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The Twenty-Second Annual

Celebration of Undergraduate Research and Creative Activity

April 14 2023 DeVos Fieldhouse

Hope College Holland, Michigan USA

Hope COLLEGE

CURCA

ABSTRACTS

Celebration of Undergraduate Research and Creative Activity

Friday, April 14, 2023
2:30 - 5:00 pm EDT
DeVos Fieldhouse

'23

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April 14, 2023

Dear Friends,

I am excited to welcome you to the 22nd annual Celebration of Undergraduate Research and Creative Activity (CURCA) at Hope College. This event highlights over two decades of celebrating the scholarly accomplishments of talented Hope students working collaboratively with exceptional faculty mentors in our annual signature research showcase.

Student-faculty collaborative research has long been a hallmark of the Hope College academic program, a distinction that has garnered national recognition. US News and World Report rank Hope College #22 in undergraduate research and is one of only 62 colleges and universities, such as Harvard, MIT, Princeton, Michigan, Stanford, and Yale, which provide outstanding research and creative project opportunities.

Our research-infused courses, ensembles, and studios facilitate students to cultivate meaningful connections with faculty, encourage the development of tangible professional skills for graduate school and postgraduate work, and offer opportunities for enhancing critical thinking and interdisciplinary collaboration. Such experiences are part of what makes Hope College a transformative and world-class educational experience.

This year's Celebration includes 151 presentations by 236 students from 21 different departments and programs working with 78 faculty mentors. Research occurs during the academic year and summer, spans the four academic divisions, and includes independent study and course-based research. During the 2022 calendar year, Hope students made 117 conference presentations at off-campus conferences, published 17 articles or scholarly chapters, and submitted another 25 papers for publication. For the 2022 fiscal year, Hope College faculty, staff, and students received 6.5 million in external funding to support 61 research, outreach, public service, and educational awards.

Thank you for your participation in and support of CURCA 2023. To learn more about student-faculty collaborative scholarship, visit the website: **hope.edu/research**.

Sincerely,

Heidi E. Kraus, Ph.D.
Associate Provost for Academic Affairs

The Coup in Iran

Per-Erik Gierlach

Mentor:
Dr. Lauren Janes,
History

The purpose of this historical research paper is to discuss the American government's motivation to transition from the mediator to the main instigator in the coup against Mohamed Mosaddeq's regime in Iran during the 1950s. The British government and the Anglo-Iranian Oil Company (AIOC) came into conflict with Iranian Prime Minister, Mohammed Mosaddeq, over the oil industry in Iran. Britain desired to maintain the oil concessions that were granted during the sphere of influence period and later re-affirmed under Reza Shah. Mosaddeq nationalized Iran's oil industry in response to Britain's unwillingness to compromise on the existing profit-sharing agreement between the AIOC and the Iranian government and improve the working conditions at the AIOC's facilities. This paper discusses the reasons the American Government became involved in the coup. These reasons included the administration change from Truman to Eisenhower, the subsequent new national security strategy under Eisenhower, and the economic consequences that would result in Iran successfully nationalizing its oil reserves and the effects nationalization would have on other rising nation states where America held economic interests. The paper concludes the consequences the coup had on Iranian American relations.

The Debate on Blackness: Deliberations of Scientific Racism in the British West Indies (1750-1840)

Natalie Prestegaard

Mentor:
Dr. Lauren Janes,
History

This article examines the development and growth of specific concepts of scientific racism including debates on polygenism versus monogenism, and acclimatization. Focusing on the medical history of British medical-scientists, British colonial military operations, and the plantation system in the British West Indies, the article demonstrates the pervasive nature of these medical theories. The growth of these medical theories supported further importation of African enslaved to the British West Indian Islands as well as led to the creation of an all-African regiment, the West Indian Regiment, in 1793. Explicitly based on the experiences of medical scientists and military commanders on the Islands, science, or rather pseudo-science, claimed that African bodies had been designed for a tropical climate. The medical-science community used their "findings" to support racist notions that had already been in place, such as the perceived inferiority of all non-Europeans. The development of scientific racism provided an "evidence-based", pseudo-scientific rationale for the marginalization of certain groups of people. The predisposition to survival in extreme conditions of humidity and heat, suggested to plantation owners and military commanders that they should use African bodies for labor rather than hiring European laborers.

Desmond Holdridge's Expeditions in South America

Caleb Van Appledorn

Mentor:
Dr. Lauren Janes,
History

South America, during the early 20th century, was a haven for commerce and trade by the U.S. and Britain. There was, however, more involvement beyond trade with the interest of profit in mind. Desmond Holdridge, through his many expeditions, revealed the prominence of emigration to South America, investment in British colonized land, and interest in ethnological research. This investigation of all of Holdridge's journals and novels covering his expeditions and interests connects t Holdridge's work to what was happening in the world at that time The result of my research concluded with evidence that the U.S. and Britain found South America valuable in more ways than just trade and commerce.

The Students' Perspectives: The American Indigenous Boarding School Experience

Holly Vincett

Mentor:
Dr. Lauren Janes,
History

The period of the Allotment and Forced Assimilation within the United States, from around 1887 to 1934, was a contentious time for Indigenous people. Residential boarding schools across America were established with the purpose of erasing indigenous culture and instilling white values within Indigenous students. Native American displacement within the nineteenth century created division between the expanding numbers of white Americans and remaining Indigenous people. As unoccupied land became scarce, displacement became an unsustainable approach for white policy makers. Efforts to assimilate Native American children within white culture defined Native American policy of the late nineteenth century. Educators of residential schools or "Indian Schools" placed emphasis on culturally "civilizing" students through invasive and harmful methods of education. Their educational methods resulted in extreme changes in student's cultural identity. The student's education regarding language, values, dress and religion caused them to be estranged from their own communities, while only being accepted on the fringes of white communities. The schools' ultimately did not achieve assimilation and acculturation without great personal loss at the cost of the student due to fundamental issues of racial bigotry.

Re-Indigenization of Song, Chant, and Dance in the Pacific

Joy Gregson

Mentors:
Dr. David Keep, Music

Dr. Rodrigo Serrao, Sociology & Social Work

Rebecca VanDeWalker, Music

Dr. Christopher Fashun, Music

Music plays a vital role in the functioning of culture and society, especially for non-literate cultures in the Pacific. Research shows that there were many different traditions of song, chant, and dance throughout Melanesia, Micronesia, and Polynesia before Europeans colonized the islands. This colonization led to a shift in traditional music and life partly because of acculturation and partly because of church censorship. Now, indigenous Islanders are reclaiming parts of their lost identity through traditional language and music, calling for policy change in their contemporary forms of music, and passing on their knowledge by educating the next generation.

Neither "Mad Genius" Nor "Man-Child": Reframing Popular Discourse Around Thelonious Monk's Music and Madness

Leah Reinardy

Mentors:
Dr. David Keep, Music

Dr. Benjamin Krause, Music

The field of Disability Studies has only begun to intersect with scholarship in music theory and musicology in the last two decades. Mad Studies, a subfield of Disability Studies, reframes Madness as a sociocultural identity instead of individualizing it as "mental illness". Joseph Straus categorizes commentary on Mad musicians based on the binary of the medical and sociocultural models of disability. These categories are all based in the medical model and are based on the degree of correlation between a composer's music and Madness. While these categories are useful to explore common tropes such as the "mad genius" or the "tortured artist", they do not fully address the systems of oppression that impacted the lives and music of twentieth-century Mad jazz musicians. Jazz pianist Thelonious Monk was famous for his dissonant, playful musical and personal aesthetic. Popular narratives around this aesthetic have focused on Monk as either a "mad genius" or a "man-child". Monk's ballad "Crepuscule with Nellie" directly undermines both of these narratives by serving as a serious, expressive, and realized piece of art. The analysis of this piece embedded within the context of popular media confronts typical stereotypes of Monk with thoughtfully rendered artistic statements.

Stage Management of *The Boy Who Hates Everything:* A Devised Theatre Production

Lydia Konings

Mentor:
Reagan Chesnut, Theatre

The purpose of this is to bring to light the experience of the Student Stage Manager for *The Boy Who Hates Everything,* which was a devised work created by the students and guest director, Chris Garcia Peak. This production was a part of the 2022-2023 season from the Hope College Department of Theatre, and was performed in Spring of 2023. Through the viewpoint Stage Management, the production process is one of paperwork, organization, and teamwork. Working heavily with the production team and the director; the stage manager helps implement the vision of the creative team. It all culminates in the week of technical rehearsals, when the stage manager transitions into the point person of the production, and ultimately during the performances where the stage manager calls all the lighting and sound cues to bring the work of the designers to life.

Pomegranates Underneath: A Student-Produced Production

Lydia Konings
Rachel Scott
Kelsey Sivertson
Katy Smith

Mentor:
Dr. Daina Robins, Theatre

The purpose of this presentation is to bring to light the work of the students involved in this fully student- produced and original production of *Pomegranates Underneath.* As a 490 project produced through the Theatre Department here at Hope College, its goal was for students to fully produce, design, and create a performance, giving them full responsibility for its execution. The thesis of this 490 was creativity under pressure. The production team spent a total of five weeks writing, designing, rehearsing, tech-ing, and performing a fully-developed production. The project was meant to push us to our limits both creatively and logistically, while still allowing us to produce a complete work of which we were proud. Each playwright, director, designer, stage manager, actor, and crew member was working on their own aspect of the production within this condensed timeline, which emphasized collaboration and adaptability. Ultimately, this all culminated in a weekend run of the play which was open to all to see and enjoy!

Scientific Advancements Inspired by Religion in Early Modern Spain

Abigail Bilisko

Mentor:
Dr. Tatevik Gyulamiryan,
World Languages
& Cultures

During the Spanish Inquisition, a time of religious imposition where the expression of liberal ideals was limited, many believed that the sciences was one of the areas that was greatly hindered. However, throughout the Early Modern period in Spain, various aspects of religion, such as the general wonders of divine works, religious scriptures, and the goals of religious groups, influenced thinkers to explore new questions and work toward scientific advances. The integration of science and religion in history has given us the start to many of the scientific ideas that we still believe and use today. In this presentation, I explore the positive impact of religious expansion and ideals on the development of science as seen in the works of Michael Servetus, Friar Juan of Santa Ana, and Juan Huerte. I contend that science and religion should not be seen in opposition to one another, but inspire greater explorations, especially when we consider their expression in the Early Modern period.

Effect of delaying HCA exposure on the development of manic/depressive behaviors in Sprague Dawley rats

Eden Comer
Rachel Mast
Natalie Olander
Mackenzie Williams

Mentor:
Dr. Leah Chase,
Biology and Chemistry

This project was funded by A. Paul and Carol Schaap Undergraduate Research Funds with contributions from the Biology, Chemistry and Neuroscience Programs.

Bipolar disorder (BD) is a neuropsychological disorder that is characterized by cyclical periods of depressive and manic behaviors. The Chase lab is focused on developing a reliable animal model for BD in order to characterize the critical neurophysiological and neurochemical changes that trigger BD. Previous studies in the lab have shown that daily injection of rat pups from postnatal day 3 through 19 (P3-P19) with homocysteic acid (HCA) leads to the development of a mixed manic and depressive state after puberty. These behaviors can be reversed by treatment with lithium and involve changes in gene expression in the prefrontal cortex that are also improperly regulated in BD. Despite the reproducibility of this animal model, we observed subtle, but critical changes in the behavior of our HCA-treated rats that we analyzed during the summer of 2021, such that the animals exhibited more manic behaviors relative to depressive behaviors. Upon further analysis, we discovered that the weight of the pups in the 2021 cohort were 1.3-2.0 g heavier than previous cohorts ($F_{1,39}=17.1$, $p<0.001$) on the first day of injection, suggesting that either the 2021 pups were about 2 days older than indicated by the vendor or the pups exhibited a faster rate of growth than the previous cohort. Our current study is focused on measuring behavior in rats given daily HCA injections beginning postnatal day 5, rather than the previous postnatal day 3, in order to determine the effects of a delayed treatment period. We hypothesize this adjusted exposure window may match that of the 2021 cohort and thus produce similar resulting behaviors. Ultimately, this work will allow us to understand how timing of HCA exposure impacts the associated behavioral changes and may provide a better understanding of the variations in behavior associated with bipolar disorder.

Neurodegeneration and neuroinflammation in the olfactory bulb of zebrafish following acute hypoxia

Skylar DeWitt
Evan Thomas

Mentor:
Dr. Erika Calvo-Ochoa,
Biology

Research reported in this publication was supported in part by funding provided by the National Aeronautics and Space Administration (NASA) under award numbers G00028549 and G00028550, Michigan Space Grant Consortium and the Biology Department of Hope College.

Hypoxia, the lack of sufficient oxygen in tissues to sustain bodily functions, has a deleterious effect on physiological and behavioral health. Unlike mammalian brains, which are restrained in their capacity to recover following damage and hypoxic injury, zebrafish are an excellent model to study exposure to hypoxia due to substantial neuroplasticity mechanisms within their brain. Specifically, the olfactory bulbs (OBs) display high neuroplasticity and neurogenesis (i.e., generation of new neurons), making it a useful model to study neural responses under stressed environmental conditions such as hypoxia. Here, we establish a new paradigm of hypoxic exposure in zebrafish to uncover the effects of oxygen deprivation on the olfactory system. To induce hypoxia, we displaced dissolved O_2 (DO) by perfusing N_2 gas into the water until we reached hypoxic levels of 0.6-0.8 mg/mL DO compared to the normoxic (control) DO of 5.0 mg/mL. We then allowed zebrafish to recover for either 1-hour post hypoxia (1 hph) exposure or 1-day post hypoxia (1 dph). To measure the efficacy of our hypoxic conditions, we stained for active mitochondrial dehydrogenase activity, determined by triphenyl tetrazolium chloride (TTC) staining. To assess degeneration in the OBs, we performed immunohistochemistry assays to label astrocytes through Glial fibrillary acidic protein (GFAP) staining and cells undergoing apoptosis through Terminal deoxynucleotidyl transferase biotin-dUTP nick end labeling (TUNEL). We observed decreased TTC staining which suggests mitochondrial activity reduction, (indicative of neural death or damage) caused by hypoxia in the olfactory bulbs. In addition, we found that at 1 dph, the OBs present an increase in astrocyte activation and cells undergoing apoptosis. Overall, these findings validate hypoxia as an injury model for studying degeneration and regeneration in zebrafish. This research can give insights into further understanding of hypoxia's impact on the body, specifically on olfactory morphology.

Engineering a Streptavidin Binding Site on the Extracellular Surface of the Cystine-Glutamate Transporter

Kai Francisco

Mentor:
Dr. Leah Chase,
Biology and Chemistry

This research was supported by the A. Paul and Carol Schaap Undergraduate Research Fund.

System x_c^- is an amino acid antiporter that exchanges intracellular glutamate for extracellular cystine. This is a physiologically significant process since the imported cystine can be used as a precursor for the antioxidant glutathione. Antioxidants are critical in neural regions for the removal of free radicals. Previous research suggests that system x_c^- regulation is modulated by the presence of extracellular oxidants, triggering the movement of the transporter to the membrane for increased cystine uptake. Detection of when the xCT protein is intracellular versus expressed on the cell membrane, in real time, would help to identify the exact mechanisms that allow such regulation. Therefore, our goal is to engineer a short peptide sequence (streptavidin, SA), on the extracellular domain, that can be recognized by a fluorescently-labeled ligand (biotin) to effectively track system x_c^- movement during times of oxidative stress in brain cells. To accomplish this, we identified a region within the xCT gene, corresponding to an extracellular domain on xCT, that had an endogenous XmnI restriction enzyme cut site. The xCT gene was previously inserted into the pCMV-2Tag3 mammalian expression plasmid, therefore we performed a restriction digest of this plasmid with Xmn1 and subsequently dephosphorylated the 5'-ends using calf intestinal phosphatase in order to prevent reclosing of the plasmid DNA. We then used XmnI to cut a double-stranded DNA fragment containing the sequence encoding streptavidin which was engineered with XmnI cut sites on the 5' and 3' ends. Finally, we combined our cut streptavidin gene fragment with our cut plasmid, and used DNA ligase to create our final plasmid. We are now confirming the correct insertion of our SA gene using DNA sequencing, and plan to express our SA-tagged transporter in COS7 cells to characterize its activity so it can be used to study the transporter's trafficking in real time.

Role of Neuroinflammatory Response on Cell Proliferation Following Neurotoxic Lesioning in Zebrafish

Sarah Heinowski
Nate Vorhees
Nate Koorndyk
Helen Dodge

Mentor:
Dr. Erika Calvo-Ochoa, Biology

This research was supported by the Hope College Neuroscience Program and Biology Department.

Parkinson's Disease (PD), a neurodegenerative disorder characterized by dopaminergic neuronal loss and motor impairment, affects roughly 1 in 500 people. Interestingly, olfaction loss, the loss of smell, is prevalent in over 95% of those with PD. Zebrafish provide a unique model to study neurodegenerative diseases, including PD, as they possess the unique ability to regenerate neurons (i.e., neurogenesis) throughout their lifespan. Contrary to mammals in which inflammation often has negative associations with neural injury recovery, inflammatory response within zebrafish is thought to have a key role in this regenerative capability. Thus, we aimed to inhibit the inflammatory response and investigate cell proliferation in the zebrafish olfactory bulbs following treatment with a neurotoxin. To do this, we used adult zebrafish of both sexes and injected 6-hydroxydopamine (6-OHDA), a neurotoxin that specifically targets dopaminergic neurons, into the cerebrospinal fluid at the ventricular zone. Pranlukast, an anti-inflammatory agent, was injected along 6-OHDA to reduce neurotoxin-associated inflammation. Immunohistochemistry was performed on 6-OHDA and pranlukast-treated fish as well as only 6-OHDA treated fish to assess cell proliferation and inflammatory markers. We predict that following 6-OHDA injection we will observe an increase in cell proliferation and inflammation in comparison to untreated fish. We also predict that fish treated with both 6-OHDA and pranlukast will have a weaker inflammatory response resulting in a decrease in cell proliferation in comparison to 6-OHDA only treated fish. GFAP (glial fibrillary acidic protein) was used to assess inflammation as it stains for astrocytes which are tied to the inflammatory response. Notably, astrocytes are stem cells within zebrafish, supporting the idea that inflammation and neurogenesis are correlated. This work aims to highlight the importance of the inflammatory response on the neurogenic capacity in zebrafish. Further research is needed to find distinct differences between zebrafish and mammalian models in the inflammatory response.

