data.

Localization of ARL Proteins in N18TG2 neuroblastoma cells

Xi Wang
Major: Biochemistry and Molecular Biology

Mentor: Allyn Howlett, Translational Neuroscience

Cannabinoid Receptor Interacting Protein 1a (CRIP1a) selectively binds to the CB1 cannabinoid receptor (CB1R), a G protein-coupled receptor that modulates synaptic transmission and neuronal function. CRIP1a is structurally similar to UNC119, and both bind to lipidated G proteins: Galpha-i and transducin, respectively. UNC119 trafficks myristoylated transducin within primary cilia, critical for cellular signaling and development. ARL (ADP-ribosylation factor-like) proteins regulate dissociation of the G protein from UNC119 within the cilia. This study aims to identify which ARL proteins are expressed in neuroblastoma cells and estimate where in the cell ARL proteins are localized.

Using N18TG2 mouse and SH-SY5Y human neuroblastoma cells, we fractionated post-nuclear homogenates and used Western blotting to assess the distribution of ARL proteins. In N18TG2 cells, ARL1, ARL2, ARL3, ARL13A, and ARL13B were predominantly found in the 40kxG supernatant, while ARL8A and ARL8B were associated with the particulate fraction. In SH-SY5Y cells, ARL2, ARL3, and ARL13A distributed between both fractions, with ARL8B localized in the particulate fraction and ARL13B in the supernatant. Immunocytochemistry revealed ARL13B staining in nucleus of N18TG2 cells, while ARL3 was predominantly detected in cytoplasmic region. Results revealed the co-localization of CRIP1a and ARL proteins in similar parts of the cell, indicating potential interactions.

Understanding the distribution of ARL proteins in neuroblastoma cells may offer new insights into ARL-regulated CB1R and CRIP1a processes, and their involvement in primary cilia functions may have implications for ciliopathies.

*Supported by WFU Biology Department Microscopic Imaging Core, URECA fellowship and NIH R01-DA042157.

From Debris to Masterpiece: Xu Bing's Visual and Cultural Transformations in Background Story

Xinyu (Lavender) Wang
Major: Art History

Mentor: Ruiying Gao, Art History

Xu Bing, a contemporary Chinese artist, is internationally recognized for his artistic exploration of languages and cultural identity. While his word-related works have been widely studied, scholarship on the Background Story series remains limited. In these works, Xu Bing recreates traditional Asian paintings in front of a lightbox, using cardboard, branches, and other debris behind the scenes. This paper focuses on Xu Bing's latest installation, Background Story: Autumn Colors on the Qiao and Hua Mountains, featured in the exhibition Xu Bing: World Alchemy at Asia Society Houston. I argue that this installation represents a formal and cultural innovation within the series, marking a significant turning point. Through fieldwork and formal analysis, I will demonstrate the visual complexity of the transformation from disordered materials into a cohesive painting. Notably, this is the first time Xu Bing incorporates a projector to reveal seals and inscriptions gradually across the painting's surface. By conducting a historical analysis of the original painting by Zhao Mengfu, this paper explores the relationship between words and images, further indicating the cultural significance of transmission history. The Background Story installation functions as a visual centerpiece within the exhibition, inviting viewers to reconsider notions of tradition, authenticity, and cultural identity.

Canopy Vision: Automated Palm Detection in the Amazon Rainforest?

Manqi Wang
Major: Biology

Mentor: Miles Silman, Biology

In this project, I focused on the collection of high-resolution UAV imagery and data annotation to support the automated detection and analysis of palm trees in the Amazonian tropical rainforest. Using a DJI Phantom 4 RTK drone, we conducted multiple flights over dense forest canopies, capturing precise orthomosaic imagery that formed the basis for palm tree identification. The collected data was then processed using ArcGIS to create detailed geospatial maps. Subsequently, I utilized Anylabeling, an annotation tool, to manually mark palm trees within the images. These labeled palm points were crucial in generating training datasets for machine learning models used to automate palm detection, including those developed as part of PalmProbNet, a deep learning framework. This framework employs transfer learning techniques and probabilistic modeling to detect palm distributions, even in challenging environments with overlapping canopies and variable lighting. The data and labels provided from this subproject contributed to increasing the accuracy and robustness of the model, aiding in the detection of palm trees with an accuracy of over 97%. My work enhanced both the precision and scope of palm tree analysis in a complex tropical ecosystem, demonstrating the value of combining UAV technology and machine learning.