Expression of Olfactory-Induced Anxiety Behaviors Following Hypoxia Treatment In Adult Zebrafish

Cassidy Larson
Luke Horsburgh
Cameron Houck
Skylar DeWitt

Mentor:
Dr. Erika Calvo-Ochoa, Biology

This research was supported by the Neuroscience Program and Biology Department at Hope College

Exposure to hypoxic conditions leads to neural loss of function or death in the nervous system of mammals. Zebrafish, given their sophisticated neuroregenerative abilities, are able to survive low-oxygen conditions with fewer consequences. These capabilities are crucial for the olfactory system of zebrafish, as their olfactory epithelium is directly exposed to damage and toxins in the environment. Given that olfaction allows for critical behaviors such as foraging, mating, predator detection, and non-visual perception of dead fish, possessing functional olfactory sensation is vital to survival. Cadaverine is a chemical compound that mimics putrescine, the scent of decaying flesh. This scent induces an anxiety response in zebrafish, observed through behaviors such as sudden rapid movements followed by freezing, sinking, and decreased exploration. By experimentally causing these behaviors, it is possible to determine the extent of olfactory function following hypoxic treatment. Our objective was to understand whether hypoxia affects olfactory-induced anxiety behaviors in adult zebrafish. We examined this through two aims: first, whether hypoxia decreases the amount of time the fish exhibited the freezing/sinking anxiety response. Second, how much time the fish spent in the lower third of the behavioral tank (i.e., decrease in exploratory behavior). Our hypoxia group was exposed to 0.6-0.8 mg/dL of dissolved oxygen (DO) levels for 15 minutes, whereas control fish were exposed to normal OD levels of 5-7 mg/dL the day before exposure to cadaverine. We recorded behavioral responses for 30 seconds before and after exposure. Our preliminary results suggest that hypoxia reduced olfaction in adult zebrafish due to a decrease in anxiety responses, as well as decreased time spent exploring. Implications of this study could lead to further research on human anxiety, as well as other olfactory methods that may be used to treat anxiety in humans without hypoxic exposure.

Effect of AKT Activation on the Post Translational Modification of System x_c^-

Sofia Petix

Mentor:
Dr. Leah Chase,
Biology and Chemistry

This research was supported by the A. Paul and Carol Schaap Undergraduate Research Fund.

System x_c^- is a cystine glutamate antiporter that, among other functions, is important for regulating oxidative stress in cells because cystine is a precursor for the antioxidant GSH. Previous experiments have shown that exposure to H_2O_2 increases the localization of system x_c^- on the cell membrane. The Chase lab has been working to identify the trafficking mechanism of xCT, the transmembrane domain of system x_c^-. Prior research suggests that post translational modifications play an important role. Specifically, ubiquitination of intracellular lysines of xCT appears to decrease surface expression of the transporter. Recently, it has been shown that Akt kinase, an enzyme involved in multiple cell signaling pathways, may play a part in the regulation of system x_c^-. In prior research, cells transfected with a dominant negative version of Akt that were exposed to H_2O_2 showed decreased cell surface localization compared to cells with normal type Akt. In this project, the role of Akt in coordinating the movement of system x_c^- was investigated by transfecting separate cells with either a dominant negative version of Akt or a constituently active version. The xCT protein in both of these cells was initially analyzed with a western blot that revealed information about the protein's molecular weight. Preliminary research suggests that the dominant negative Akt produces a higher molecular weight xCT than the control or constituently active version. After this is confirmed through repeated western blots, the high molecular weight form of xCT will be characterized using antibodies directed to specific post translational modifications to reveal whether the increased molecular weight seen with the dominant negative Akt is due to ubiquitination or some other modification. This data will help to identify the specific role of Akt in the trafficking mechanism of system x_c^-.

Does ubiquitination of System x_c^- affect its turnover rate within the cell?

Sofia Rosenberger

Mentor:
Dr. Leah Chase,
Biology and Chemistry

This research was supported by the A. Paul and Carol Schaap Undergraduate Research Fund.

System x_c^- is a protein antiporter which imports extracellular cystine and exports intracellular glutamate. Its presence and concentration on the plasma membranes of glial cells in the CNS has been shown to increase directly with the introduction of the stressor hydrogen peroxide into the cellular environment. The antioxidant glutathione is synthesized, in part, through the usage of available cystine imported through the antiporter, which is why System x_c^- is an integral part of these cells' response to reduce oxidative stress. While the importance of this system and its potential implications on numerous neurological diseases and conditions cannot be easily understated, its mechanism of regulation is not well understood. Examining how the synthesis and degradation rates of System x_c^- may be impacted by cellular signaling processes is useful in developing a clearer understanding of its turnover and trafficking within the cell. Ubiquitin, a small protein, is directly involved in the recycling and degradation of numerous proteins within cells and has been shown to bind to System x_c^-. However, it is not understood how ubiquitination of the transporter impacts its activity. Therefore, the objective of this project is to directly assess how changes in the level of ubiquitination affect transport activity. To accomplish this goal, we are expressing System x_c^- in COS7 transfected with varying levels of ubiquitin and measuring the effect that this has on the turnover rate of System x_c^-. We hypothesize that as ubiquitin levels increase in the cell, there will be an increased rate of removal of the transporter from the membrane and degradation in the lysosome. Ultimately, this work will allow us to better understand the mechanisms by which System x_c^- activity is regulated.

Dopaminergic Synapse Loss in 6-OHDA Lesioned Zebrafish

Grace Stalions
Heather Van Dort
Gabriella Taylor

Mentor:
Dr. Erika Calvo-Ochoa,
Biology

This research was supported by the Neuroscience program and Biology Department of Hope College.

Parkinson's disease is a neurodegenerative disorder caused by degeneration of dopaminergic neurons, and an early symptom of Parkinson's disease is olfactory dysfunction. A common animal model used in Parkinson's disease research is zebrafish because of their unique neuro-regenerative ability, which is particularly in their olfactory bulb. In order to create a model of the early stages of Parkinson's disease we injected zebrafish with the neurotoxin 6-hydroxydopamine (6-OHDA) to induce the degeneration of dopaminergic neurons in the olfactory bulb. Olfactory system recovery post 6-OHDA injection has been recorded in previous literature, but the state of synaptic dopaminergic synapses post-injection has not yet been investigated. In this study, we explore the effects of 6OH-DA lesions on dopaminergic neuron number and synaptic density within the olfactory bulbs of control and experimental samples at 1- and 3-days post 6-OHDA injection. For this, we harvested zebrafish brains post-injection and performed immunohistochemical staining on the neural tissue. We used primary antibodies against SV2 (synaptic vesicle 2) and TH (tyrosine hydroxylase) that allowed us to observe pre-synaptic terminals of dopaminergic neurons, respectively, as well as their overlap. We observed the tissue using confocal microscopy, measured the optical density of the signal, and counted the number of dopaminergic neurons present within each tissue sample. So far, we have qualitatively observed differences in the location of the synaptic vesicles and olfactory glomeruli (i.e., sites of synaptic connections) between treatment groups. Our research is the first to examine dopaminergic synapse loss resulting from treatment with 6-OHDA, and may give insight into preventative treatments of neurodegenerative disorders like Parkinson's disease in the future.

Beyond the Binary: Considering Gender, Leadership, and Femmephobia

Nicole Galloway

Mentor:
Dr. Sarah Kornfield,
Communication

Discourse surrounding gender and leadership varies considerably. This study uses the Business-focused Inventory of Personality scale to assess measures on power and leadership motivation through a self-report survey. With data collected from the survey, this study showcases the perceptions individuals have of their own leadership qualities and how such perceptions may be related to gender. Though discussions on gender and leadership are often focused on difference or the lack thereof, this study argues through the lens of femmephobia that we must move beyond conversations about difference and into conversations about oppression when striving to create a feminist impact on leadership occupancy.

Walking the Digital Line of Profit and Empowerment: Period Products on Social Media

Kaylee Stanton

Mentor:
Dr. Sarah Kornfield,
Communication

Instagram posts from mainstream and alternative menstrual product companies showcase varying styles of branded advertising including product placement, education, and artistic expression. Through an analysis of a collection of the most liked posts from Always, Tampax, U by Kotex, August, and The Divacup, I argue that the combination of environments between Instagram and femvertising results in contradictory and often ineffective messaging about periods where companies struggle between capitalizing on period stigma to sell products and facilitating authentic empowerment. These unique positions of the brands reveal a need to reshape empowerment and display the pitfalls of feminist advertising on neoliberal social media.

How Students at Hope College Reflect on Their Relationship with Their Own Bodies and Perception of Body Positivity

Sutton Steensma

Mentor:
Dr. Sarah Kornfield,
Communication

This research was supported by the Women's & Gender Studies Program and provided funds for purchasing research materials.

Fatphobia is woven within the fabric of our society. This form of sexism is a tactic of control, manipulating women's bodies and their perception of self; this control fuels our patriarchal society. The current study pursued fatphobia as a gendered issue, specifically using data from the lived experiences of students at Hope College. Through a mixed methods approach, I found that fatphobia shows itself to be a gendered issue among this demographic where weight bias has taken form in many ways, specifically impacting and targeting women. Every participant had been impacted by fatphobia in some way, and expressed that the "Body Positivity Movement" is exclusive and requires revisions to make it representative and accessible to all bodies. Additionally, participants expressed a desire to relate to their bodies in holistically healthy ways, which they saw as the intended purpose behind the "Body Positivity Movement."

The Storytellers of Climate Change: Women in the Global South as Changemakers

Anna Whittle

Mentor:
Dr. Sarah Kornfield,
Communication

The evidence of environmental and gender inequalities is clear. Not only are poorer countries affected the most by the pollution from wealthier countries, but climate change affects women in the Global South the most through overlapping layers of oppression. By exploring the intersection of gender and climate change through a diversity of disciplines, this project seeks to develop a sustainable, feminist approach to mitigating climate change. An intersectional lens, storytelling by women, and the inclusion of women in all levels of climate action are critical in the development of a non-hierarchical, polycentric approach to climate change.

Optimization of xCT purification methods to enable future post-translational modification analysis

Connor Bricco

Mentor:
Dr. Leah Chase,
Biology and Chemistry

This research was supported by the A. Paul and Carol Schaap Undergraduate Research Fund.

Membrane protein xCT and its heavy chain component 4F2 make up the x_c transport system. 4F2 may be necessary for membrane localization of the heterodimer and xCT is responsible for transport activity. The xCT protein transports cystine into cells by pumping out intracellular glutamate. Cystine transported into the cell is used to make antioxidant glutathione (GSH) which metabolizes free radicals that have built up in the cell. At an organismal level this system becomes active during times of high metabolic activity and prevents cellular failure linked to oxidative stress in the brain. Because of how dangerous oxidative stress can be xCT is stored underneath the membrane in vesicles ready to be moved to the membrane upon oxidative insult. Understanding how xCT is activated and moved to the membrane is critical for us to understand the typical cellular response to oxidative stress. Part of understanding the movement of xCT to the membrane is post-translational modifications (PTMs). For example, added phosphoryl groups and other organic groups are known to mark membrane proteins to regulate their passage to and from the membrane. The overall goal of this project is to use mass spectrometry to detect the PTMs of xCT isolated from cells grown under basal conditions and those exposed to oxidative stress. To do this a procedure must be optimized to maximize expression of xCT in the cells and maximize the output of protein from the purification process. Therefore, we have chosen to study endogenously expressed xCT in U138MG cells. Currently, we are evaluating detergents in order to maximize xCT protein purification and digestion by trypsin. Detergent tests include NP40, SDS and CHS:LDMS. CHS:LDMS forms a micelle around the proteins which have been shown to increase the purification of membrane proteins. Once we have optimized this process, we will transition to mass spectrometry analysis.

Cell Based Studies on the Effect of POLRMT and MRPL12 Post Translational Modifications on Mitochondrial Protein Synthesis

Ryan Erdmann
Alexis Erickson

Mentor:
Dr. Kristin Dittenhafer-Reed,
Chemistry

This material is based upon work supported by the National Science Foundation under Grants No. MRI-2017708 and RUI-1814845, the Herbert H. and Grace A. Dow Foundation, and Schaap Endowed Research Funds.

Mitochondria play an essential cellular role in the production of adenosine triphosphate (ATP) through the process of oxidative phosphorylation. To synthesize ATP, mitochondria rely on their own genome that encodes 13 protein subunits of the electron transport chain. The regulation of mitochondrial transcription is not well understood. We hypothesize that post-translational modifications (PTMs) of two proteins involved in mitochondrial transcription may alter their function and serve as a way to regulate gene expression in response to the nutrient status of the cell. Using mass spectrometry, PTMs, including lysine acetylation and serine/threonine phosphorylation, were identified on the mitochondrial RNA polymerase (POLRMT) and ribosomal protein L12 (MRPL12), a protein that binds and stabilizes POLRMT. Site-directed mutagenesis was performed to create MRPL12 and POLRMT mutants mimicking these PTMs (acetylation mimic (lysine to glutamine) and phosphorylation mimic (threonine to glutamate). POLRMT and MRPL12 mimics were overexpressed in HeLa cells. DNA, RNA, and protein were isolated 24 hours after transfection to determine mtDNA content, transcript level, and protein abundance, respectively. The transcript levels varied upon overexpression of POLRMT PTM mimics, while mtDNA content was unchanged except for POLRMT K402Q and T993E. Western blot analysis showed POLRMT was successfully overexpressed. CYTB protein levels slightly decreased in HeLa cells transfected with POLRMT mimics. A slight decreasing trend in transcript levels of mitochondrial-encoded genes was observed upon overexpression of MRPL12 PTM. To determine if PTMs of POLRMT and MRPL12 vary in response to the nutrient status of the cell, we induced the short-term loss of available glucose coupled with the addition of pyruvate and glutamine, growth conditions which have been previously shown to increase oxidative metabolism. DNA and RNA were isolated at multiple time points to analyze mtDNA content and transcript level, respectively. Transcript and mtDNA levels trend higher with increasing nutrient deprivation time.

Characterization of Select Lysine Mutations of the Cystine/Glutamate Transporter, System xc-

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This research was supported by the A. Paul and Carol Schaap Undergraduate Research Fund and the De Vries Summer Research Fund.

System xc- is a membrane transport system that plays a critical role in mitigating oxidative stress. As such, its regulation is critical for proper brain functioning. Recent work in our lab has shown that System xc- activity increases immediately during an oxidative insult by undergoing a change in localization to the plasma membrane, but we have yet to identify the specific mechanism for the redistribution of the transporter. Previous studies have demonstrated that post-translational modifications of proteins can lead to differential protein distribution within cells. Therefore, in this study, we sought to determine if post-translational modification (PTM) of the transporter regulates its trafficking. First, we identified four conserved lysines (K37, K422, K472, K473) which exhibit decreased activity upon mutation to arginine, suggesting that PTM of these sites increases activity. We used biotinylation to examine the effects of the mutations on transporter localization in the cells, and we evaluated the effects these mutations had on the tendency for these transporters to undergo PTM. As such, this approach allowed us to directly relate changes in PTM status at these select lysines with changes in transporter localization. Our biotinylation results demonstrate K472R and K473R do not appear to shift to the membrane following peroxide treatment, and follow up immunocytochemistry analysis suggests they may be stuck in the endoplasmic reticulum. We also observed that K473R exhibits a 5-10 kD decrease in the molecular weight, indicating that K473 is modified under basal conditions. However, neither mutation impacted the ubiquitination status of xCT. Therefore, we are currently working to identify the PTM that occurs at these lysines, and our preliminary data suggests that K473R may exhibit changes in its glycosylation relative to wild-type and the other mutants. Collectively, these data suggest that PTM of K472 and K473 support xCT delivery to the membrane under basal conditions.

Does Phosphorylation on Serine 26 of System Xc- Lead to Changes in Cell Surface Expression?

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This research was supported by the A. Paul and Carol Schaap Undergraduate Research Fund and the De Vries Summer Research Fund.

System x_c^- is involved in transporting cystine into cells and glutamate out of cells, and ultimately in production of the antioxidant glutathione. Antioxidants are important in protecting cells from oxidative stress which can occur when waste products like H_2O_2 build up in the cell. Previous studies have shown that a critical regulator mTORC regulates system xc- by phosphorylating serine 26 (S26) on the N-terminus of the cystine/glutamate antiporter xCT, leading to a reduction in transport activity. The specific objective of this study is to determine the mechanism by which phosphorylation of S26 affects activity. To address this question, we used site-directed mutagenesis to create two mutants, one in which S26 was changed to alanine (S26A) and one in which S26 was changed to aspartate (D). S26A is unable to be phosphorylated because it is lacking a hydroxyl group on its sidechain, and S26D is a phosphomimetic, as aspartate is similar in size and charge to a phosphorylated serine. We are currently expressing these two mutants of xCT in COS-7 cells to determine how these mutants alter the cell surface expression of the antiporter. In addition, we are evaluating whether these mutations impact the post-translational modification of the transporter at another site, given that mTORC is commonly upregulated. Ultimately this work will allow us to understand the specific mechanism by which S26 phosphorylation and the mTORC pathway regulate transporter activity.