Increased expression of Piezo2 and TRPM8 in *TrkA* knockout mice

Elodie Wardle
Major: Chemistry

Mentor: Juan Carlos Arévalo, El Instituto de Neurociencias de Castilla y León

Pain can be beneficial in the short term; it protects the body from harmful situations and gives it time to recover. However, pain can also become chronic, reducing the protective benefits and instead creating economic and social burdens. It is key to understand the molecular mechanisms involved in pain sensitivity in order to understand how to treat chronic pain. Previous research has found that, compared to the wild type mice, heterozygous mice with a *TrkA* knockout are more sensitive to the cold. As such, it was hypothesized that there is a connection between *TrkA* and pain sensitivity. Immunofluorescence stainings were conducted to examine the expression of *TrkA*, Piezo2 (a protein involved in mechanoreception), and TRPM8 (a protein involved in cold detection) in *TrkA* knockout mice. Preliminary stainings show that Piezo2 and TRPM8 had an increase in expression in heterozygous mice when compared to the wild type mice, suggesting *TrkA* plays a role in regulating the levels of Piezo2 and TRPM8, and therefore in regulating a mouse's sensitivity to cold. This is consistent with past behavioral results. However, there was little specificity in the stainings, so further tests must be done to ensure the widespread increase in expression results from the knockout of *TrkA* and not a procedural error or a problem with the antibody. Repeat stainings and quantitative tests on Piezo2 and TRPM8 in relation to *TrkA* are necessary to gain a deeper understanding of the molecular mechanisms behind the behavioral patterns previously identified in the Arévalo lab.

Impact of Mitochondrial Genome Heterogeneity on Endurance Exercise Training Response

Harry Wei
Major: Biochemistry and Molecular Biology

Mentor: Bumsoo Ahn, Internal Medicine, Gerontology and Geriatrics, Wake Forest University School of Medicine

Sarcopenia is an aging-associated skeletal muscle disorder characterized by the loss of muscle mass and function. To date, no pharmacological intervention has been approved, and endurance exercise training remains as the only remedy that preserves aging muscles. However, individuals tend to show a wide variation of training-induced responses to the same endurance exercise program, which makes it impractical to consistently achieve optimal training effects among older adults. Mitochondria is a key contributing factor in endurance exercise training response, since the inhibition of mitochondrial electron transport chain activity blunts training responses. Hence, we investigated the impact of mitochondrial genome heterogeneity on endurance exercise training responses. OKC-HET^{B} and OKC-HET^{W} rats, rat models with identical nuclear genotypes but divergent mitochondrial genomes, were subjected to 8 weeks of voluntary wheel running. While no exercise amount differences were reported, the male OKC-HET^{W} rats exhibited considerably higher training-induced exercise tolerance than the male OKC-HET^{B} rats, and the female OKC-HET^{W} rats demonstrated higher motor coordination improvements than the female OKC-HET^{B} rats. Consistently, the post-training mitochondrial oxygen consumption rates of the OKC-HET^{W} rats were higher. The OKC-HET^{W} rats also had moderately higher mtDNA deletion mutation frequency, an indicator for a tolerable amount of ROS that stimulates training-induced improvements. The acetylcholine receptors of the OKC-HET^{W} rats were also less fragmented. Collectively, our data revealed the substantial impact of mitochondrial genome on responses to endurance exercise training. Our study shines light on the potential of improving exercise-based interventions against sarcopenia by manipulating mitochondria, which is still a highly underexplored topic.

Coffee, Tea, and Tourism: Analyzing How Taiwan's Globalization Has Shaped Language through a Linguistic Landscape Study

Ally Werstler
Major: Chinese Language and Culture

Mentor: Qiaona Yu, Chinese

In 2018, Taiwan announced a bilingual policy entitled Bilingual Nation, aiming to incorporate English in tandem with Mandarin by 2030 to aid in the country's globalization. This government initiative as part of Taiwan's globalization effort is likely influenced by international tourism. My Richter Scholarship research looked at Taiwan's rapid globalization through a Linguistic Landscape study approach. The study of Linguistic Landscape refers to research about the presence, representation, meanings, and interpretation of language displayed in public places. To understand Taiwan's complex linguistic landscape I traveled to six different cities throughout Taiwan. Three of these cities were high-tourism destinations and the other three were low-tourism cities. Boba tea and coffee shops were used as sites of research where the collected digital images of external and internal signage and other goods containing a language component were used as deliverables of the city's Linguistic Landscape. By comparing the different location's usage of multilingualism and presentation of language, my research improved our understanding of how English, Mandarin Chinese, and other languages operate in an increasingly globalized Taiwan. My project "Coffee, Tea, and Tourism: Analyzing How Taiwan's Globalization Has Shaped Language through a Linguistic Landscape Study" found that English regularly operates in high and low-tourism cities as a symbolic script of globalization in the Taiwanese public space.

Poster Presentation 106

Examining the Mechanical Properties of Hydrated, Electrospun Fibrinogen and Polycaprolactone Blends

Walker Wilkins
Major: Physics

Mentor: Martin Guthold, Physics

Electrospinning is a promising method of manufacturing nanofibers on a large scale with finely tuned mechanical properties. Fibrinogen and polycaprolactone are especially intriguing materials in the field of tissue engineering, as both could potentially construct scaffolds for building new tissue in the case of traumatic injury.

By testing the mechanical properties of these electrospun fibers in wet conditions similar to real trauma sites, we are able to predict how fibers, scaffolds, and the cells grown upon them may behave in tissue engineering applications. Former experiments have examined blends of fibrinogen and polycaprolactone in dry conditions, but it appears from preliminary examination that the presence of a liquid buffer significantly increases the softness and extensibility of these fibers.