Intersection of one-carbon metabolism and mitochondrial genome maintenance

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This material is based upon work supported by the National Science Foundation under grant No. 2141375 and Schaap Endowed Funds for Undergraduate Research.

Mitochondria contain their own DNA (mtDNA), which encodes 13 subunits necessary for oxidative phosphorylation. The nuclear genome encodes all other mitochondrial proteins. Nearly 60 nuclear-encoded proteins are associated with mtDNA in nucleoid complexes, but the role of nucleoid proteins in regulating the mitochondrial genome is unclear. Interestingly, a group of proteins involved in one-carbon and redox metabolism, including methylenetetrahydrofolate dehydrogenase 1 like (MTHFD1L) and serine hydroxymethyltransferase 2 (SHMT2), have been assigned as nucleoid proteins. MTHFD1L creates formate for transport to the cytoplasm, where it is used for purine synthesis. SHMT2 catalyzes the cleavage of serine to glycine, synthesizing 5,10-methenyltetrahydrofolate, an important coenzyme in the synthesis of amino acids and nucleotides. We hypothesize that nucleoid proteins MTHFD1L and SHMT2 may relay nutrient status signals to control mtDNA maintenance and expression. MTHFD1L and SHMT2 were overexpressed in HeLa cells. DNA, RNA, and protein were isolated 24 hours post-transfection. Western blot analysis confirmed overexpression of MTHFD1L and SHMT2. Quantitative PCR was used to analyze mtDNA content and transcript levels to ascertain the effect of MTHFD1L and SHMT2 overexpression on mtDNA replication and transcription. No significant change in mtDNA content was observed. MTHFD1L overexpression increased mitochondrial transcription, while SHMT2 overexpression had little effect. MTHFD1L and SHMT2 were knocked down in HeLa cells using siRNA. RNA was isolated at 24 hours post-knockdown. Quantitative PCR was used to analyze transcript levels to ascertain the effect on mtDNA transcription. MTHFD1L and SHMT2 knockdown decreased mitochondrial transcription at 24 hours, although a loss of cell viability was also observed. We conclude that SHMT2 levels do not significantly impact mtDNA transcription. MTHFD1L levels impact mtDNA transcription.

Do post-translational modifications of mitochondrial RNA polymerase and ribosomal protein L12 control mitochondrial DNA transcription?

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This material is based upon work supported by the National Science Foundation under grants no. MRI-2017708 and RUI-1814845. This research was also supported by the Herbert H. and Grace A. Dow Foundation and the Schaap Endowed Research Funds.

Mitochondria play an important role in energy production and cellular metabolism. Mitochondria contain their own DNA (mtDNA), which encodes 13 subunits necessary for oxidative phosphorylation (OXPHOS). Over 1500 other mitochondrial proteins, including the 77 remaining OXPHOS subunits and the machinery for transcription and translation of mtDNA, are encoded by the nuclear genome. Thus, transcription of the nuclear and mitochondrial genomes must occur in concert to respond to the energetic needs of the cell. The mechanism of this communication is unclear and transcriptional regulation in the mitochondria is poorly understood. The mitochondrial proteome, including the transcriptional machinery, is subject to post-translational modifications (PTMs) such as phosphorylation of serine and threonine, and acylation of lysine. We hypothesize that PTMs of the mitochondrial transcriptional machinery regulate mitochondrial gene expression, akin to mechanisms controlling nuclear gene expression. Transcription of mtDNA requires three nuclear-encoded proteins: mitochondrial transcription factor A (TFAM), transcription factor B2 (TFB2M), and mitochondrial RNA polymerase (POLRMT). Mitochondrial ribosomal protein L12 (MRPL12), an accessory factor, may stabilize POLRMT and promote transcription. Using mass spectrometry, POLRMT and MRPL12 were shown to contain numerous sites of acetylation and phosphorylation, including previously undocumented sites. The biochemical functions of these modifications are unknown. PTMs were studied using site-directed mutagenesis to replace the amino acid of interest and mimic acetylation (lysine to glutamine) and phosphorylation (threonine to glutamate) of POLRMT or MRPL12. Mutated proteins were purified by affinity and ion exchange chromatography. Their binding affinity for the mtDNA promoter was determined by fluorescence anisotropy experiments. These experiments revealed that POLRMT PTM mimics had little effect on mtDNA binding. In addition, when MRPL12 and MRPL12 PTM mimics were co-incubated with WT POLRMT, mtDNA binding affinity was largely unaffected. Efforts are ongoing to characterize additional PTM mimics and assess the stability of POLRMT in the presence of MRPL12 PTM mimics.

Use of mass spectrometry-based proteomics to study post-translational modifications of the mitochondrial transcription machinery

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This material is based upon work supported by the National Science Foundation under grant No. 1814845 and MRI grant No. 2017708, and Schaap Endowed Funds for Undergraduate Research.

Mitochondria are unique sub-cellular compartments that contain their own genome which encodes for 13 protein subunits required for the synthesis of ATP. Currently, the regulation of mitochondrial gene transcription in response to changing energetic needs is not well understood. We hypothesize that protein post-translational modifications (PTMs) play a role in nutrient sensing and the control of mitochondrial transcription, similar to some mechanisms that control nuclear gene expression. We used liquid chromatography tandem mass spectrometry (LC-MS/MS) to identify PTMs on the mitochondrial protein expression machinery, including the mitochondrial RNA polymerase protein (POLRMT) and the ribosomal protein L12 (MRPL12). POLRMT and MRPL12 were overexpressed in mammalian cells and immunoprecipitated. Immunoprecipitated proteins were subject to trypsin digestion and the resulting peptides were analyzed by LC-MS/MS. Spectral library searching was used to identify peptides and PTMs. We obtained 41% sequence coverage for MRPL12 and 20% for POLRMT. We identified 5 distinct PTM sites on MRPL12, with the acetylation of K163 occurring in biological replicates. We additionally identified multiple sites of acetylation and phosphorylation on POLRMT. Additional biological replicates are being performed to confirm modified amino acids in both proteins. These PTM sites are being characterized using in vitro and cellular studies to develop a better understanding of the roles of PTMs in mitochondrial transcription and translation regulation.

Creation of an N-terminal xCT mutant lacking lysines for use in protein turnover studies

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This research was supported by the A. Paul and Carol Schaap Undergraduate Research Fund.

xCT plays a role in protecting cells from oxidative stress as well as intracellular glutathione synthesis. If this process is impeded, reactive oxygen species accumulate in the cell, leading to cellular damage, and if left unchecked, it can lead to neuronal loss. Ubiquitin is a small protein that some evidence suggests can negatively affect the stress response pathway modulated by xCT, as well as induce cell death. It is hypothesized that ubiquitin binds to xCT on the N-terminal lysine residues, and there are six conserved lysines in the N-terminal domain at positions K4R, K12R, K30R, K37R, K41R, and K43R. Previous work in the Chase lab has shown that the replacement of individual lysines with arginines does not result in a change in the ubiquitination of a transporter. Therefore, the goal of this project is to create a mutant of xCT in which all of the lysines in the N-terminus are replaced with arginines in order to determine if that will lead to a loss of ubiquitination of xCT and an overall change in the activity and regulation of the transporter. To do this, we did a successive site-directed mutagenesis approach to ultimately produce a mutant with all lysines replaced with arginines. Currently, we have created a construct that has mutations at K4R, K37R, K41R, and K43R, and we are attempting to add the final mutations. Once this is accomplished we will express it in COS7 cells, and determine if the mutant can still be ubiquitinated.

Development of a fluorescence-based assay to measure System xc- activity

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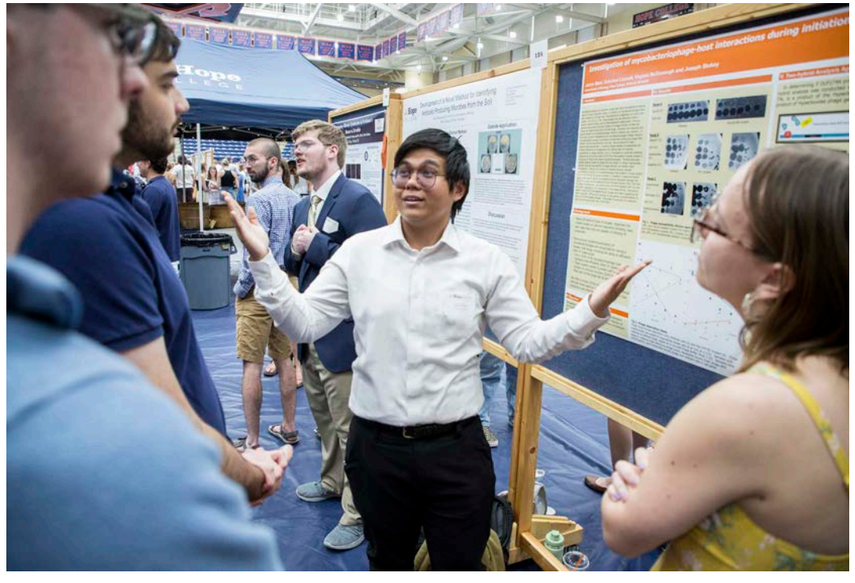
This research was supported by A. Paul and Carol Schaap Undergraduate Research Fund.

System x_c^- is a cell membrane antiporter that imports cystine while exporting glutamate. Cystine is essential for the synthesis of glutathione within cells, which is an important antioxidant. Abnormalities in the levels of these amino acids can have detrimental effects due to build up of H2O2 leading to neurodegenerative diseases. Given that the uptake of cystine is exchanged for glutamate, we aimed to develop a high throughput assay that detects glutamate output to measure system x_c^- activity. After adding cystine to cells transfected with x_c^- DNA, the concentration of glutamate outside the cell was determined by adding a solution of Glutamate oxidase and Horseradish peroxidase, along with Amplex Red, which produces a fluorescent product that is stoichiometric to the glutamate released. Fluorescence was measured from a 96 well microplate containing a glutamate standard curve, untransfected, and transfected cells at 30 second intervals over 5 minutes. Results showed significantly greater glutamate release in cells transfected with wild type xCT and 4F2HC compared to untransfected cells. Cells transfected with mutants of System x_c^- have also shown differences among classes of mutants. Mutants K37R, K37,43R, and K43R exhibited significantly decreased activity relative to wild type xCT. K41R, however, exhibited no difference in activity relative to wild type. These results are comparable to previous uptake assays performed in the Chase lab that were performed using radiolabeled substrate. Thus, this high throughput fluorescence-based assay will allow us to screen the activity of newly created xCT mutants in future studies aimed to identify critical sites of regulation.



Performance of Microbial Source Tracking Methods: Molecular Markers & qPCR/ddPCR

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This research was supported by the National Science Foundation (NSF), State of Michigan Department of Environment, Great Lakes, and Energy (EGLE), and Hope College Chemistry Department Schaap Research Funds.

Fecal contamination serves as a major public health threat, especially in drinking or recreational waters. Identifying the source of contamination serves as an important risk indicator when mitigating the effects of the pollution or preventing it from initially entering the water. Microbial source tracking (MST) is employed to achieve the quantification of dominant sources of fecal contamination. Specifically in this study, a library-independent method was utilized in the sample level detection of host-associated 16s rRNA markers. Among the most prevalent bacteria in human and animal gut microbiomes is the phylum Bacteroidetes, which prove to be extremely useful in MST assays. TaqMan primers and probes targeting host-independent Bacteroidetes were compared to human, pig, and cow host-specific primer/probes. We report application of this technology to water samples from Lake Macatawa and its tributaries in Ottawa County. Lake Macatawa is a drowned river mouth of Lake Michigan impacted by agricultural activity and urbanization. As control host-specific targets, solid fecal samples were acquired from a local petting zoo and from wastewater treatment plants. Samples were filtered using membrane filtration technology. Upon DNA isolation, the concentration of DNA was measured and the samples were subjected to qPCR or ddPCR assays. Results indicate effective primer/probe selectivity. Cross-reactivity between samples and primers demonstrated that the targets were not exclusive to the presumed host and could overlap. We find that the greater sensitivity of ddPCR compared to qPCR allows the establishment of reliable baseline marker DNA levels.

The impact of aerosolized iron oxide nanoparticle exposure on behavior of the house sparrow (Passer domesticus)

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Increased urbanization poses a threat to avian viability due to the introduction of air pollutants. Metallic nanoparticles, a component of particulate matter air pollution, can invade the bloodstream and brain and alter personality, or an animal's set of repeated behaviors. Previous research has found decreased antipredator behavior — scanning, freezing, and fleeing — and decreased movement time as an effect of nanoparticle exposure. Observationally, urban birds demonstrate increased exploratory and risk-taking behavior, both of which are facets of foraging. However, it is unclear if this is due to environmental demand or personality changes from air pollution exposure. This project examines the effects of iron oxide nanoparticle (IONP) exposure, as they are abundant in polluted areas like cities, on the personality of house sparrows *(Passer domesticus)*. This species occupies environments across the urbanization gradient and has a variety of food sources and predators, so house sparrows may serve as a sentinel species of the environmental impact of air pollution. We specifically looked at antipredator behavior and puzzle-solving capability and found no behavioral differences between exposed and control birds, so future work will reexamine antipredator behavior, as primarily measured by flight latency following a predator hawk call. We are also introducing a novel-environment foraging test in order to measure risk-taking, as measured by initial latency to forage, and exploratory behavior, as measured by total movement time and sites visited. We predict shorter latencies to flee following a predator call for IONP exposed birds, indicating lowered antipredator responses. We also predict shorter latencies to forage and decreased movement time in IONP exposed, indicating high risk-taking but less exploration overall. Results may identify behaviors that are connected to urbanization and increased air pollution, and how we can observationally measure certain behaviors to assess the relative threat of air pollution to an ecosystem.

Female Vocalizations in Response to Male and Female Urine

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Intersexual and intrasexual communication shapes courtship behavior and social interactions in mice. Studies have shown that mice use vocalizations, both broadband and ultrasonic, to communicate with one another. Broadband vocalizations (BBVs), which are detectable by humans, are shown to be produced predominantly by female mice. Ultrasonic vocalizations (USVs) are shown to be produced by male mice, and recently shown to be produced by female mice as well. There is ample research that has been conducted concerning male vocalizations in response to female urine, but there has been little research on the corresponding vocalizations that are produced by females in response to male and female urine. Because mice are used in a variety of scientific studies and scenarios, understanding this communication model will be essential in gaining a complete picture of the dynamics of social interactions and communication among mice. This fills a large gap in the literature which has previously been limited to studying males. This study aims to examine the vocalizations , if any, that a female mouse might elicit in response to the urine of another female or male mouse, and if female estrus state has any impact on this communication. We measured the frequency and duration of vocalizations produced when diestrus and estrus females were introduced to female urine, as well as urine from dominant and subordinate male mice. We hypothesized that male urine will elicit more BBVs from females, while female urine will elicit more USVs. We also hypothesize that females in estrus will vocalize less when paired with both males and females, compared to when they are in the diestrus stage. Results of this study will provide information on sex-specific communication between mice, and whether female mice produce vocalizations to communicate with other females.

Degeneration and neurogenesis following an excitotoxic focal lesion to the olfactory bulb of zebrafish

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This material is based upon work supported by the Dow Foundation and the Hope College Biology Department

Neurogenesis is the process of new neuron generation in the brain. Zebrafish have 16 different neurogenic sites, which allows for effective damage and lesion repair because of the ability to constitutively regenerate neurons. In zebrafish, the olfactory bulbs — part of the olfactory system – are highly regenerative and neurogenic. Our lab established a model of excitotoxic lesion (that targets glutamatergic neurons), and determined that the olfactory bulbs are structurally and functionally recovered. However, the processes of neurogenesis in the olfactory bulb following direct injury has not been studied. In this work, we use the same neurodegenerative model using an excitotoxic lesion to the right olfactory bulb of the zebrafish brain in order to investigate the neurogenic mechanisms occurring in the olfactory bulbs during its recovery. We generated a unilateral focal excitotoxic lesion by injecting quinolinic acid (QA) to the right olfactory bulb while the left bulb was not lesioned as an internal control. We assessed recovery of the olfactory bulb at 1 and 21 days post-lesion. In order to analyze recovery and regeneration, we used immunohistochemistry to tag newly generated cells following the lesion. Our results showed that lesioning the olfactory bulb reveals new cells being generated in the ventricular zone in the adjacent telencephalon, which is a highly active neurogenic niche, after 1 day post-lesion. After 21 days post-lesion, our results showed that the new cells have begun migrating away from the ventricular zone and towards the damaged olfactory bulb, which contributes to the restoration of the right olfactory bulb back to its non-lesioned form. These preliminary findings are the first to suggest cells performing neuronal regeneration following an excitotoxic lesion in the olfactory bulbs and ventricular zone of zebrafish brains.

Response of House Sparrows (Passer domesticus) to Predator-Based Auditory Cues and Consequent Threat Level Assessment

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This material is based upon work supported by the National Science Foundation under grant number 2217870.