We tested the fibers by means of Atomic Force Microscopy, which essentially uses a very fine needle to make microscopic manipulations on the fibers, and it is able to measure the minute forces applied in the manipulation. Due to the very precise nature of the measurements, the AFM tips are very fragile, and testing in wet conditions makes them prone to breaking from turbulences in the fluid medium. As such, I have not been able to test all of the fibers I set out to test, though I have collected a good deal of the data and have begun to analyze the tendencies. The presence of a liquid buffer softens the fibers, which is in keeping with similar prior research.

The Anthropology of Accessibility

Annelise Witcher
Major: Anthropology

Mentor: Andrew Gurstelle, Anthropology

Photogrammetry is the process in which a 3D model of an object or landscape is rendered from hundreds to thousands of images captured from all different angles. In anthropology, photogrammetry is sometimes used to recreate artifacts or museum objects to allow for research, repatriation, or accessibility purposes. Partnered with the Lam Museum of Anthropology, I experimented with photogrammetrical techniques in order to render and print out 3D models of museum objects. These 3D-printed objects allow for patrons, particularly those who are blind, to experience and interact with exhibits the same way abled patrons are able to.

Electrophysiologic Monitoring of Oxidative Stress in Jurkat Cells

Xen Woods
Major: Engineering

Mentor: Erin Henslee, Engineering

A cell's basic functions, characteristics, and structure can be characterized by its electrophysiological properties. Dielectrophoresis (DEP) is a label-free tool used to analyze and measure these properties of a cell. Specifically, the 3DEP system was developed to provide real-time monitoring of DEP properties to discern subtle differences in cells. This work explored the application of 3DEP in monitoring the cell response of oxidatively stressed Leukemia cells (Jurkats), to better understand the mechanistic features of oxidative stress. Cells were treated with hydrogen peroxide at 10M and 100Mfor two hours and then monitored by 3DEP. Results indicated there was a significant increase in the membrane conductance and decrease in the cytoplasmic conductivity for the 100M treatment, with only a subtle decrease found in the membrane capacitance. This is in agreement with previous work done on apoptosis (cell death) studies on these cells. Encouragingly, the differences observed in this OS study were of smaller magnitude than this previous work, indicating we can observe damage in cells through these properties, and not just cell death. There appears to be a dose limitation however, as we weren;t able to detect significant changes in the 10M treatment group. Future work will investigate die thresholds and other mechanisms of OS in these cells.

Quantifying Bone Loading Exercise Adherence in Mitigating Bone Loss

Jamie Wu
Major: Health and Exercise Science

Mentor: Kristen Beavers, Health and Exercise Science

Background: Osteoporosis is a major health concern that can cause potential bone fractures when fall. To address the challenge of preserving bone health while conducting weight reduction, we hypothesize that resistance training (RT) and bone-loading exercise and/or bisphosphonate use will minimize loss of hip areal bone mineral density among older adults. Thus, the purpose of this project is to measure the compliance of bone-loading exercise through literature review and data analysis to advance the overall understanding of bone-loading exercise. Methods: 34 overweight elders are randomly assigned to the group that receives RT with alendronate and the group that receives RT with placebo. Participants are divided into three waves that attend exercise sessions three days a week. The prescribed bone loading exercises include stair climbs, box steps, and single leg hop/heel drop (SLH) with the use of weighted vests. Results: Of 10 participants in wave 1, 50% met the requirements for stair climb, 45.7% for box steps, and 43.7% for SLH. Of 10 participants in wave 2, 89.1% met the requirements for stair climb, 87.6% for box steps, and 81.4% for SLH. Of 14 participants in wave 3, 87.1% met the requirements for stair climb, 84.5% for box steps, and 81.1% for SLH. Conclusion: While monitoring the data in real time, the participants are generally compliant. Wave 1 has the lowest percentage of meeting bone loading requirements, wave 2 has the highest percentage, and wave 3 has the percentage in between.

The Origins, Practices, and Relationships of the Two-Stringed Bowed Fiddle Across East Asia

Haozhen Xu
Major: Music

Mentor: Stewart Carter, Music

As contemporary East Asian nation-states—namely China, the Koreas, Japan, and Vietnam—seek to distinguish their cultural identities from the broader Sino-sphere, East Asian musical culture, like language, art, and philosophy, has become a point of debate regarding its originality and historical significance. Consequently, investigations into the origins of musical instruments have gained attention not only in musicology but also due to their broader political implications. This paper argues that two-stringed bowed fiddles are transnational instruments that evolved as symbols of folk entertainment. Although these instruments share physical and functional similarities, they differ in materials, timbre, and stylistic use across East Asia. The lack of historical records concerning their origins emphasizes their role as cultural artifacts focused on popular entertainment, rather than ceremonial or courtly music. Historians and musicologists in China and Japan offer different theories. The Chinese school claims that the erhu originated from Han communities, gained popularity in the Song dynasty, and spread to Korea and Japan. Conversely, the Japanese school argues that the kokyu derives from the Japanese shamisen, which evolved from the Chinese sanxian. This paper challenges the Han-origin theory, asserting that two-stringed bowed fiddles are transnational, lacking a singular political identity. Moreover, these instruments resist modern nation-states' efforts to nationalize cultural artifacts, instead embodying a cross-cultural identity shaped by the shared contributions of people in the broader Sinic world.