The ability to distinguish between auditory stimuli of potential predatory threats is a significant evolutionary advantage seen in vertebrates and invertebrates. Small bird populations can detect predator threats from non-vocal auditory cues, but little is known about their ability to effectively assess potential threat levels of auditory stimuli. House sparrows *(Passer domesticus)* were chosen as they are highly auditory animals and may be able to detect attacks based solely on auditory cues from predators. Additionally, house sparrows have a significant history of commensalism with humans. While extensive studies have confirmed the house sparrow's ability to respond to differing predatory stimuli, here, we aim to test the house sparrow's ability to audibly assess potential threat level and distinguish between predator and non-predator auditory cues within a more urbanized environment. We intend to use differing types of auditory stimuli including: a control (i.e., non-predator bird song), a loud startling noise, and a predatory noise (e.g., running terrestrial animal). The sparrow's ability to respond and then consequently distinguish what type of noise was produced will be measured based on latency between flushing and returning to foraging. We hypothesize that the house sparrows will have no response to the control sound, but will have sudden responses to both the loud, startling noise and predatory noise. We predict that the latency between flying away from the noise and returning to foraging will be shorter after hearing the loud, startling noise compared to the sound of the predator. Furthermore, house sparrows will be able to characterize predator auditory cues from non-predator auditory cues and assess potential threat level associated with both. It is important to understand how noise pollution created within an urbanized environment impacts the house sparrow's ability to perceive predatory threats.

Urbanization Alters the Song Propagation of Two Human-Adapted Songbird Species

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Urban expansion has increased pollution, which includes both the physical (e.g. exhaust) and sensory (e.g., anthropogenic noise) components. Research shows that birds increase the frequency and amplitude of their song in urban areas to reduce masking by low frequency noise pollution. However, bird song (i.e., a signal) is also affected by the environment and accompanying ambient noise. This study investigates how anthropogenic disturbances alter the ability of birds to communicate. Specifically, this study examined differences in active space, or the maximum distance a receiver can detect a signal, across an urbanization gradient. This study utilized the house sparrow *(Passer domesticus)* and the house finch *(Haemorhous mexicanus),* as both species can inhabit urban areas and rely on vocal cues from conspecifics. Recorded songs were played back with a speaker at urban, rural, and suburban locations in Holland, MI, and recorded at distances up to 100 meters. This set-up mimicked bird communication, with the speaker acting as the sender, the song as the signal, and the recorder as the receiver. We expected songs in rural areas to have a larger active space compared to urban environments due to lower noise pollution. Results suggest a significant two-way interaction in which active space differed depending on urbanization and species. In rural and suburban areas, house finches had a larger active space than house sparrows. However, this trend did not exist in rural areas, where house sparrows and house finches had similar active spaces. Furthermore, we also found a significant main effect in which active space differed depending on song exemplar. These results suggest that urban environments constrain the propagation of vocal signals. This has implications in which urban environments may inhibit the ability of birds to communicate to potential mates or kin.

Does the House Sparrow (Passer domesticus) Prefer Color or Location-based Cues When Exhibiting Foraging Behavior?

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This material is based upon work supported by the National Science Foundation under grant number 2217870.

Foraging impacts an animal's fitness as it is an essential dimension to an animal's ability to survive and reproduce. Animals use different memory tactics to successfully select their food source, including color and location-based cues that have proven successful in past foraging events. In particular, some birds have been found to have preferences in utilizing color-based cues while foraging, such as the hummingbird feeding from bright, attractive flowers, while other birds utilize location-based methods, such as the albatross navigating with precision. However, less is known about which cue is preferred during foraging behavior when observing the house sparrow (Passer domesticus). House sparrows are an optimal model of study due to their high learning capacity and their expansive population density. This study aims to determine the preferred memory cue used by house sparrows while foraging. To test this, each house sparrow was placed into a cage with two feeders – a blue feeder or red feeder, placed on either the right or left side. After acclimating the house sparrow to these conditions, we switched either the location or color of the feeders to observe which memory-based cue the sparrow preferred while foraging. The preferred cue was determined by totalling up the amount of birds that went to each feeder first. We hypothesize that house sparrows will prioritize location-based cues due to the spatial memory often exhibited by bird families as they return to specific previously successful feeding sites. These findings will increase our understanding of how these birds are able to access the food resources essential to survival.

Genomic Analysis of the Novel F1 Mycobacteriophage Stap

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Fifteen new mycobacteriophages were isolated from soil samples collected around the campus of Hope College and other locations in Michigan. All phages were capable of infecting Mycobacterium smegmatis and were isolated through either enrichment at 37°C, enrichment at 34°C, or direct plating at 34-35°C. A variety of plaque morphologies were produced based on size, shape, and clarity; both lytic and temperate phages appear represented in this collection. The mycobacteriophage Stap was chosen as one of two phages for complete genome sequencing and comparative genomic analyses. The predominant plaque produced by Stap after 24 hours at 34-35°C is a clear plaque about 1 mm in size. After one week at 4°C, the plaque will gain a crescent comet tail about 3mm in diameter. The complete genome sequence for Stap showed it was similar to mycobacteriophages of cluster F, subcluster F1, which now contains 203 sequenced members. Comparative genomic analyses show it most similar to the F1 phage Ramsey isolated in 2005 in White Bear, Minnesota, and least similar to phage Bipolar isolated in 2013 in Caldwell, Indiana. Stap has a genome size of 54,395 bp and contains about 100 protein-encoding genes but no tRNA or tmRNA genes. This genome size is at the small end of all F1 phages, which range from 52,141 bp to 61,164 bp. Like other F1 mycobacteriophages, Stap shows a high degree of genomic sequence and structural variability making annotation of this genome an interesting challenge. For example, there are several initial predictions for genes being encoded in overlapping segments on both strands of the double-stranded DNA genome (e.g., genes 34-35, 45-46, and 99-100) — an unusual organization of genetic information even for phage genomes. The F1 phages also show a high degree of sequence and gene variability in the region centered around Stap genome coordinate 44,000 bp.

Impact of Male Dominance Behavior on Female Receptivity in Laboratory Mice

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Amongst social animals, dominance behavior is understood to be an extensively common phenomenon. Individuals that display dominant behavior are much more likely to emerge victorious in measures of social competition and survival due to success in gaining food. Maintaining social dominance requires increased energy demands while subordinates may sacrifice foraging attempts and avoid aggressive engagements for safety. Most research into dominance status has focused on male mice, however female mice play an important role in social behavior. Female mice can become pregnant during the estrus stage, and may also display rejection or escaping behavior in mating. Little is known, however, about how male dominance status influences female receptivity in mating during differing estrus stages. The present study attempts to investigate how hierarchical dominance formation in male mice influences female receptivity at differing estrus stages. Male mice were allowed to develop domination behavior hierarchies through exposure to cage mates. Sexually experienced males and females were placed simultaneously into a container with a novel partner to observe which type of male, dominant or submissive, the females accepted, and how this related to female estrus state at time of male mounting. We hypothesize that males showing dominant behavior will correspond with an increase in female receptivity to mounting behavior. Additionally, we hypothesize that this correlation will be particularly strong in the estrus stage of female mice. We predict that the female mice will not reject or escape more dominant males during the estrus stage. Results of this study will provide further insight into behavioral mechanisms of dominance as a means for social and reproductive fitness as well as reveal mating behavior patterns and selection criteria of female mice. This knowledge is important as it will highlight how future research can take into consideration social status such as dominance and estrus state of females.

A Comparison of Antipredatory Responses to Visual and Olfactory Stimuli in House Sparrows

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Eden Comer

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As of 2019, the house sparrow population has declined 84 percent in North America since 1966. Antipredatory behavior in birds has long been observed, but little is known about the relative roles of visual, auditory, and olfactory cues in triggering antipredator responses. This research focuses on the visual and olfactory influences on the antipredatory response of the house sparrow *(Passer domesticus).* House sparrows are an ideal model because they are gregarious, innovative birds on which previous research has focused concerning visual and olfactory stimuli. There is conflicting evidence as to the extent that birds respond to olfactory cues, and further research is necessary to determine the relative importance that birds attribute to olfactory information. Our research seeks to answer this question by asking how house sparrows respond differently to visual feline stimuli, olfactory feline stimuli, and a combination of both. We chose the domestic cat *(Felis catus)* as our model predator because they are the most common threat to house sparrows, especially in urban environments. House sparrows collected from Holland, Michigan will be placed individually in an enclosure and their antipredator behavior will be recorded in the presence of visual (i.e., model cat), olfactory (i.e., urine), and combined stimuli. We predict that house sparrows will have a stronger antipredatory response when exposed to combined stimuli, becoming vigilant and flushing to cover more often than when exposed to isolated stimuli. We also expect a stronger response to visual than olfactory stimuli because birds have been shown to rely primarily on visual stimuli. Results of this study will provide information on how house sparrows use olfaction relative to vision, which may illuminate their predator detection and evasion strategies and provide important insights into their population decline.

Investigation of mycobacteriophage-host interactions during initiation of phage infection

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Mycobacteriophages are bacterial viruses that infect mycobacterial species. Nearly 40 distinct genomic types, or clusters, of mycobacteriophages have been isolated on a single host, *Mycobacterium smegmatis,* but only a few clusters — A2, A3, G, K, AB — have phages that can efficiently infect a broader range of hosts, such as *Mycobacterium tuberculosis.* Previous analyses have shown that the initiation of phage infection is often the critical and determining factor of host range. However, the molecular and genetic details of mycobacteriophage infection initiation are unknown. In this study, we are investigating how mycobacteriophages initiate infection, from adsorption through reversible-to-irreversible binding and phage DNA transfer into the mycobacterial host cell. We are taking two basic experimental approaches: 1) isolating phage-resistant mycobacterial cell mutants following UV-mutagenesis and testing them for reduced susceptibility to phage infection, and 2) investigating a particular predicted phage tail tip structural protein (DUF2744) that appears uniquely present in this group of broad host range mycobacteriophages. Mutants previously isolated against cluster A2 phage D29 and cluster K1 phage Hyperbowlee, showed reduced susceptibility to phage infection and remain under investigation. We are now looking for mutants showing reduced susceptibility to Soul22, a mycobacteriophage that contains a unique version of the DUF2744 tail tip structure protein. In addition, a yeast two-hybrid system was used to test for a predicted physical interaction between the DUF2744 protein and the adjacent known tail gene product (TAL) from the K1 phage Hyperbowlee. Our results show DUF2744 interacts with TAL and with itself, suggesting it is a component of the phage tail tip. Attempts to isolate a viable DUF2744-deleted Soul22 phage have failed suggesting the gene is essential. Efforts are underway to use genetic complementation to recover DUF2744-deleted phages. This system would allow for extensive testing of the function and role of DUF2744.

Can you hear me? The Role of Urbanization on Auditory Sensitivity in the House Sparrow *(Passer domesticus)*

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This research was supported by the Dows Scholars Foundation and the Christian Scholars Foundation

Animal communication involves a sender producing a signal (e.g., a vocalization) that travels through the environment before being detected by a receiver. Increased urbanization can complicate receiver sensory processing as anthropogenic activities (e.g., noise pollution) affect the way birds communicate. This study examined the influence of urbanization on the auditory processing system of house sparrows *(Passer domesticus),* known for inhabiting urban areas and relying on vocal cues from conspecifics. Birds (N = 48) were collected across an urbanization gradient in Holland, Michigan and performed an auditory brainstem response (ABR) test. ABRs are generated from the auditory brainstem at the onset of a sound stimulus. We presented birds with 6 different frequencies (0.5, 1, 2, 3, 4, 6 kHz) at 9 intensity levels (from 8 dB to 72 dB in 8 dB intervals). The amplitude, latency, and threshold (the lowest intensity level at which there is still an ABR) of each waveform was analyzed. We predicted decreased auditory sensitivity in urban birds because they are exposed to consistent anthropogenic noise. In Holland, urban areas are roughly 10 dB louder than rural areas, which has the potential to cause hearing damage. Moving from rural to urban, we expected decreases in amplitude and increases in threshold. Our results showed two significant three-way interactions between season, sex, and urbanization level on threshold and between season, intensity, and urbanization level on ABR amplitude. Although males showed no significant difference, females presented differences based on season and urbanization level. It has been suggested that females tend to have greater frequency selectivity during breeding months in order to select mates. Thus, our results exhibiting sex and seasonal effects were not surprising and provide insight to understanding the impacts on bird communication, especially in regards to mate choice and reproductive success.

Characterization of a Novel Peptide Binding in HUVEC Cells Using Fluorescent Polarization Approach

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This research is funded by The American Heart Association

CUL5 acts as the scaffold protein in the E3 ligase complex in the ubiquitin-dependent protein degradation pathway and has been implicated to play a role in cancer pathways. Overexpression of CUL5 in endothelial cells (HUVEC) inhibits proliferation, whereas inhibition of CUL5 expression induces cellular proliferation. In our search to identify proteins that interact with CUL5, we have isolated a novel peptide (LB) that attenuated cell growth in control HUVEC (PX) but not in cells where CUL5 was knocked out using the CRISPR approach (KO). Thus, the aim of this study was to examine if this effect of LB on HUVEC proliferation was dependent on direct CUL5-LB interaction. Our preliminary results, using fluorescent polarization approach, suggest that fluorescent LB binding in KO cells is attenuated when compared to PX cells. Our current work focuses on further characterizing these interactions and how they affect specific signaling pathways that control cellular growth.

Development of a Novel Method for Identifying Antibiotic Producing Microbes from the Soil

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Mentor:
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This research was supported by the Hope College Biology Department

Multi-drug resistant (MDR) bacteria are strains of bacteria that are resistant to multiple types of antibiotics and pose a serious public health threat. Our research group has developed a novel way to rapidly screen soil bacteria isolates for antimicrobial chemical production in a clear and reproducible manner. We examined the effects of certain variables on our method including: 1) agar type on antimicrobial diffusion, 2) agar depth on antimicrobial diffusion, 3) age of the soil isolate on the amount of antimicrobial produced, and 4) soil isolate placement on the inhibition of bacterial growth. Our combined results led to the creation of a novel "bilayer plate" combining two stacked agar layers of different agar types and the use of a novel "cross inoculation" technique to screen soil isolates for the production of antimicrobial substances. This new method, which we call "The Isola-Slayton Method," was used in the identification of several soil isolates that produced substances which inhibited multiple ESKAPE bacterial species (a set of bacterial pathogens that often cause MDR healthcare-associated infections). This new method may provide a quick and effective way to test microbial isolates in the pursuit of new antibiotics.

Effects of Iron Oxide Nanoparticle Exposure on the Auditory Physiology and Iron Bioaccumulation in House Sparrows *(Passer domesticus)*

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Air pollution (including particulate matter, PM) has increased as a result of a dramatic increase in urbanization. Nanoparticles within PM can be detrimental to health when inhaled. Nanoparticles are small enough to bypass the blood-brain and blood-gas barriers, and can potentially accumulate in organs within the organism. Previous work has linked bioaccumulation of iron oxide nanoparticles (IONPS) to cancer and organ poisoning. Interestingly, in model organisms, nanoparticle exposure has been linked to hearing deficits, suggesting that decline in hearing may be an early bioindicator of future health consequences. While the mechanism for this hearing deficit is unknown, there could potentially be a link between IONP bioaccumulation and hearing sensitivity. This project aims to determine the effects of IONPs on the auditory physiology and the bioaccumulation of iron in the house sparrow *(Passer domesticus)*. House sparrows are an ideal model because of their prevalence around human development, complex social cues, and unique respiratory structures. To test the effect of IONPs on auditory physiology, an auditory brainstem response (ABR) test was conducted before and after exposure to either an IONP solution or sterile saline. Organs were then collected and iron content was determined via inductively coupled plasma (ICP) spectroscopy. These results will shed light on the role of air pollution on the physiological changes of avian species. Furthermore, by studying avian species, we can potentially understand the impact on the larger ecosystem.

Modeling Olfactory Dysfunction in Parkinson's Disease in Zebrafish

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This research was supported by the Kenneth G. Campbell Foundation, an Ed and Ann Anderson Award, a Stewart research fellowship, the Alfred and Dorothy Popma Fund for Biology, and the Hope College Biology Department.

Parkinson's Disease (PD), a neurodegenerative disorder characterized by dopaminergic neuronal loss and motor impairment, affects roughly 1 in 500 people. Interestingly, olfaction loss is prevalent in over 95% of those with PD. However, the underlying mechanisms of PD and olfactory dysfunction are not well understood. Zebrafish provide an ideal model to study neurodegenerative diseases and regenerative processes as they present neurogenic capability (i.e., generation of new neurons) and a high degree of neuroplasticity. We developed a model to study the association between dopaminergic loss and olfactory dysfunction in zebrafish. To do this, we used adult zebrafish of both sexes and injected 6-hydroxydopamine (6-OHDA) into the cerebrospinal fluid at the ventricular zone. We assessed dopaminergic neuronal loss, markers of inflammation, and motor and olfactory behavior 1 and 3 days post injection (dpi). We predicted that following the injection of 6-OHDA there would be dopaminergic neuronal loss and an increase in neuroinflammation, resulting in olfactory loss. We show that at 1 dpi, the olfactory bulbs present a dramatic increase in the number of apoptotic cells, confirming an effective lesioning method. Our preliminary results convey no significant difference in the amount of dopaminergic (TH, tyrosine hydroxylase +) neurons, although a clear trend exists. This trend continues 3 dpi, however we observed control levels of cell apoptosis 3 dpi. Further, there was a stark increase in the neuroinflammatory response, by means of GFAP staining 1 and 3 dpi. Interestingly, we found that 1 and 3 dpi fish displayed increased swimming distance and speed, suggesting that injections might be altering motor behavior. Surprisingly, even after the disclosed morphological differences in the bulbs, we found no differences in olfactory function. Overall, our results show that we successfully optimized a method for injection of 6-OHDA to target dopaminergic neurons in the olfactory system.