Marital Status and Labor Market Outcomes: A Gender-Based Analysis

Qiaoou (Jasmine) Xu
Major: Economics

Mentor: Leah Lakdawala, Economics

This paper investigates the gender wage gap using both Ordinary Least Squares (OLS) fixed-effects estimation and the Wasserstein distance method to analyze labor market outcomes by gender and marital status. The motivation stems from the observation of a persistent gender wage gap, even after adjusting for inflation. OLS is applied to estimate the mean wage differences between men and women across marital status groups, controlling for factors such as Metropolitan Statistical Area (MSA), industry, education, age, and number of children. To provide a more comprehensive understanding of gender-based disparities, I apply the Wasserstein distance to assess the overall difference between wage distributions, accounting for both magnitude and probability. Simulating the marital status benefits that men experience and applying them to women narrows the mean wage differences, explaining 64% of the gap. The remaining 36% of the overall gender gap is attributed to women having different observable characteristics compared to men. This indicates that gender disparity is significantly influenced by differences in characteristics such as marital status, education level, or occupational choices. The findings highlight the importance of addressing these characteristic differences to reduce the wage gap and promote gender wage equality. Additionally, it is important to note that although 64% of the gap is explained through mean calculation, the overall distance between wage distributions remains substantial.

Production Analysis of Ceramic "Toys" in the Changsha Museum Collection

Zhiqiu Ye
Major: Anthropology

Mentor: Andrew Gurstelle, Anthropology

The Tongguan Kiln is an archaeological site from the late Tang Dynasty (618-907 CE) located in Changsha, Hunan province, China. The Changsha Ware ceramics produced at the kiln are well known for their range of utilitarian forms and their Central Asian decorations. Scholars have primarily studied Changsha Ware in relation to its distribution and consumption outside of China. However, it is also famous for producing toys and writing accessories in a considerable range of forms. These forms vary in function from whistles to paperweights, and vary in style from chickens to acrobats, showing the diversity of people's daily lives in the Late Tang Dynasty. I conducted artifact analysis on ceramic figures from the Tongguan collections in the Lam Museum, to investigate how ceramic figures were manufactured. The present research study investigated five categories of defects: glazing issues, physical defects, irregular forms, abrasion, and roughness. The goal is to determine the criteria for how ceramics were discarded and thus postulate what successfully manufactured ceramics look like. My results showed that glaze issues, irregular forms, and physical defects are the most frequent defects in the Lam Museum and Changsha Museum samples. The glaze is the most critical determinant of a successful figure, similar to what has been observed for the better studied utilitarian forms. This contrasts with the ceramic toys, whose physical defects and irregular forms are more likely to be evidence of the hand-made production method, and evidence that these artifacts were not subject to the same production standards.

Point-searching on projective curves over number fields

Flora Yi
Major: Mathematics and Computer Science

Mentor: Jeremy Rouse, Mathematics
Jacob Mayle, Mathematics

In this project, we developed code that searches for K-rational points of a specified height (which measures the complexity of a point), on a given projective curve C defined over a number field K.

The algorithm takes the approach described in C.L. Turner's PhD thesis (also M. Watkins's notes), which involves lifting points modulo an ideal p, searching for vectors in integer lattices, and evaluating points on the curve. An improvement from the previous approach is optimizing the runtime by considering the ideal to work with. Our code computes a work estimate (heuristically, based on runtime data gathered) of lattice construction and vector search for each potential ideal. Selecting an ideal which minimizes the work estimate results in significant runtime reduction.

Further improvements can be made to the work estimation, including that of a more rigorous and involved computation. The code is implemented in Magma, and available on GitHub (PointSearchNumberFields).

Electrophysiology-based sorting of heterogeneous glioblastoma multiforme

Ella Yoder
Major: Engineering (Biomedical concentration) and Neuroscience minor

Mentor: Erin Henslee, Engineering

Glioblastoma multiforme is the most common malignant tumor of the central nervous system. It is the most aggressive and invasive brain cancer, with a 5-year survival rate at a mere 5% and a median survival at less than 15 months. Standard therapies include surgical resection, high-dose external-beam radiation therapy, and regional or systemic chemotherapy. However, there is still no known cure. The difficulty in glioblastoma treatment derives from its massive intertumoral molecular heterogeneity, which current treatments fail to address. Due to the widely variable cell types in glioblastoma tumors, targeted therapies are challenging, as it is difficult to effectively target all tumor cells. Glioblastoma heterogeneity has been studied in terms of variations in the morphology and proliferative capacities of different tumor populations, but current therapies that rely on these characteristics for isolating cancers are often invasive, dangerous, or painful. Little is known about differences in electrical properties of glioblastoma, but these parameters could provide novel means of isolating different populations to pilot therapies.