Genomic Analysis of the Novel A4 Mycobacteriophage Spino

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Fifteen new mycobacteriophages were isolated from soil samples collected around the campus of Hope College and other locations in Michigan. All phages were capable of infecting *Mycobacterium smegmatis* and were isolated through either enrichment at 37°C, enrichment at 34°C, or direct plating at 34-35°C. A variety of plaque morphologies were produced based on size, shape, and clarity; both lytic and temperate phages appear represented in this collection. The mycobacteriophage Spino was chosen as one of two phages for complete genome sequencing and comparative genomic analyses. The predominant plaque produced by Spino after 24-48 hours at 37°C was about 1mm in diameter with a small variation in size. The edges taper off to a small turbid perimeter and no additional plaque rings or comet tails were observed. Spino has a genome size of 51,372 bp and contains 87 protein-encoding genes but no tRNA or tmRNA genes. The complete genome sequence for Spino showed it was similar to mycobacteriophages of cluster A, subcluster A4, which now contains 132 sequenced members. Comparative genomic analyses across the A4 subcluster show Spino most similar to phage Funston, which was isolated in 2012 in Hartford, Connecticut, and least similar to phage BangNhom, which was isolated in 2018 in Providence, Rhode Island. Despite the A4 subcluster of mycobacteriophages being very similar across its 132 members, we are exploring several interesting genomic features in Spino including a region of repeat sequences in a predicted minor tail protein, the presence of 2 predicted DNA methyltransferases and a SprT-like protease. About half of all A4 mycobacteriophages have the serine-type of integrase, including Spino. Although Spino shows features of being a temperate phage, attempts to isolate a stable lysogen were unsuccessful.

A New Beginning — How noncoding sequences could be the force behind phage genome evolution

Ethan West

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This material is based upon work supported by the National Science Foundation under Grant No. 1662655. Additional funding for this project comes from the Clare Boothe Luce Program.

Mycobacteriophages are incredibly diverse in their genetic constitution and contain protein sequences found in other viruses, bacteria, and even humans. Their genomes display many unique features in comparison to the genomes of cellular life including having a large number of genes of novel sequences and without known functions, tightly packed genes with little non-coding space, and a large number of genes that appear nonessential. It is not clear how all that diversity is created and maintained in phage genomes. We predict that selection pressure on certain regions of non-coding, intergenic sequence, especially when followed by genes essential for phage reproduction, drives the evolution of new genes at those non-coding intergenic sequence sites to maintain higher phage fitness. To test this hypothesis, we are building, and will test for growth and relative fitness, genome-modified test phages with and without non-coding intergenic sequence space. For each phage pair, a gene not essential for growth and followed in the genome by a gene that is essential for growth, was replaced with an artificial gene sequence or a corresponding non-coding sequence of identical size and nearly identical DNA sequence but which is not translatable (i.e., lacks translation start codons includes extra translation stop codons). We are using the mycobacteriophage Giles genome as a platform for this work; it has been analyzed and non-essential genes identified. To date, one phage pair (Giles_57S and Giles_57SN) has been assembled and tested with those results supporting the hypothesis. The test phage with the artificial gene produced a significantly higher plaque titer than the paired test phage containing the non-coding, intergenic sequence. The goal of this work is to complete the construction and test additional pairs of test phages starting with the adjacent non-essential Giles_56 gene site.

Auditory Differences between Two Species of Sexually Dimorphic Songbirds

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Mentor:
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Auditory sensitivity directly impacts songbird survival and reproduction by mediating communication between male and female conspecifics. Different sex-specific pressures (e.g., song discrimination and detection during mate selection) on the auditory processing system have been shown to produce variation in auditory sensitivity of male and female individuals. Recent evidence has suggested a seasonal variation in auditory sensitivity between sexes, establishing greater sensitivity in females during the breeding season, due to elevated concentrations of auditory-sensitive hormones produced by females. However, similar studies have found only subtle differences in auditory function between sexes during the non-breeding season. In this study, we explored unknown sex differences in two common passerine species that show sexual dimorphism in their plumage coloration, the house finch *(Haemorhous mexicanus)* and northern cardinal *(Cardinalis cardinalis)*. Birds were collected from locations near Holland, Michigan during the early breeding season. To assess sex differences in auditory processing, auditory brainstem response (ABR) tests were performed to measure individual ability to detect sounds at varying frequencies and intensities. Birds were presented with an acoustic stimulus at six frequencies and nine intensities to measure latency (speed of signal transmission), amplitude (quantity of neuronal response), and threshold (minimum signal intensity producing an ABR). Females were hypothesized to have greater auditory sensitivity due to the sex-specific physiological mechanisms mediating auditory processing during the breeding season. Results from this study will provide novel baseline information on sex differences in auditory threshold data for two relatively understudied songbird species.

Exploring quinoline-functionalized long-wavelength BF_2-coordinated azo dyes

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A decade ago, Aprahamian and coworkers first reported their initial accidental discovery of a series of BF_2-coordinated azo dyes which photoisomerize at much longer (lower energy) wavelengths than conventional azo dyes. Shortly thereafter they published a second paper using electron donating groups on only the phenyl moiety to tune the spectroscopic and photophysical properties of these dyes before returning to their intended hydrazone chemistry. These BF_2-azo dyes' longer wavelength absorbance would make them ideal for many applications where conventional azo dyes are limited by their shorter wavelength higher energy absorbance spectra (leading to biomedical incompatibility, competitive absorbance, and photodegradation). At Hope College, in the Gillmore undergraduate organic photochemistry research group, we began preparing analogs of Aprahamian's dyes with polymerizable "handles" in an attempt to incorporate the dyes into photomechanical polymer systems. Unfortunately, we soon discovered that there was yet too much unknown about these dyes for such an ambitious project. However, we did demonstrate methods to functionalize the quinoline as well as the phenyl moiety, and had preliminary indication of similar effects upon substituting either moiety. The Gillmore group has undertaken an ACS PRF funded project to capitalize on these preliminary results to better understand these dyes. Substitutions on the quinoline moiety have the potential to allow even greater spectroscopic tuning of these dyes. In this poster we present our fledgling efforts toward developing both even more electron rich analogs of the dyes, with electron donating groups (EDG) on both the quinoline and the phenyl moieties, and also push-pull systems in which there are electron withdrawing groups (EWG) on the quinoline and EDG on the phenyl (potentially increasing effective conjugation length and single bond character of the azo bond). Effects of substitution at the 4- and 6-positions of the quinoline will also be described.

Selective Preservation of Structural Carbohydrates During Peat Formation

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The structural carbohydrate "sphagnan" has been hypothesized to play a role in slowing the degradation of Sphagnum moss, and therefore contribute to carbon sequestration in peatlands. Sphagnan is composed of a galacturonic acid and rhamnose backbone. However, it is currently unclear whether sphagnan persists beyond early-litter degradation and plays a role in the long-term preservation of organic matter in peatlands. In this study, we analyzed hydrolyzable neutral sugars, using rhamnose as a proxy for sphagnan content, and tracked the concentration of rhamnose present within moss before and after a 270-day period of decomposition, as well as the concentration of rhamnose at different depths within five peat cores collected from a southwest Michigan bog. While there was a clear increase in the relative abundance of rhamnose during the moss decomposition process, there was little change in the rhamnose concentrations within the peat cores in relation to depth. This implies that the degradation of sphagnan occurs at roughly the same rate as other sugars. However, an increase in the concentration of glucose with depth, with decreasing abundances of xylose and arabinose, indicates that cellulose is selectively preserved compared to hemicelluloses, accumulating over degradation. Overall, our results show that sphagnan is selectively preserved during litter decomposition, but other structural carbohydrates may play a larger role in the long-term preservation of organic matter in peatlands.

Automating a Data Analysis Pipeline Including Automated Colony Counting

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Mentors:
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Dr. Aaron A. Best, Biology

Dr. Brian P. Yurk, Mathematics & Statistics

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The poor condition of the Macatawa watershed has long been an area of focus for the greater Holland community. Urbanization and agricultural development introduce excess nutrients, which lead to hypereutrophication and affect reduced water quality. Hope College has been collecting data to better understand patterns in a variety of chemical and physical measures and their relationships to bacterial communities. This poster focuses on streamlining the input process for the monitored data sources. This includes automating various tasks, such as copying and pasting data, formatting data, performing arithmetic operations, and downloading and uploading data files. These automations are expected to both save time and reduce error. One particularly time-intensive task is counting bacterial colonies as a part of EPA Method 1603, which reports the concentration of Eschrichia coli in a water sample in colony forming units. This poster also reports a combined color processing transformation and machine learning analysis that is believed to be a novel method of automated colony counting.

Microbial Community Composition Dependence on Season and E.coli Abundance in the Macatawa Watershed

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The poor condition of the Macatawa watershed has been an area of focus for the greater Holland community for decades. Urbanization and agricultural development are key reasons for the poor water quality as they introduce excess nutrients. These nutrients, such as nitrates and orthophosphates, lead to hypereutrophication of the lake and catalyze the growth of algal blooms and the spread of potentially dangerous bacteria. Hope College has been collecting data to better understand trends and patterns within the lake that affect both levels of nutrients and the bacterial communities. We continuously monitor levels of *Escherichia coli*, orthophosphates, nitrates, total suspended solids (TSS), and other biological and chemical attributes. This poster focuses on investigating the composition of microbial communities using ordinations and DESeq analyses. A series of ordinations plots were made to identify key factors that are associated with variation in the microbial communities. DESeq analysis was then used to identify the OTUs (which are approximately species) with the most significant differences in abundance depending on a particular factor. Significant difference was determined by the log two-fold change threshold, in which the variability between conditions was represented as the log base-two of the ratio of the abundances. In the analyses reported here the primary variables of interest were winter versus summer season and low versus high E. coli abundance (as measured by mTEC counts). The DESeq results based on seasons showed high thresholds and clustering due to other factors. The mTEC DESeq results showed lower thresholds and little to no clustering. These changes in microbial communities are presented in the form of heatmaps showing the effects of these variables on the Macatawa Watershed.

Structural investigation of novel supramolecular anion cages with synchrotron X-ray diffraction

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Mentor:
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Synchrotron radiation provides an intense, tunable energy X-ray beam. Synchrotron single crystal X-ray diffraction (SSXRD) are very powerful tools to study crystalline materials. SSXRD provides high-resolution and quality x-ray diffraction data compared to conventional laboratory XRD. The recent development of supramolecular anion cages for nonspherical anion sequestration by the Hernandez-Sanchez group has prompted interest into their crystalline structure. This research aimed to investigate the crystal structure of samples at the Argonne National Laboratory.

Nanoparticle Interactions in Cartilage-Mimicking Hydrogels

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Andrew Lanham

Mentor:
Dr. Meagan Elinski, Chemistry

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The prevalence of osteoarthritis along with the associated pain, limited mobility, and mental health impacts, has resulted in numerous treatment strategies including the use of nanoparticles as drug-delivery systems in the joints and multiple uses of hydrogels. For hydrogels, the synthetic control and cartilage tissue-like features lend them to applications in cartilage engineering and regenerative efforts, as well as synthetic cartilage replacements, for combating degraded articular cartilage. However, in many of these approaches, the concerted mechanical-chemical effects and potential tribochemical processes from joint sliding is not well understood. This work aims to understand fundamental tribochemical reactions for hydrogels in the presence of nanoparticles. Well-studied hydrogels (e.g. polyvinyl alcohol) were used as model systems. In situ sliding tests were conducted with the hydrogels immersed in an aqueous solution of nanoparticles, comparing carbon-based, metal oxide, and metal nanoparticles. Optical imaging and confocal Raman microspectroscopy was used pre- and post-sliding to assess changes in the hydrogel surface as a result of sliding in the presence of nanoparticles. This research helps understand mechanochemical relationships in model systems, contributing to the ongoing development of effective treatments for osteoarthritis.

Development of Directing Groups for Rhodium-Catalyzed Decarbonylation Reactions

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Mentor:
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Selective metal-catalyzed C-C bond activation is useful in constructing and simplifying pathways to synthesize complex molecules. Consequently, several methods of C-C bond activation have emerged in the past few decades. Previous work has utilized rhodium-catalyzed decarbonylation to form new C-C bonds from pyridyl ketone starting materials, where the nitrogen on the pyridine ring acts as a directing group. Though this reaction is easily replicated and gives high yields, the need for a pyridine directing group limits the range of molecules that can be synthesized. The goal of this project is to develop new directing groups to increase the scope of this decarbonylation reaction. To this end, various ketones with amine-containing moieties were synthesized, and success was found with several directing groups.

Carbon-Carbon Bond Activation: Optimization of Exchange-Decarbonylation Reactions of Diortho-Fluoro Pyridyl Ketone with Boronic Acids

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Rhodium-catalyzed decarbonylation reactions occur readily with a variety of substituted pyridyl ketones. However, the 2,6-diortho-fluoro pyridyl ketone does not undergo decarbonylation on its own. When examining this unreactive ketone, a reaction was found with boronic acids that leads to an aryl ring exchange and subsequent decarbonylation. This decarbonylation-exchange reaction was evaluated using three promising sets of experimental conditions to assess the scope of boronic acids compatible with this transformation.

Comparing the Efficiency of Directing Groups in Rhodium-Catalyzed Decarbonylation of Ketones

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This material is based upon work supported by the National Science Foundation under grant No. CHE-1716411 and the Schaap Endowed Fund for Undergraduate Research.

The mechanism for rhodium-catalyzed decarbonylation is relatively well understood, and the reaction proceeds with a variety of effective directing groups. This study investigated the efficiency of known directing groups in rhodium-catalyzed decarbonylation of ketones, specifically in the oxidative addition step of the mechanism. The directing groups studied include pyridine, benzoquinoline, pyrazole, and pyrimidine. Competition reactions were set up between each directing group and ^{1}H NMR analysis was used to visualize starting material consumption. Pyridine was discovered to be the most efficient directing group followed by pyrimidine, pyrazole, and finally benzoquinoline.

Influence of Molecular Structure on Interactions with Nanodiamonds Under Shear Stress

Lindsay Martin

Mentor:
Dr. Meagan Elinski,
Chemistry

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The transportation and energy sectors of society rely on lubricants that serve to protect the surfaces of moving components during sliding contact, but there is still a need to improve the energy efficiency and meet increasing demands for specialized lubrication schemes. Complicating these efforts are the tribochemical processes — chemical reactions driven by shear forces — that occur when two surfaces come into direct physical contact. Research strives to take advantage of tribochemical reactions through combining additives that form surface-protecting films, but there is still little known about the role of the chemical environment on film formation. Moreover, composite additive systems show promising cooperative and synergistic behaviors but depend on several parameters, including surface chemistry. Therefore, this work focuses on gaining a more detailed understanding of the environmental and interfacial parameters in sliding contacts that govern tribochemical processes. Tribopolymerization reactions on steel substrates were measured for molecules with concurrent alcohol and alkene functionality in varied positions (8-nonen-1-ol, cis-2-nonen-1-ol) using a rheometer with a tribology adaptor. The impact of nanodiamonds on each molecule was assessed for catalytic effects. These sliding test results combined with ex situ analysis (confocal Raman microspectroscopy) will provide further insight into tribochemical processes to help advance the field towards a predictive ability in designing next-generation lubrication schemes.

Multifaceted Surface Coatings from Composite Dry Lubrication Schemes

Nicholas Migaldi

Mentor:
Dr. Meagan Elinski,
Chemistry

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Two-dimensional (2D) materials are an attractive route to modulate interfacial behavior both in dry lubricant applications and in electronics. This positions them particularly well for potential use as multipurposed coatings for emerging technologies such as electric vehicles or space-based interfaces. As stand-alone materials, there is a growing selection of 2D materials with well controlled chemical composition and mechanical and electronic properties. These properties can be further altered through nanoscopic curvatures to control out-of-plane bending. With respect to dry lubrication, composite systems comprised of 2D materials and nanoparticles provide low friction through a nanoscrolling mechanism in which the 2D materials wrap around the nanoparticles. With respect to electronic applications, surfaces with nanoscopic roughness provide a platform to tune the bandgap of 2D materials through induced strain. This project seeks to understand the mechanical-electronic intersection of these observed effects, focusing on induced strain in 2D materials that have scrolled around nanoparticles as a result of sliding forces. Molybdenum disulfide (MoS_2) and phosphorene 2D materials were used in conjunction with metal oxide nanoparticles of varying sizes, implemented to induce varying degrees of strain. Sliding tests were carried out at nanoscopic length scales (atomic force microscope, AFM) and macroscope length scales (rheometer tribology adapter). Post-sliding confocal Raman analysis assessed the degree of strain through monitoring peak shifts. This helps establish workable parameters for designing tailored multipurposed surface coatings.

Synthesis and characterization of clusters of TiO2-Fe3O4 nanoparticles

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Mentor:
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Chemistry

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The Nano Goch group focuses on developing multifunctional nanomaterials. To achieve this, a solvothermal synthesis that produces clusters of nanoparticles is being modified. My work focuses on using nanoparticles formed by coprecipitation as an extra reagent in the solvothermal synthesis. The purpose of this project was to understand how the multiple synthetic parameters affect the size and shape of the nanoparticle clusters. To study this, we characterize our new nanomaterials with Zeta Potential, Dynamic Light Scattering, and a Scanning Electron Microscope. Our goal is to be able to control the synthesis in order to generate clusters of specific sizes. In this presentation we will discuss our progress in reaching this goal.

Environmental Injustice in Northwestern Indiana

Avery Reimink
Maddelyn Jannusch

Mentor:
Dr. Kenneth Brown, Chemistry

This research was supported by the Hope College Global Health Program, the Northern Lake County Environmental Partnership, and the Chemistry Department Endowed Funds.

Decades of industrial activity have led to dangerous levels of both metal and organic contaminants within residential and public areas of Lake County, Indiana, United States. While there has been notable efforts to remedy this contamination, the underlying concern from the community remains. Therefore, the goal of this research is to evaluate and understand the environmental contamination in soil, sediment, water, and air within Lake County, including Gary, Hammond, and East Chicago. Preliminary steps of this project included testing and developing various analytical methods to find the most accurate and time-conscious method to determine metal and organic contaminants within the samples. For the metals detection, the samples were processed using an electrochemical Anodic Stripping Voltammetry and Inductively Coupled Plasma methods specific for lead detection, as lead has proven to cause numerous health concerns upon exposure. For the organic compounds, the EPA has designated Polycyclic Aromatic Hydrocarbons (PAHs) as being a potential environmental and human health hazard. For PAH detection, the samples underwent various processes to extract PAHs, and then were analyzed using High Performance Liquid Chromatography (HPLC) and Gas Chromatography-Mass Spectrometry (GC-MS). In the preliminary steps of this project, the detection of both metals and organic compounds was considered a success. After refining the methods, samples from three different sites in the Lake County community were obtained, and one sample from Indiana University Northwest was analyzed for both metal and PAH content. In the samples tested, there was a significant presence of benzene, a known environmental contaminant, and derivatives of benzene, as well as pyrene, a PAH. These methods will be used in the future to test more samples and encourage future remediation efforts.

Mechanistic Understanding of the Synthesis of Clusters of Fe3O4 Nanoparticles Through Headspace Byproduct Analysis

Rachel Thomas
Luke George
Andrew Reiffer

Mentor:
Dr. Natalia Gonzalez-Pech, Chemistry

This research was supported by the James H. and Marion Klassen Zwemer Chemistry Fund.

Multiple efforts have been made to develop multifunctional materials, but one of the greatest challenges is the homogeneity of the hybrid material. The nanoGoch group focuses on developing multifunctional nanomaterials by embedding nanoparticles of different compositions into nanoclusters in the hierarchical structure. Typically, the clusters of nanoparticles are prepared by a solvothermal method while the reaction mixture is heated in a closed container. Some mechanisms have been proposed for this synthetic method, however most of them are based only on the physical properties of the clusters (shape and composition). Here we follow the reaction by analyzing the gasses resulting from the reaction at different conditions. This analysis is carried out using gas chromatography. We expect that by identifying the generated byproducts in combination with the characterization of the resulting nanomaterial, a deeper understanding of the reaction will be obtained, which can be applied to further synthetic modifications.

Patient-Handling Tasks and Posture Classification with Machine Learning

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Annie Ngoc Tran
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Aine Snoap
Noah Bradford

Mentors:
Dr. Omofolakunmi Olagbemi, Computer Science
Dr. Brooke Odle, Engineering

This research was supported by the Howard R. and Margaret E. Sluyter Faculty Development Fund, the Clare Boothe Luce Research Scholars Program, and the HopeCollege Department of Computer Science."

A 2016 survey indicated that 39% of registered nursing respondents had reported musculoskeletal injuries after two years of regularly performing patient-handling tasks. Optical marker systems (considered the gold standard) can be used in laboratory settings to explore mechanisms of injury during patient-handling tasks, but deploying inertial measuring units (IMUs) in biomechanics allows data collection in both laboratory and clinical environments. IMU-based capture systems are also preferable to optical marker systems because they avoid marker occlusion during more complicated patient-handling tasks. The aims of our study are (1) to identify machine learning models that can accurately predict patient-handling tasks performed and the quality of posture adopted by participants performing those tasks (using data from wearable sensors — IMUs — and force plates), and (2) to determine an optimal combination of those IMUs. Using trunk-and-pelvis IMU data from two participants performing three tasks with good and poor postures, the MiniRocket machine learning model was the fastest of five models utilized (123s) and also the most accurate (98.1%). Future work includes involving additional participants and expanding the range of tasks.

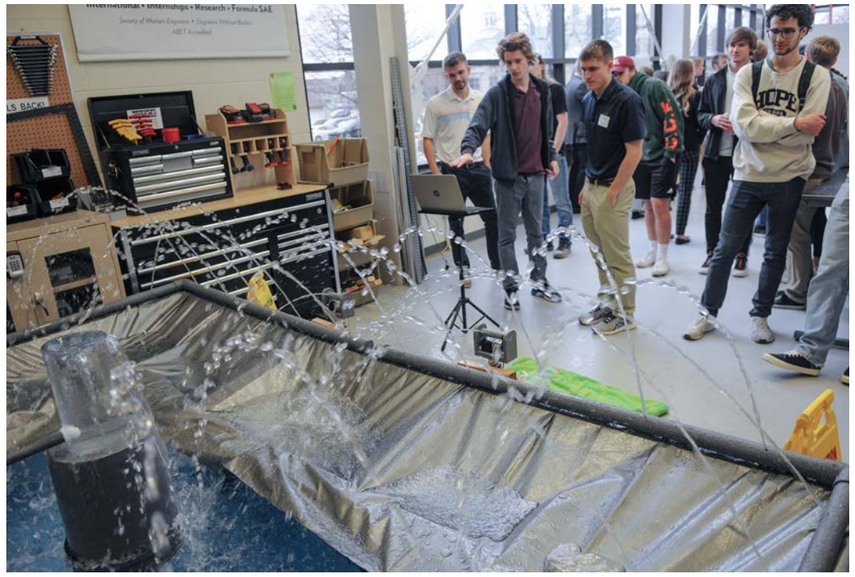
Experimental Validation of Real-Time, Weighted Control Algorithm on High Rise Structures

Dylan Clem
Clara Voskuil

Mentor:
Dr. Courtney Peckens, Engineering

Research reported in this publication was supported in part by funding provided by the National Aeronautics and Space Administration (NASA) under award number 1662655, Michigan Space Grant Consortium. This material is based upon work supported by the National Science Foundation under Grant No.1662655. In addition, funding for this project comes from the Ernest Haight Summer Research Fund in Engineering.

In this study, the experimental validation of a streamlined, embeddable control algorithm is proposed in an attempt to validate its anticipated benefits. In particular, the control algorithm seeks to alleviate many of the challenges currently faced when using wireless sensing units for the purposes of control. These challenges include a higher probability of data loss due to wireless communication and potential computational inundation at the low-power computing node when embedding complex control algorithms or state estimators. This study employs front-end signal processing at the sensing node to alleviate computations at the control node and results in a simplistic sum of weighted inputs to determine a control force. This research focuses on validating this control law on a small-scale, four-story structure subject to seismic base excitation. In particular, the El Centro, Kobe, and Northridge earthquakes are used. The results for each of these tests are quantified based on four cost functions that consider the ratio between the uncontrolled and controlled tests for maximum displacement, average displacement, maximum acceleration, and average acceleration. When each of these metrics have a value less than one then it indicates effective control. For El Centro, the cost function for maximum displacement averaged across the four floors was 0.88, while average displacement, maximum acceleration and average acceleration were 0.77, 1.28 and 0.88 respectively. This yields a combined cost function of 3.80, and this proves to be effective control as this holds a value less than four. Kobe had a combined cost function of 3.88, and Northridge had a value of 1.98. Overall, control was effectively achieved for all three of the earthquake signals using the proposed control approach.



Modeling Selective Activation of the Median Nerve

Madelyne Klunder
Marianna Urdaneta Morillo

Mentor:
Dr. Katharine Polasek, Engineering

This material is based upon work supported by the National Science Foundation under Grant No. 1805447.

Achieving referred sensation via surface electrical stimulation for the median nerve is difficult and time consuming. Our goal is to design an efficient method to adjust the voltages of an electrode array to be placed over the median nerve at the elbow until a good referred sensation is achieved.

A 3-dimensional, anatomically-based finite element method model of the arm was used to model nerve activation due to electrical stimulation at the skin. The model included electrodes near the elbow and electrical properties for each tissue type. Simulations were run with two different electrode configurations: an 8 rectangular electrode arrangement consisting of a 2x4 electrode array; and a 3 circular electrode arrangement consisting of a 1x3 electrode array. The NEURON programming environment was used to determine the percentage activation of every fascicle for different voltage combinations used as stimulus. The ability of each electrode arrangement to selectively activate one fascicle or groups of two or three fascicles was evaluated.

For the eight electrode array, two single fascicles could be selectively activated, two pairs of fascicles could be selectively activated and three sets of three fascicles could be selectively activated. For the three electrode array, one example each of single, double and triple fascicle selectively was found. Overall, the eight electrode arrangement could activate more fascicles and fascicle groups selectively.

Computer modeling was used to evaluate different stimulation parameters with the goal of selective nerve activation. These simulations suggest that selective activation is possible and may be found with fewer electrodes.

The Design and Fabrication of a 2 Story, Small-Scale Shear Structure

Parker Perry

Mentor:
Dr. Courtney Peckens, Engineering

This work was supported by the Bair Talent Development Fund and the Hope College Engineering Department. This material is based upon work supported by the National Science Foundation under Grant No.CMMI 1662655.

External forces such as high winds and earthquakes can cause damage to buildings and because of this, active control systems are often integrated into such structures. Active control systems use sensors to measure the structure's response to external loads and actuators to provide counteracting forces to the undesired response. A small-scale, two-story structure was designed and fabricated such that it could be used as an experimental testbed for active control. The height of the structure is 0.47 m and the mass of each floor is 2.98 kg and 2.58 kg, yielding natural frequencies of 1.25 Hz and 2.74 Hz. The active control techniques were validated in simulation for this structure using two different control techniques. The first method that was explored was an optimal control theory technique, the linear quadratic regulator (LQR). The second method focused on a distributed sensing technique that alleviates computations at the control node and results in a simple sum of weighted inputs to determine a control force. To quantify the control effectiveness of the two methods, the ratios of the uncontrolled response to the controlled response of the structure is considered for the maximum displacement, average displacement, maximum acceleration, and the average acceleration when the simulation is run.

The four ratios were averaged across both floors of the structure and then they were combined. This resulted in the combined value of the ratio to be 3.37 for the first control method and 3.10 for the second control method; therefore the second method had a better set of results.

Comparing Cortical Responses to Mechanically- and Electrically-Evoked Somatosensations

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Mentor:
Dr. Katharine Polasek,
Engineering

This material is based upon work supported by the National Science Foundation under Grant No. 1805447.

Phantom limb pain (PLP) is characterized by pain and discomfort in an amputated extremity which may be caused by altered electrical signals coming from the severed nerves. Researchers hypothesize that PLP may be reduced by restoring sensation in the amputated extremity through electrical stimulation. The goal of our group is to develop an at-home therapy that consists of electrically evoked somatosensation in the amputated extremity to promote neural changes within the brain. This project aims to quantify brain responses to mechanically and electrically-evoked tapping sensation in able-bodied subjects.

Electroencephalography (EEG) was used to measure cortical activity in response to two types of stimuli: 1) electrically-evoked sensations in the hand using transcutaneous stimulation of the median nerve at the elbow (stim condition) and 2) mechanically-evoked sensations with and without visual feedback (vision and no vision conditions) via tapping on four fingers, including the location corresponding to the perceived location of the stimulated sensation (match location). The EEG data were analyzed using EEGLAB and the ERPLAB plugin. The EEG data were preprocessed and then analyzed by calculating the global field power (GFP) of the cortical activity and cross-correlating the GFP of each condition. The GFP vectors were shifted based on the lag corresponding to the maximum cross-correlation coefficient to account for timing differences between conditions. The correlation coefficients between conditions were then calculated using the shifted GFP vectors.

It was expected that the correlation would be the highest between the vision and no vision conditions for the match location, which was true in eight of twelve subjects. The conditions for the match locations were also expected to be highly correlated with the stim condition, which was true in seven of twelve subjects. These preliminary results suggest a similarity between cortical responses to electrically-evoked sensations and mechanically-evoked sensations.

Hydraulic head differential for fluid flow vectors in sub-axial magma systems of the Mid-Atlantic Ridge (30°N to 30°S) subject to rotational shearing

Taylor Hudson

Mentor:
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Geological &
Environmental Sciences

This research was supported by the Geological and Environmental Science Department and the Nicholas Ver Hey '75 Geology Summer Research Fund.

Fluid flow in a porous medium, as with magma produced by partial melting, is governed by hydraulic head differential, porosity, and viscosity. Calculations of magmatic hydraulic heads were completed using ocean depth, crustal approximations, densities, and gravity values. Based on previous studies, the magmatic system was defined as a prismatic region produced by decompression melting under the mid-ocean ridge. Bathymetry-based analysis of the Mid-Atlantic Ridge (MAR) system was conducted for the region within 30° N and S of the Equator. ArcGIS was used to produce quantitative evidence of differential loading for areas of a 20 km radius at intervals of about 9 km for the non-transform ridge segments. Pressure loading under the MAR showed an overall gradient toward the Equator where ocean depths were the deepest and geoid gravity values were the lowest. Porosity values were used for the 50 km depth, 10 km depth, and high porosity melt regions. This analysis showed flow vectors between ridge points with averages of 0.78 cm/yr. at 50 km depths and 4.28 cm/yr. at 10 km depths with even greater velocities in the high porosity areas along the flanks of the melt prism. With horizontal flow established, investigation continued with geometric analyses of the ridge and transform segments. If original fracture patterns for the MAR were N-S for ridge segments and E-W for transform offsets, patterns indicate left-lateral, strike-slip faulting of transforms and primarily clockwise rotation in the N. Hemisphere. Comparatively, the S. Hemisphere exhibits counterclockwise rotation primarily right-lateral strike-slip faulting up to 30° latitude. Previous studies suggest connections between the Coriolis force and observed rotation, but lack evidence for large-scale mantle movement. This study presents the potential for localized flow under the MAR system that may be subject to the Coriolis force thus producing rotational shearing.

Organic matter quality influences aerobic and anaerobic respiration rates in peatland soils

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Christian Lundy
Alexis Koehl
Grace Behrens
Mackenzie Dole
Madeleine O'Donnell

Mentor:
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This research was funded by the Hope College Department of Geology and Environmental Science, the Rex Johnson Geology Summer Research Fund and the Smies Summer Research Fund. Research reported in this publication was supported in part by funding provided by the National Aeronautics and Space Administration (NASA) under award numbers NNX15AJ20H and 80NSSC20M0124, Michigan Space Grant Consortium.

The vulnerability of peatland carbon reservoirs to decomposition in a warming climate remains a key uncertainty in Earth System Models. This will be determined in part by the "quality" of the peatland organic matter, i.e. the ease by which it is decomposed by the microbial community. We developed an index of organic matter quality based on the biochemical composition of the peat. The index uses a principal components analysis of proxies based on the carbohydrate composition, hydrolysable amino acids, C:N, pH, and nutrient availability in the peat porewater. The index was compared with measurements of aerobic and anaerobic respiration rates from microcosm incubations of peat from several depth intervals in cores collected from four areas of Miner Lake Bog (Fennville, MI). We found that both the index and respiration rates declined with depth in the cores. In general, the correlation between organic matter quality and respiration was strongest for aerobic CO2 production, intermediate for anaerobic CO2, and weakest for CH4. This indicates that organic matter quality is an important predictor of the vulnerability of peat to decomposition. However, other factors may be more important in determining CH4 production. With further development, the index can be employed in other peatlands to interpret the organic matter quality and predict future greenhouse gas emissions.

Temperature sensitivity of nitrogen mineralization in peat from a southwestern Michigan Bog

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Mentor:
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Chemistry and Geological
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This work was funded by the Hope College Departments of Chemistry and Geology & Environmental Science, the Rex Johnson Geology Summer Research Fund and the Smies Summer Research Fund.

In this study, we measured inorganic nitrogen (nitrate and ammonium) released from peat cores from Miner Lake bog at two temperatures to analyze the impact of climate warming on the peatland nitrogen cycle. We hypothesized a higher nitrogen release in samples incubated at warmer temperatures. Furthermore, previous research indicates shallow peat decomposes faster than deeper peat. Therefore, we hypothesized faster nitrogen mineralization in shallow samples. We collected peat cores from two locations from Miner Lake Bog in Allegan County, Michigan: a plot in the center of the bog and a sedge meadow site near the edge. Two samples for each depth (0-0.5 meter, 1.5-2 meters) were taken at both sites and homogenized. Microlysimeters, consisting of two-chambered filter towers, were acid washed and 20 g of acid washed sand was added to each upper chamber. 50 g of peat was added onto the sand and was left to equilibrate for four days. Microlysimeters were leached with 80 mL of 0.01M $CaCl_2$ solution and the concentration of nitrate and ammonium in the leachate were quantified using ion chromatography. Microlysimeters were incubated for two weeks before leaching procedures were repeated. A separate field-based cation-anion exchange analysis was performed through the installation of plant root simulators. In both the lab and field experiments, we consistently found that cumulative mineralization was higher at the warmer temperature, indicating that warming will increase the rate of nitrogen cycling in peatlands. We also found that at a lesser extent mineralization was higher in surface peat than in more degraded deep peat layers.

Identity Development and Empathy Among Pre-Health Students: A Longitudinal Study Employing Latent Class Analysis

Bergen Johnson
Gabe DeYoung
Matthew Stafford

Mentors:
Dr. Mark Pearson,
Mathematics & Statistics

Dr. Aaron Franzen,
Sociology & Social Work

Dr. Paul Pearson,
Mathematics & Statistics

This research was supported by Tanis Mathematics Research Fund."

Pre-health students endure rigorous education to prepare for treating patients, but potentially not for every aspect of patient care. Beyond medical knowledge, successful patient interactions often include moral decision making and the possession of traits such as empathy. There is little research on early physician and nurse development, with a substantial gap at the undergraduate level. This is significant as the trend toward a decrease in empathy could begin sooner. We explore this using latent class analysis to categorize participants based upon survey response patterns regarding numerous indicators, the most dominant class indicators being religion and political views.