In this study, a CytoRecovery machine was used to sort the glioblastoma multiforme into three subpopulations based on the cells' various trapping frequencies. Zeta potential was measured with the ZetaAnalyzer; and average cell cytoplasmic conductivity, membrane conductance, and membrane capacitance were recorded with the 3DEP. Experiments have revealed relationships between subpopulations' electrophysiology and invasiveness; and serve as a first step for determining a correlation between metastatic potential and cellular electrophysiology. A better understanding of glioblastoma heterogeneity is essential to design effective therapies for this devastating cancer.

Synthesis of Mycothiol and Bacillithiol for probing redox reactions with nitroxyl

Yang Zeng
Major: Chemistry

Mentor: Stephen King, Chemistry

Low molecular weight (LMW) thiols regulate the redox environment in biological systems, given their potent nucleophilic and reducing properties. Glutathione (GSH) is the major LMW thiol found in most mammals and bacteria and protects cells from damage caused by reactive oxygen species (ROS) and reactive nitrogen species (RNS). Some Gram-positive bacteria do not produce GSH but instead produce bacillithiol (BSH) and mycothiol (MSH). BSH and MSH are structurally similar, and participate in redox hemostasis in their respective environments. Despite being lesser-known, the biochemical role of these thiol speciess are equally essential. Understanding their roles potentially aids the development of novel treatments for diseases caused by these bacteria.

Nitroxyl (HNO) is the one electron-reduced and protonated form of NO, possessing noteworthy redox and electrophilic properties. HNO can both donate and accept an electron, allowing it to participate in a range of redox reactions. HNO reacts with thiols to give disulfides or sulfinamides. Previous work by our group establishes distinct reactivity of HNO with GSH and BSH. However, more work needs to be done to understand the reactivity in a more fundamental way.

We describe further synthetic and analytical studies on BSH and MSH to better define the structural features that determine the reactivity. The successful synthesis of both BSH and MSH in significant amounts provides enough materials for study. The use of 4,4'-Ddithiodipyridine enables us to see the sulfinamide vs disulfide ratio in a more direct way.

Sparsity Preserving Tucker Decomposition

Lixun Zhang
Major: Computer Science

Mentor: Grey Ballard, Computer Science

Many applications in data science and scientific computing involve very large and extremely sparse datasets that are difficult to load in memory and to manipulate. However, these datasets often possess inherent multidimensional structure that can be exploited to compress and store the dataset in an appropriate tensor format. We develop a sparsity-preserving Tucker tensor decomposition algorithm with randomization that preserves the structure and sparsity of the original tensor. The idea in our algorithms is to perform randomized sketches with Kronecker-structured random matrices, which reduces computation compared to unstructured matrices and can be implemented using a modified fundamental sparse tensor computation. We also develop a randomized algorithm for computing the approximation error. We consider several different datasets for our numerical experiments, both synthetic sparse, low-rank test tensors and realistic applications such as the word counts in the Enron email dataset and comments in the MovieLens dataset from Yahoo.

Physics-Informed Modeling of Complex Dynamic Systems from Data

Scott Zhao
Major: Applied Statistics

Mentor: Huan Lei, Department of Computational Mathematics, Science and Engineering at Michigan State University

Predictive modeling of agent dynamics in various physical systems is an important research problem across many disciplines. From small-scale interactions of macromolecules to the orbits of objects in space and even extending to the movement of people and ideas in society, learning the governing equation of a system can give us a greater understanding of the physical insight. However, it can be difficult to compute or analytically solve for the exact underlying interaction law controlling a system's behavior. The goal of this research is to develop an effective way to infer interaction laws governing an agent system. For this project, the researcher first simulated the dynamics of ordinary differential equations in order to synthetically generate time-series trajectory data with a chosen interaction law. Using this data and principles developed from deep learning neural networks, an interaction kernel function can be calculated to estimate the interaction law governing the observed paths. Performance on opinion dynamics interaction kernels illustrates that such a data-driven estimation can not only accurately predict interaction laws, but can also ensure numerical convergence and adaptivity. Ultimately, this technique can hopefully be used on observational data to deduce information about an unknown kernel and gain a scientific understanding of an agent's complex dynamic behaviors.

The Inherent Limitation on Interpretability of Large Language Models

Heng Zhao
Major: Computer Science

Mentor: Fan Yang, Computer Science

The interpretability of large language models (LLMs) is central to the development of artificial intelligence (AI). This research aims not only to push the boundaries of our understanding of current LLMs but also to pioneer methodologies that enhance transparency and accountability in future AI systems. By constructing specialized domain knowledge datasets — chemistry, geography, math, genetics, and translation — we rigorously tested various LLMs, including, LLaMA2, LlaMA3, and GPTs, to investigate where and how factual information is stored within these models.