Classification of Land Cover on Sand Dunes

Heleyna Tucker
Micah Sterk

Mentors:
Dr. Darin Stephenson,
Mathematics & Statistics

Dr. Brian Yurk,
Mathematics & Statistics

This research was supported by the Strosacker Foundation Faculty Development Fund and the Jobe And Julie Morrison Family Faculty Development Fund.

As members of the Hope College Coastal Research Group, we have studied the mechanisms for and effects of sand transport. In particular, we have worked to model vegetation coverage in West Michigan sand dune complexes in order to better understand how sand movement and resident vegetation affect one another. We use aerial drone imagery to develop machine learning algorithms for creating ground cover classification mappings in an automated way. Our team collected drone imagery ranging from high-resolution, low-altitude photographs to high-altitude stitched and rectified orthomosaics. We developed accurate ground cover classification methods for the low-altitude imagery and then explored ways of using those results to make similar predictions based on data collected from higher elevations. This required us to develop mappings between images using key point matching for image alignment. This poster details our work in using random forest models to classify land cover from low elevations and subsequent attempts to use these results for surface cover classification over a broader spatial extent.

The Milk Microbiome Feasibility Study

Ava Doty

Mentors:
Dr. Anita Esquerra-Zwiers,
Nursing

Dr. Brian Yurk,
Mathematics & Statistics

This research was supported by the Kenneth Baker student summer research fund, Toji Mathematics Faculty-Student Research and the Frank and Dorothy Sherburne Mathematics Summer Research Fund.

Little is known about the colonization of human milk. One hypothesis is the microbiota enters the milk via the entero-mammary pathway, or the translocation of maternal gastrointestinal bacteria to the mammary gland during altered tight junction regulation that occurs during pregnancy, labor, birth, or early in lactation (Rodreguez et al., 2021). The purpose of this study is to compare the changes in the human milk microbiome over three periods of mammary epithelial development: 38 weeks pre-birth (secretory proliferation), 2 days post-birth (secretory differentiation), and 10 days post-birth (secretory activation). The sodium and potassium concentrations of the samples will be used to confirm the period of mammary epithelial development. The DNA of the microbiome will be sequenced and analyzed; the abundance of each strain will be calculated and compared to other samples.

β-decay strength function of 54,52 Co and 55, 53Ni

Gabriel Balk

Mentors:
Dr. Paul DeYoung, Physics

Dr. Belen Monteagudo Godoy, Physics

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The nucleosynthesis of proton-rich isotopes is an open question within nuclear astrophysics. This work deals with the decays of four proton-rich nuclei, 52, 54Co and 53, 55Ni. β+ decays for each isotope were recorded with the Summing NaI(Tl) detector at the National Superconducting Cyclotron Laboratory. A preliminary β-decay Intensity Function was derived with Total Absorption Spectroscopy for each isotope. Total energy spectra, individual γ energy spectra, and multiplicity spectra for decays to levels in the child nucleus were modeled with GEANT4 based on information from the National Nuclear Data Center. The measured spectra when fit with the simulated spectra, give the probability that a particular child level is populated during the decay. Energy spectra from beta-delayed proton emission in isotopes with low proton separation energies were recorded with a double sided silicon detector and modeled with GEANT4. Results, when compared to theory, will provide insight into refining the theory.

Neutron-Unbound States in ^{33}Mg

Bishop Carl

Mentors:
Dr. Belen Monteagudo Godoy, Physics

Dr. Paul DeYoung, Physics

This material is based upon work supported by the National Science Foundation under grant No.PHYS-2209138 and the L.T. Guess Physics Summer Research Fund.

Unbound states of very neutron-rich nuclei decay by the emission of one or multiple neutrons over a very short period of time, some decaying as quickly as a few milliseconds. These states are extremely important as they help us to understand the nuclear structure of isotopes. However, information on neutron-unbound states is scarce for nuclei in intermediate masses, such as ^{33}Mg. An experiment at the National Superconducting Cyclotron Laboratory (NSCL) was performed to study the neutron-unbound states of ^{33}Mg: a 100 MeV/u ^{36}Si beam impinged on a segmented reaction target causing a knock-out reaction. The excited states of ^{33}Mg* decayed into ^{32}Mg and a neutron. Following the calibration of all detectors, the decay energy of the system was reconstructed using the invariant mass technique. A simulation of the full setup was developed and benchmarked against several experimentally reconstructed observables (positions, kinetic energies, relative velocities). The decay energy spectrum was then fitted and the energies of the resonant neutron-unbound states of ^{33}Mg energies determined. A tentative new level scheme for the unbound states of ^{33}Mg will be presented.

Design for Next Generation Neutron Detector

Miguel Castelan Hernandez

Mentor:
Dr. Belen Monteagudo Godoy, Physics

This material is based upon work supported by the Hope College Physics department and the Bilbart fund for summer undergraduate research as well as the National Science Foundation under Grant No. PHYS-22090138 and the Dr. Jennifer Hampton Summer Research in Physics Fund.

Having good detection techniques allows one to understand the physics and structure of neutron-rich nuclei beyond the neutron dripline. The Facility for Rare Isotope Beams (FRIB) will give access to more exotic nuclei where multi-neutron decay is expected. The next generation MoNA detector will need to measure multi-neutron events, and improved algorithms are needed to enhance the extraction of these events with a good signal to noise ratio (cross-talk). A complete Geant4 simulation was developed to study the possible configurations of this new array. Implemented models include a description of multi-neutron decays. Various combinations of geometrical parameters were simulated and analyzed. The resolution and efficiency of the detector were calculated for 1n through 4n decay for each case.

Studying the Dynamics of Solar Convection Cells through Eigenmode Decomposition

Gillian Donley

Mentor:
Dr Zachary Williams, Physics

This work was funded by support from the Clare Booth Luce Research Scholars.

This project studies the fundamental fluid dynamics phenomenon referred to as Rayleigh-Benard convection. This can be applied to a wide variety of fluid systems, including atmospheric currents, ocean flows, and the convection zone in stellar interiors, to describe how complex fluid motions can transport heat between hot and cold boundaries. My work is dedicated to the validation of a novel approach referred to as a truncated eigenmode expansion. In principle, this approach describes the system dynamics in a theoretically much simpler and more efficient manner without losing any of the essential details. Fundamental aspects of Rayleigh-Benard convection will be examined, including the well-known Nusselt number which quantifies the ratio of conductive to turbulent heat flow.

Calibrating the Faraday Cup for Ion Beams using Rutherford Backscattering Spectroscopy

Joey Fogt
Nolan Miles
Megan Haeussler
Hope Weeda

Mentors:
Dr. Kyuil Cho,
Physics

Dr. Paul DeYoung,
Physics

Dr. Andrew Bunnell
Physics

This research is supported by the Department of Physics and the Dean of Natural and Applied Sciences.

Particle accelerators are useful pieces of technology for a variety of experiments, from testing for contaminants in the water supply to testing the durability of materials exposed to radiation. In order to measure the amount of radiation being delivered by the accelerator's beam, a Faraday cup is used. This tool can measure the amount of ions impacting a surface by measuring the current generated by the incident ions; however, they often overestimate current due to the emission of secondary electrons. This is an inherent property of the Faraday cup, but we still want an accurate measurement of the beam current. So we set out to calibrate the cup. Our research explored the use of the properties of Rutherford backscattering spectroscopy (RBS) and software known as SIMNRA to calibrate the Faraday cup of ion beams.

β-decay strength function of ^{99,100}Y

Nathaniel Jobson

Mentor:
Dr. Paul DeYoung,
Physics

This research is supported by the Department of Physics and the Dean of Natural and Applied Sciences.

The rapid neutron capture process (r process) is responsible for the formation of numerous nuclei in the universe. To obtain better models for heavier nuclei that are part of the r process, the decay paths of ^{99,100}Y were analyzed. This work was done using the Summing NaI(Tl) detector at the National Superconducting Cyclotron Laboratory. The $I_\beta(E)$ and the Beta Gamow-Teller function (BGT) were extracted from the measured Total Absorption Spectroscopy (TAS), Sum of Segments (SEG), and Multiplicity spectrum The $I_\beta(E)$ and the Beta Gamow-Teller function (BGT) were extracted from the measured and then compared to the Quasi Random Phase Approximation theory (QRPA).

An Analysis of Eigenmode Activity in Visco-Resistive Magnetic Reconnection

Nicholas Kaipainen

Mentor:
Dr. Zachary Williams,
Physics

This work has been funded in part by the generosity of the Dr. Harry F. and Jeannette Frissel Research Fund. Research reported in this publication was supported in part by funding provided by the National Aeronautics and Space Administration (NASA) under award number 80NSSC20M0124, Michigan Space Grant Consortium.

Magnetic reconnection is the dynamically complex process in which energy is transferred from magnetic fields permeating a plasma into the particles that make up the plasma. One significant area where this occurs is in the Sun's atmosphere, driving events such as solar flares and coronal mass ejections. The equations describing this complex behavior are difficult to solve and parse for a better understanding of the system. This work studies the utility of a simplified model that frames the dynamics of the system in terms of its eigenmodes, both stable and unstable. It is theorized from prior studies that only a small fraction of the eigenmodes may be needed to quantify the system effectively. This is done here by numerically studying the resistive tearing instability in both linear and nonlinear regimes. The relevance of the eigenmodes over various system parameters, including viscosity, resistivity, and wavenumber, is discussed

Exploring a Truncated Eigenmode Expansion for Collisionless Models in Tearing Modes

Nathan Stolnicki

Mentor:
Dr. Zachary Williams,
Physics

This worked was completed with support from the Charles and Kathy Bibart Summer Research Fund.

This project studies the important plasma phenomenon referred to as magnetic reconnection, specifically focusing in very hot plasma regimes where the dynamics are essentially collisionless. This is of particular interest to the solar and space physics communities, as magnetic reconnection is a primary driver of coronal mass ejections and subsequent space weather. My work is dedicated to the validation of a novel approach referred to as a truncated eigenmode expansion. In principle, this approach will describe the system dynamics in a theoretically much simpler and more efficient manner without losing any of the essential details. Fundamental aspects of collisionless magnetic reconnection will be examined using a simplified eigenmode description, including an explicit calculation of the reconnection rate, which moving forward can be compared against satellite measurements to assess the true effectiveness of the theory.

Utilizing GPU and CPU Parallelization to Efficiently Calculate Compton Scattering Cross Section in Magnetar Magnetosphere

William Vance

Mentor:
Dr. Peter Gonthier,
Physics

Research reported in this publication was supported in part by funding provided by the National Aeronautics and Space Administration (NASA), under award number 80NSSC20M0124, and from the National Science Foundation (grant AST-1813610).

Compton scattering is the process which we understand to yield the high-energy radiation we observe from magnetars, neutron stars with very strong magnetic fields. It is desired to model this process in Monte Carlo simulations, which will require calculating the Compton scattering cross section many times via a C++ code. For this reason, efficiency is highly desirable. Modern computers typically have multiple cores, and it is not uncommon that they have a GPU as well. Therefore, to achieve minimum computation time, it is necessary to be able to run the code on a NVIDIA GPU, as well as all the CPU cores. Both types of parallelization can be achieved through OpenMP, a parallelization package. CPU parallelization is done very frequently, and on a broad level un-complex. GPU parallelization, in comparison, is more of an art than a science. As such, the summer research focused largely on GPU parallelization.

Decoding Insta-therapy: a case study pediatric therapists' Instagram accounts

Nicole Galloway

Mentor:
Dr. Marissa Doshi,
Communication

This work was completed with support from the Matthew J. and Anne C. Wilson Foundation Faculty Development Fund.

This project sought to understand the gendered nature of microcelebrity on Instagram by conducting an ethnographically-informed thematic analysis of 4 pediatric therapists' Instagram accounts. Specifically, we examined the Instagram activities of female pediatric therapists who use their social media presence to provide pediatric therapy tips to (primarily) mothers while also showcasing their private lives. Overall, their content appears to promote intensive mothering. Importantly, the popularity of this cohort of "therapy" microcelebrity underscores the ways in which health professionals participate in the neoliberalization of health in the United States by shifting the burden of pediatric health interventions to mothers, who are implicitly expected to invest time and energy absorbing and applying medical knowledge to play the role of amateur therapists for their children. Thus, our study exposes one mechanism via which gendered neoliberalism is perpetuated and normalized.

Compassion Fatigue within pre-service teachers: An Analysis within Hope College's Education Department

Kambree DeWitt
Marta Johnson
Macy Kerr

Mentor:
Dr. Jane Finn,
Education

With growing signs of burnout along with increased compassion fatigue reported in teachers, we were interested in studying whether this burnout and compassion fatigue begins to show during the student teaching semester. This semester occurs during the last semester of the pre-service teacher's undergraduate studies. This semester should align with the "real world of teaching", and set up individuals to get ready to enter the field.

Current research shows a correlation between teacher burnout symptoms to teaching enthusiasm levels. Analysis of previous research proved that gender, seniority, and the teacher burnout symptoms of emotional exhaustion and a decreasing sense of personal accomplishment were significant predictors of both teaching and subject enthusiasm (Dağyar & Kasalak, 2022). Additionally, research by King and Wheeler (2019) explores the "dark side" of interpersonal communication allowing students to open up about traumatic personal experiences and the stress that can lead to compassion fatigue in teachers. Furthermore, Ziaian-Gafari and Berg's (2019) qualitative research explored compassion fatigue and burnout, which both appeared when general education teachers worked with students with exceptionalities or those students with trauma. Compassion fatigue has been shown to affect one's health-related quality of life negatively (Jackson et al., 2021).

Looking at this previous research, we were interested in exploring when this compassion fatigue begins to show during teaching. Specifically, our research questions are: (1) Do pre-service teachers show signs of compassion fatigue during the student teaching semester? (2) Do pre-service teachers report needing additional assistance (such as mentorship or counseling) during the student teaching semester? To explore these questions, we gave the standardized survey, The *Professional Quality of Life Scale* (ProQLS) to 55 pre-service student teachers in Spring 2022. Our poster will dive into the qualitative results.

Empathy and pre-service teachers: How much is too much?

Macy Kerr

Mentor:
Dr. Jane Finn,
Education

Research shows that burnout happens when educators feel emotionally exhausted (Crosby, Howell & Thomas, 2018). Similar to burnout, compassion fatigue is a result of emotional exhaustion that occurs after repeatedly being exposed to secondary trauma (Johnson, 2018). It has been documented that roughly 75% of educators experience high levels of compassion fatigue (Koenig Rodger, & Specht, 2018) and many of these educators leave their job. This information is vital to school administrators, parents, and the community in order to keep good teachers in the field.

In this research, we are wondering if signs of compassion fatigue show up as early as the student teaching semester. In that vein, our quantitative research question is: "Do student teachers demonstrate signs of compassion fatigue?" For this study, 55 out of 75 (73%) of student teachers from a midwestern small liberal arts college anonymously completed the instrument, *Professional Quality of Life Scale* at the end of their student teaching semester. Interestingly, 100% (n=55) of these student teachers reported that they are feeling some level of compassion fatigue. This vast number shows the need for future and continued research in this area of compassion fatigue and how early it shows in a teacher's career.

Culturally Responsive Teaching and Religious Diversity

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Grace Critchfield
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Mentor:
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Education

With the ever-increasing classroom diversity, developing competency in culturally responsive teaching is critical to successful teacher preparation. Culturally responsive teaching values diverse students' cultures and utilizes them to maximize instructional effects for each student. Keeping in mind that Hope College is a Christian Institution, there may be some religious biases and unique challenges compared to a public university. Religion is a less discussed topic in diversity-related courses, so our research aims to investigate the influence of religious diversity in teaching. For our study, we administered a survey to eight classes at Hope College in varying grades (i.e., Freshman vs. Seniors) and major disciplines (Education majors vs. non-Education majors). The survey asked students to classify words that imply different religious beliefs and briefly explain their choice. We predict that people with low prior knowledge about the world's various religions will agree more on these stigmas because they base their opinion on common stereotypes rather than facts. Consequently, higher exposure to cultural diversity in education will result in students forming more informed views on religions and their stereotypes, developing individuals into more effective, culturally responsive teachers.

The Effect of Motivational Music on Power in an Anaerobic Sprint Test

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Previous literature suggests music can enhance exercise performance. Extant work has focused on high intensity anaerobic exercise with emphasis on two conditions: 1) music preference (preferred, non-preferred, no music), and 2) music tempo (slow, middle, fast). The primary objective outcome used to define performance is peak power. To date, previous work has examined music preference and music tempo separately. More recent work has explored the influence of motivational music; posited to incorporate elements of music preference and tempo simultaneously. Purpose: The purpose was two-fold: 1) to examine the effect of music condition (motivational, non-motivational, no music) on peak power performance during the Running-Based Anaerobic Sprint Test (RAST); 2) to assess whether motivational music survey scores (assessed the degree of motivation the motivational music provided) predict peak power. Methods: 20 college-aged participants completed a modified RAST consisting of 6 consecutive sprints over 17.5-meters. Each sprint was followed by a 10 second rest period. A total of four testing days (baseline & three formal testing days) were completed one week apart. Participants were randomly assigned to three conditions: motivational music (*Eye of the Tiger* by Survivor – music selection mirrors previous literature), non-motivational music, (*Window in 7's* by Meredith Monk – self-selected by researchers) and a no music condition. All participants were counterbalanced to complete each music condition. Participants completed motivation music surveys each day. Results: Repeated measures ANOVA analyses showed a main effect of time (peak power increased each day). No interaction effect was found for Time X Condition. Regression analyses revealed that self-reported motivational music did not predict peak power scores. Conclusion: Findings show evidence for increased peak power over time. However, lack of differences across conditions suggests a more nuanced approach is warranted to more appropriately capture the effect of music on exercise.