Utilizing causal tracing [Meng, et. al, 2022] as a key analytical tool, we conducted an in-depth exploration of the internal mechanisms of LLMs to identify where and how domain-specific information is encoded within the models' architectures. Causal tracing allows us to pinpoint the exact layers and tokens responsible for storing and processing factual information across different domains. By systematically mapping these components, we tried to uncover distinct patterns in the distribution of knowledge across the token layers of each model, offering new insights into how LLMs internalize and manage vast amounts of data. Furthermore, by visualizing head activations under the influence of causal tracing, we can directly observe the pathways through which information is accessed and utilized within the model. This granular analysis tries to highlight how different layers and heads contribute to the overall performance of the model in generating accurate and relevant outputs. Moreover, we extended our analysis by comparing head activations with and without the application of causal tracing.

A Design-Centric Approach to Improving the Precision and Consistency of Fog Measurements for Enhanced Environmental Monitoring

Sihang Zhao
Major: Engineering

Mentor: Lauren Lowman, Engineering
David Carchipulla-Morales, Engineering

Fog is an important water resource in environments like tropical mountain cloud forests where plants frequently experience cloud immersion. However, measuring ecosystem fog water inputs is challenging as it requires a device that intercepts fog in any wind direction while minimizing the interception of vertical precipitation (i.e., rain). The goal of this research project is to design a low-cost, high-accuracy fog gauge by innovating on the traditional Juvik-type screen. Specific innovations include increasing the surface area for fog droplets to adhere to through the use of concentric interception screens and designing rain hats informed by raindrop impact angle calculations. In order to evaluate the performance of different fog gauge designs, experiments are performed in a fog chamber where the amount of fog water input is known. Preliminary results show that the concentric fog screen design captures more fog water than the traditional Juvik design. The long-term goal is to develop open-access 3-D computer-aided design (CAD) models so that researchers have reliable access to low-cost fog gauges. This technology will provide more accurate data to inform water cycle studies and water resource management.

Analyzing Asian American Candidates' Success in U.S. Elections

Yipeng Zhao
Major: Politics and International Affairs

Mentor: John Dinan, Politics and International Affairs

Asian Americans are the fastest-growing racial group in the United States, but they have not received adequate attention in scholarly studies of minority groups' influence in politics. As a result, many questions remain unanswered regarding the conditions under which Asian Americans achieve electoral success. This study investigates the factors that affect Asian American candidates' electoral success by undertaking case studies of examining twelve Asian American candidates who won state legislative elections in 2022 and 2023. The twelve cases are selected from districts with relatively small numbers of Asian Americans and where elections are generally competitive between the parties, and they include six districts with majority white populations and six districts with majority African American and Latino populations. I found strong support for several hypotheses, including my expectation that successful Asian American candidates would align their image with positive Asian American stereotypes held by whites and would come from districts encompassing small- or medium-sized cities. My case studies did not provide solid support for several other hypotheses, including my expectation that Asian American candidates are more likely to highlight their Asian identity when running in majority-white districts than in districts with a majority of African American and Latino residents and my expectation that successful Asian American candidates would have a record of holding elected office.

Judicial Elites and Chinese Exclusion: Shaping Immigration Policy and Federal Authority in the Exclusion Era.

Jack Zhu
Major: History

Mentor: Simone Caron, History

In 1881, David J. Brewer, a justice on the Kansas Supreme Court, dissented from the court's decision in Board of Education of Ottawa v. Tinnon, which upheld the civil rights of African Americans by ruling that the local school board lacked the authority to segregate students based on race. Twelve years later, however, as an associate justice on the Supreme Court of the United States, Brewer defended the civil rights of Chinese immigrants, another racial minority in American society, in the case of Fong Yue Ting v. United States. In this case, he argued that it was a “great wrong” to arrest and forcibly deport thousands of Chinese people from the country. Why did Justice Brewer take such opposing positions in these two civil rights cases involving racial minorities? Why did this white upper-class justice choose to stand with Chinese immigrants, who were at that time oppressed by Chinese exclusion laws? By closely analyzing federal and state laws, judicial cases, and the personal experiences of the Chinese who faced exclusion policies in the late 19th and early 20th century, this paper focuses on explaining the nuanced attitudes of white elites in the judicial sector toward Chinese immigration, the Chinese exclusion laws, and the anti-Chinese sentiment within American society. The paper argues that white elites in the judicial sector of the United States used their expressed views or rulings in Chinese exclusion cases as a platform to encourage either the expansion or the restriction of the power of the federal government.

Not In Attendance

Using Machine Learning and High Dimensional Flow and Mass Cytometry To Predict AML Relapse Following Transplant

Ruby Flanagan
Major: Computer Science

Mentor: Natalia Khuri, Computer Science
Jason Grayson, Immunology

This project focused on optimizing the integration of single-cell RNA sequencing (scRNA-seq) data from 10X Genomics formats, particularly in the context of Acute Myeloid Leukemia (AML). The objectives were to enhance memory and computational efficiency by comparing integration methods—Harmony for larger datasets and Canonical Correlation Analysis (CCA) for smaller datasets—using publicly available data from AML patients and healthy donors.

The methodology involved selecting and preprocessing datasets from the Gene Expression Omnibus (GEO), with a focus on the Solute Carrier (*SLC*) gene family, which plays a crucial role in cellular transport. Differential expression analysis was performed at diagnosis (day zero) and two weeks post-diagnosis (day fourteen) to identify key biomarkers. The *SLC2A* family served as a control for integration accuracy, while *SLC40A1* was noted for its increasing expression as the disease advanced.

The findings indicated that Harmony was more suitable for large-scale datasets, while CCA performed well with smaller ones. Importantly, *SLC40A1* was identified as a potential prognostic marker, with its expression correlating with AML progression.

Future work will focus on further exploring the role of *SLC40A1* in AML. Understanding its involvement could lead to the development of new therapeutic strategies. Additionally, the integrated datasets generated could be employed in machine learning models to predict disease outcomes and uncover novel gene expression patterns associated with AML, potentially offering new insights into its pathogenesis.

Not In Attendance

Inclusive Processes for Health Policy Making regarding Data Sovereignty initiatives in Research with Indigenous Peoples

Orrin Jones
Major: Philosophy: Minors in Politics and Bioethics

Mentor: Ana Iltis, Philosophy

In recent years, there has been a global push for more inclusive health policies, echoing the principle "Nothing about us, without us" (Charlton, 1998). True inclusion goes beyond token representation by valuing diverse perspectives and empowering individuals with different backgrounds to shape policies meaningfully. It is an ethical imperative essential for achieving equitable and accountable policies (OECD, 2013).

However, inclusion is often symbolic rather than substantive, with many health policies failing to protect vulnerable communities. One area that has seen significant progress in inclusion is Indigenous data sovereignty. Over the past 50 years, Indigenous communities have reclaimed control over data related to their people, territories, and ways of life, asserting their rights and interests (Carroll et al., 2020). Initiatives like the Te Mana Raraunga Maori Data Sovereignty Network and the US Indigenous Data Sovereignty Network emphasize partnerships between Indigenous communities and institutions, legal recognition of data rights, and ongoing community consultation.

Despite this progress, a systematic review of inclusion models in Indigenous data policy is still lacking. Analyzing these practices could provide valuable insights for other areas of health policy, especially as data collection expands with AI-driven technologies. Identifying effective practices from Indigenous data sovereignty could inform efforts to include other marginalized groups in health policy development.

Not In Attendance

Roadblocks to Constitutional Reform in Jamaica

Anya Huggins
Major: Politics and International Affairs

Mentor: Katy Harriger, Politics and International Affairs

For decades, the nation of Jamaica has been attempting to transition from a constitutional monarchy to a democratic republic but has been unsuccessful in each attempt. Explanations cited Jamaica's distinctive political culture, the island's small size, and the constitutional reform process in practice as roadblocks that collectively begin to explain the lack of change. Previous research has primarily relied on comparative analysis, specifically in Guyana and Trinidad and Tobago, to identify patterns of obstacles that could apply in the case study of Jamaica. In my study, I used both qualitative and quantitative survey questions posed directly to members of different departments within the Jamaican government, to gauge their perceptions of the factors that may hinder constitutional reform. Thirteen individuals participated in the survey. My findings revealed the following common themes as factors that hinder constitutional reform efforts: disunity amongst political parties, lack of parliamentary consensus, and lack of public participation. These factors have important implications for a successful systemic transition.

Not In Attendance

Revitalizing Latin Education Through Translation-Based Learning and AI-Enhanced Grading

Sarah Grace Raynes
Major: Latin

Mentor: Michael Sloan, Classics

This project addresses the decline of Latin education in the United States by assisting my supervisor, Dr Sloan, in developing a software aimed to make Latin more accessible to the 98% of American schools without a program. Tailored to learners of all experience levels, the software incorporates Dr. Sloan's nine-fold order of operations - a structured technique that breaks down translating Latin into a simple nine step process.

The project also involved parsing and diagramming various ancient Latin texts. At the same time, lesson plans were created, ranging from beginner to advanced topics, that introduced students to the fundamentals of grammar and syntax. These lessons were paired with authentic Latin examples of the topics that were covered from authors like Cicero, Caesar, Seneca, Ovid, and Virgil, promoting translation-based learning that connects modern learning to ancient examples of the language's linguistic structure.

Over the course of the summer, this project evolved to include the integration of AI as a grading tool. One of the key struggles in the early development of this app was determining how student's translations would be graded, given that there is no single "correct" translation for a text. However, after extensive experimentation, AI was found to provide instantaneous and accurate feedback for translations, offering a more interactive and efficient learning experience.

Ultimately, although still in the early stages of its development, Dr. Sloan's software aims to make Latin education more accessible and less complicated, hopefully sparking a revival of interest in Latin across America.

Not In Attendance

Skate before you run: Investigating developmental mechanisms of sensory neuron maturation in Leucoraja erinacea

Elena Singer-Freeman
Major: Biochemistry and Molecular Biology

Mentor: Jeremy Dasen, Neuroscience (NYU)

It is crucial to understand the molecular and genetic mechanisms contributing to the development and function of complex motor circuits to help inform the treatment of neurological disease. *Leucoraja erinacea*, or the Little skate, represents an intermediate step in the evolution of motor development, displaying both undulatory swimming and limb-based walking patterns. The presence of sensory-neuron cell types (not characteristic of most fish) may contribute to the skate's unique motor phenotype. The present study aimed to investigate the wildtype and fin-ablated development of skates' sensory neurons to understand which features are conserved or divergent from mammalian sensory systems. It was hypothesized that skates would rely on target-derived signaling for sensory neuron differentiation. Using HCR-FISH, fin-ablated DRGs were analyzed for changes in expression of *Etv4*, *Runx3*, and *Ntrk1*, three genes essential for the development of sensory neuron subtypes. Decreased *Etv4* expression was observed in DRGs ipsilateral to the fin ablation, supporting the skate's reliance on target-derived signals to direct sensory neuron diversification. When studying the wildtype development of skate sensory neurons, probes for putative nociceptor and mechanoreceptor classes were used in HCR-FISH experiments: *Piezo2, Ret, Etv4, Trpm2, Trpa1. Piezo2* expression was found to be largely conserved across mammalian species while the other markers diverged from mammalian expression patterns. The study of wildtype and fin-ablated skate sensory neurons provided additional information related to skate sensory neuron differentiation and confirmed that target-derived signals play a role in this differentiation.

Not In Attendance

Effects of Inhibition on Behavioral Development in the Western Honey Bee

Nate Whitworth
Major: Biology

Mentor: Susan Fahrbach, Biology

Apis mellifera, the Western honey bee, progresses through strict developmental stages, completing life as a nectar or pollen forager. Upon beginning foraging, they have great behavioral and neural plasticity and are able to convert environmental cues into mental maps of flower types and locations. However, after gaining foraging experience, this ability diminishes. We analyzed the distribution of the inhibitory neurotransmitter GABA in a brain region called the mushroom bodies (responsible for learning and integration of sensory information) at different life stages to ask if GABA is tied to plasticity. We hypothesized that experienced foragers would have more expression of GABA in the brain, because in other model species, GABA is a prerequisite for structural and behavioral plasticity. Additionally, we predicted that total GABA concentration would increase throughout the life cycle, with intermediate concentrations associated with maximal plasticity. To test these hypotheses, we obtained brains from bees with different amounts of foraging experience and used antibody-based fluorescent markers to visualize GABA in 100 µm-thick brain slices. Brains were imaged on the Zeiss 880 laser scanning confocal microscope using the Airyscan detector to improve resolution. Images were analyzed using FIJI software. Results from this experiment are not yet finalized, but one trend is clear: experienced foragers have larger average synaptic punctae size than those in the newly emerged (least experienced) group. This finding is consistent with our initial hypothesis. Further analysis is required to determine whether there is a change in total GABA concentration in the oldest, most experienced experimental groups.

Not Presented

PRESENCE OF GASTROESOPHAGEAL REFLUX DISEASE IS NOT ASSOCIATED WITH WORSE OUTCOMES IN PATIENTS WITH MYCOBACTERIUM AVIUM COMPLEX PULMONARY DISEASE

Mayank Nihalani
Major: Health and Exercise Science

Mentor: Dr. Andree Koop, Department of Gastroenterology, Mayo Clinic, Jacksonville Florida

Mycobacterium avium complex (MAC), an infection complicating the clinical course in patients with chronic lung disease, was previously associated with gastroesophageal reflux disease (GERD) although the effects of GERD on MAC outcomes remain unclear. The goal of this study was to assess the prevalence of GERD in patients with MAC pulmonary disease and its association with clinical outcomes.

We identified adult patients with confirmed MAC pulmonary disease who underwent ambulatory pH monitoring with wireless telemetry capsule or catheter-based testing while off proton pump inhibitors for at least 7 days. Pathologic acid reflux was defined as a total acid exposure time (AET) ≥6% in the distal esophagus or a DeMeester score ≥14.7. The primary outcomes were severity of lung disease assessed by pulmonary function testing and treatment for MAC infection.

132 patients were included with a median age 63.0 years, 109 (82.6%) female. 35 (26.5%) patients had an AET ≥6 and 46 (34.8%) patients had a DeMeester score ≥14.7. There were no differences in pulmonary function tests between patients with and without pathologic acid reflux by AET including FEV1% predicted (p=0.68), FEV1/FVC% predicted (p=0.34) and DLCO% predicted (p=0.09) or by DeMeester score.

Although prior studies have implicated GERD in the pathogenesis of MAC pulmonary disease, this study did not find different outcomes in patients with or without GERD by pulmonary function testing or need for MAC treatment. Further study is needed to better delineate the relationship between GERD and MAC pulmonary disease.