Team Dynamics Among Collegiate Athletes in Sports

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Peer motivational climate has garnered increased research as of late. Extant work suggests peers are motivationally salient members of the sport context. Despite this understanding, peers have been understudied compared to coaches, parents, and teachers (adult influence) in the sport context. In addition to peer motivational climate, limited research has addressed the role of accountability and trust among sport teams. The purpose of this research was to measure peer motivational climate, accountability, and trust to identify whether sport teams motivational climate may predict accountability and trust among teammates. We hypothesized that higher reported levels of peer motivational climate would be linked to higher levels of accountability and trust among team members. Collegiate athletes (N = 66, M age 19.96) provided demographic information and completed established measures of sport commitment, confidence, trust, accountability, and team dynamics. This study is ongoing, and results will be available during the poster celebration.

Reported Experience in Collegiate Swimmers

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Paige Kuhn

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Collegiate athletes have a wide range of sporting experiences. Swimming in particular has unique qualities given the independent nature of most events. Extant work suggests that psychological variables such as anxiety, burnout, athlete orientation, and competitiveness might be unique in individual sport athletes like swimmers compared to team sport athletes. The purpose of this research is to examine associations between accountability, athlete orientation, competitiveness, burnout, flourishing, and trait anxiety among collegiate swimmers. We hypothesize that higher levels of burnout will be linked to higher levels of ego orientation (extrinsic motivation) and lower levels of task orientation (intrinsic motivation). We also believe that swimmers will rate relatively high levels of competitiveness relative to the scale. Lastly, we believe those who categorize themselves as non-scorers will report higher trait anxiety than those who categorize themselves as scorers. This project is ongoing, and results will be available during the poster celebration.

Ammonia Inhalants Impact on Shot Put Throw Distance

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Mentor:
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This study was funded by the Hope College Kinesiology Department

A variety of ergogenic aids have been researched in the past to assess effects on athletic performance. One potential aid relatively unstudied is ammonia inhalants (AI's), commonly referred to as smelling salts. AI's have been found to enhance peak and mean power output (PPO/MPO) in anaerobic activities. Because shot put throws rely primarily on anaerobic power, there is the potential for AI's to improve performance. This study was designed to determine whether an acute, one second inhalation of a commercially available AI immediately prior to a shot put throw would increase the total distance a college athlete shot putter (n=10) could throw in meters. Following a baseline analysis, subjects were matched into two separate groups based on initial shot put throw distance without the use of AI's. During the first testing day one group performed three trials using a one-second acute inhalation of AI immediately followed up by a maximal shot put throw. Shot puts were thrown using a standing/power throw, rather than with full technique (glide or spin) to reduce error. The second group performed the same procedure but with a placebo inhalant. Ten minutes of passive rest separated each trial. The second testing day involved the same procedure with the exception that the substance each individual used was switched. It was hypothesized that the three second inhalation of AI would significantly increase the shot put distance thrown. Significant results would suggest that an acute ammonia inhalation may improve shot put throw distance. This study is ongoing and the results will be available during the spring research poster celebration.

Physical Activity Behavior and Cognition in Collegiate-Aged Students

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Previous research shows physical activity participation is linked to improved cognition (e.g., inhibition & working memory) and scholastic performance (Drollette et al., 2014). Despite this evidence, a vast majority of individuals in western society fail to meet physical activity recommendations for a healthy lifestyle. To date, there exists limited research exploring the importance of physical activity motivation in explaining the relationship between physical activity behavior, cognition, and scholastic performance. This project was a pilot study where we sought to provide a nuanced understanding of how physical activity motivation might explain objective physical activity behavior, cognition, and scholastic performance. **Purpose:** The purpose was two-fold: 1) to provide a descriptive account for the relationship between physical activity motivation, physical activity behavior, cognition, and scholastic performance; and 2) to examine whether physical activity motivation predicts physical activity behavior, cognition, and scholastic performance. **Methods:** 9 college-aged participants provided informed consent, and completed the Physical Activity Readiness Questionnaire (PAR-Q) and Health History form. Next, participants completed anthropometric measures (e.g., height, weight). After anthropometric measures were taken, participants were asked to complete a survey that asked about academic achievement (e.g., major & current cumulative GPA) and motivation to engage in physical activity (Behavioral Regulation Exercise Questionnaire). Participants then completed cognitive testing which was counterbalanced between inhibition (Flanker task) and working memory N-back 1 & 2). Following cognitive testing, participants were provided with a pedometer that they were asked to wear for one week prior to returning to the lab to complete a second round of counterbalanced cognitive testing. This is an ongoing study and we are continuing to collect data through the end of spring 2023.

The Chronic Effects of a Stretching Program on Range of Motion and Velocity Output of an Overhand Throw in Collegiate Baseball Players

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All resources were provided by the Hope College Department of Kinesiology, with exception of the Xsens Motion Capture system which was provided by Technos College. This research was supported by the Constantin Kinesiology Student Research Fund.

Current acute stretching programs have been reported to increase shoulder range of motion (ROM) utilizing the cross-body stretch and the sleeper stretch but have not examined how this increase could affect throwing velocity in overhead athletes. Few methods have been found to increase throwing velocity with the exception of various weighted ball and strength training programs, often associated with high rates of injury. The aim of this study was to determine if a nine week stretching protocol would result in improvements in shoulder ROM which may lead to an increase in overhand throwing velocity. It was hypothesized that a 9-week stretching program would increase the ROM of the glenohumeral joint and increase the throwing velocity among collegiate baseball players. Participants baseline shoulder ROM and overhand throwing velocity were assessed manually and using wearable motion capture sensors. Participants were then matched into either a control group (n=8) or an experimental group (n=8). The experimental group then performed four sets of two stretches, 30 seconds each, five times per week for a duration of nine weeks. A significant interaction was observed in the manually recorded velocity data ($p=0.014$) with the control groups velocity decreasing over the testing period and the stretching groups velocity slightly increasing, however no significant interactions were found between groups from pre to post test, between groups in both active and passive flexion, extension, internal rotation, external rotation, or horizontal abduction ($p>0.05$). There were main effects over time for both active and passive internal rotation and horizontal abduction. Analysis of the sensor data indicates a significant interaction for extension ($p=0.04$) and a trend towards interaction in flexion ($p=0.054$). Further data analysis suggests differences in throwing techniques which may have impacted the results. Future work should focus on throwing technique.

Temporal Analysis of Former High School Athletes' Perceptions of Fitness as They Enter College

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Sophia K. Rosiek
Adam H. Ibrahim

Mentor:
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Researchers suggest that physical activity promotion may be necessary to preserve former athletes' long-term health and transition out of sport in retirement. Exploratory research has revealed that the fitness perceptions (a known contributor to exercise behavior) of former high school athletes (FHSAs) who do not continue sports in college fluctuate over the course of their freshman year. To inform potential intervention efforts in this population, the purpose of this study was to explore why FHSAs' perceptions of fitness vary over their freshman year of college. **Methods:** Participants completed eight online surveys over their first year of college, within which they explained their present perceptions of their fitness via an open-ended response. These responses were thematically analyzed by survey and a frequency analysis was conducted to determine how often each theme appeared over time. **Results:** Thirty-five participants completed the surveys (28 women, 18±0 years). Sixteen themes were constructed that occurred anywhere from 1-7 times (M±SD: 3±2) across the eight surveys. Themes incorporated, but were not limited to, factors including perceptions of body image, maintaining a consistent routine and effort toward exercise, comparison to past athleticism, and varying degrees of acceptance of fitness given barriers associated with their college and sports transition. **Conclusion:** Common themes mentioned by participants fluctuated over time. Certain themes (i.e., "body image considerations," "putting in effort to maintain exercise," "seeks to improve fitness") were constructed across multiple surveys, indicating these factors were more constant in contributing to participants' perceptions of fitness over time than others that occurred less frequently (i.e., "desires previous high school fitness," "physical ailments," "no change/continuing usual routine"). Understanding how these factors fluctuate and affect fitness perceptions over the course of FHSAs' transition provides key information that will aid in creating more specific and effective behavioral interventions in the future for this population.

The Effect of Supplementation on a 20m Shuttle Run Performance in Collegiate Women's Soccer Players

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A product called BOA Ignite is a supplement marketed toward athletes that claims to have the ability to provide rapid performance enhancement through its aerosol ingestion method. Several studies have shown that the aerosol nature combined with the ingredients result in improved athletic performance; however, there is limited research on the effectiveness of the specific blend and small dosage found in the BOA Ignite spray. Therefore, the primary purpose of this study was to examine the effect of BOA Ignite on a 20m shuttle run in collegiate women's soccer players. In addition, we examined whether competitiveness (potential covariate) predicts performance on the Yo-Yo Intermittent Recovery Level 1 (YYIR1) test. We hypothesized that there would be an increase in performance on the 20m shuttle run consumption of BOA Ignite vs the placebo. We also hypothesized higher reported trait competitiveness would predict greater distance covered during the YYIR1 test. 20 female division III soccer players completed the YYIR1 test where their maximum level was recorded. Next the participants completed two 20m shuttle runs at a speed of 95% of the maximum level completed on the YYIR1 test following supplementation. Participants were assigned either a BOA Ignite or a placebo (pure oxygen). Participants were randomly assigned which supplement they received for each shuttle run with all participants ingesting both supplements accordingly. Test days were spaced one week apart. Significant results would allow this product to be recommended as an effective ergogenic aid for athletic performance, specifically in this population. This study is ongoing, and results will be available during the poster celebration.

A Christian Framework for Competitive Sport

Owen Leibrock

Mentor:
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Kinesiology

Christianity and competitive sport have a long history of interaction, oftentimes adversarial in nature. Yet in the last century and a half, Christians have embraced sport in such foundational ways that it is often now hard to imagine sport without certain Christian ideas and images. Competitive sport has taken on many forms and has been used in many ways both destructive and constructive. This wide range of Christian responses to sport throughout history begs the question: Does competitive sport truly fit within a framework of Christian ethics and values?

In order to answer this question, I will engage with theories from a variety of scholars from philosophy, kinesiology, sport studies, and religious studies who have taken different angles — sometimes antithetical — to offer their own answers to this question. Some answer with a simple "no", others a more complex "no", and many others a reluctant or sometimes resounding "yes". Hidden in this question are a few other questions that will illuminate how I approach this larger question: How do we define competition in sport? Is competition amenable to virtue development? Do the positives of sport outweigh the negatives?

Once these questions are answered, the ultimate goal of this project is to answer the simple and yet infinitely complex question of, How? How does a Christian engage in sport in healthy ways, edifying ways? There are some theories which encourage healthy engagement in sport, and I will explore some of them in order to provide a roadmap for Christians in the world of competitive sport.

Effect of Post-Warm-Up Transition Time on Anaerobic Performance in Female Collegiate Volleyball Players

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This research was supported by the Department of Kinesiology at Hope College.

Post-warm-up transition time (PWTT) is the period of time between the end of a pre-game warm-up and the beginning of gameplay at a particular sporting event. During this period of time, typical pregame traditions are completed such as the playing of the National Anthem and recognition of players and coaches. This length of time can vary from sport to sport. Research shows that a dynamic warmup is encouraged to improve performance and decrease the risk of injury. Further, rest periods are necessary for optimal performance. Too short of a recovery time can result in muscle tissue damage, but too long of a recovery time can nullify the effects of the warm-up. Little research exists to determine the optimal PWTT that results in peak anaerobic performance. Therefore, the purpose of this study was to identify the PWTT that resulted in optimal performance on a series of anaerobic fitness tests among female collegiate volleyball players. Biologically female Hope College volleyball players will participate in three testing sessions in which they will complete a standard dynamic volleyball warm-up followed by one of three randomized conditions: a 5-minute, 12-minute, or 20-minute recovery period. Following their recovery time, participants will then complete a vertical jump test, agility T-Test, and 20 m sprint test. Maximum heart rate will be monitored and recorded throughout each testing session, along with perceived intensity following the completion of each test. It is hypothesized that the 5-minute condition will yield the best performance results among participants, while the 20-minute condition will yield the worst. Significant results would encourage the revision of pregame traditions in order to optimize PWTTs in an effort to maximize anaerobic performance during volleyball gameplay. This study is ongoing and the results will be available during the research celebration.

The Effect of Auditory vs. Visual Stimuli on Reaction Time on Skill Position American Football Players

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Mikayla Roman

Mentor:
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Kinesiology Department

Reaction time (RT) is defined as the amount of time it takes for an individual to react to a specific stimulus. In a physiological sense, it is the amount of time it takes for the nervous system to recognize the stimulus, relay this message to the brain, spinal cord, and desired muscles in order to call on the muscle fibers to create movement. It is well known that in the world of sports, quick reaction time can be a valuable skill. For football players specifically, the offense is required to respond to either verbal (from Quarterback) or visual (Center snapping the football) cues. The purpose of this study was to examine the effect of varied stimuli (auditory: "go cadence," visual: the snap of the football) on reaction time of skilled position American football players. 15 current and recently retired American football players were assessed on visual and auditory reaction time. All players were considered skilled positions (wide receiver, tight end, or running back) and were familiar with a wide receiver stance. Participants were asked to come in the lab once a week for four weeks. Each visit they were asked to complete 20 trials (two sets of 10) of either the auditory stimulus or the visual stimulus. The order in which stimulus they would get that week was randomized. For each trial, they were set in a wide receiver stance and presented with the stimulus. The participants reaction time was measured using the Brower TCi Timing System, which utilized laser technology that tracked the initial movement following the stimulus. This system started a timer once the stimulus began and stopped once they crossed the laser. Based on previous research, it is expected that the auditory stimuli condition will have a quicker reaction time than the visual stimuli condition when responding to physical movement. If the outcome of this study results in a significant difference between the two stimuli, this may act as a catalyst for future research examining reaction time via varied stimuli. This study is ongoing, and results will be available during the poster celebration.

Examination of athletic identity, perfectionism, and sport commitment among collegiate athletes

Mikayla Roman

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This research was funded by the Albertus Pieters (Shoemaker) Faculty Development Fund.

Peers play a vital role in shaping athletes' positive and negative sporting experiences (Weiss & Smith, 2002). Extant work provides support for the link between quality peer relationships and sport commitment (Oluyedun, 2020). Although capturing the relevance of peers in sport is warranted, more work is needed to investigate introspective personality variables that may be associated with sport commitment. The purpose of this study was to examine the role of athlete identity and perfectionism on sport commitment. In addition, we explored if perfectionism and sport commitment shared a multivariate relationship. Collegiate athletes (N = 89, M age = 19.68; 61% female) provided demographic information and completed established measures of athletic identity, perfectionism, and sport commitment. Our results supported our primary purpose with athletic identity predicting sport commitment above and beyond perfectionism with the final step accounting for 39% of the variance in sport commitment. In addition, a significant multivariate relationship emerged that indicated a strong association between the two sets of variables (perfectionism dimensions & athletic identity as predictors; enthusiastic and constrained commitment as criterion). Enthusiastic commitment exhibited a significant loading while constrained commitment did not show a significant loading. Higher personal standards, concern over mistakes, perceived parental pressure, and perceived coach pressure were associated with higher enthusiastic commitment. Future work should utilize path analysis to better understand how personality variables relate to sport commitment.

Temporal qualitative analysis of former high school athletes' exercise satisfaction during their freshman year of college

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Alec W. Kowalski
Adam H. Ibrahim

Mentor:
Dr. Paula-Marie Ferrara, Kinesiology

Research studying the exercise behavior of retired athletes has discovered that former athletes have a more difficult time transitioning to life after sports. This comes as a surprise, as it is expected that athletes not only understand the benefits of exercise but also desire to remain physically active. Following their last competition, former athletes may feel lost without their sport holding them accountable to regular exercise. The extent of these former athletes' exercise behavior is not completely understood. Therefore, the objective of this study is to perform a qualitative analysis of survey responses aimed at further comprehending exercise behavior among former high school athletes in their first year of college. **Methods:** Thirty-five participants completed eight online surveys over the course of their freshman year of college. The survey asked participants to rate their satisfaction with their exercise behavior on a Likert scale, ranging from not satisfied (1) to very satisfied (5). Following this, participants were asked to explain why they rated their exercise satisfaction the way they did. Qualitative thematization of the responses was completed followed by the calculation of an interobserver agreement (IOA). **Results:** Each of the eight surveys were individually thematized, resulting in a total of 39 themes. IOA scores were then calculated, yielding only two themes below the recommended 85% IOA agreement. Upon further discussion, theme titles and descriptions were modified to adequately address discrepancies among the IOAs. The resolution of the disparities among the IOA resulted in 100% agreement across all themes. **Conclusion:** Those who were more satisfied with their exercise behavior commonly expressed that it was due to their efforts to exercise and remain consistent, the observation of positive results and gains accomplished from regular exercise, and the recognition of attempts to begin exercising more often. Explanations for those who stated they were not satisfied with their exercise behavior include time posing a constraint, struggles to remain consistent, and the acknowledgment that the individual is capable of doing more with their exercise routine through greater intensity or duration. Future research should focus on understanding ways to overcome the constraints that are impeding full exercise behavior satisfaction among former high school athletes in their first year of college.

A Comparison of the Nike Vaporfly and Nike Dragonfly's Effect on Running Economy

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This project was funded by Hope College Kinesiology

The purpose of this study was to compare the oxygen consumption, stride rate, and stride length of highly trained distance runners wearing the Nike Vaporfly and Nike Dragonfly spikes while running at competitive speeds. Fifteen (6 men and 9 women) collegiate volunteers (aged 18-22) were recruited from Hope College's Division III cross country team. Participants engaged in a total of 3 visits. On the first visit, all participants were familiarized with the testing protocol. For visits 2 and 3, a planned crossover was completed, and either the Vaporfly or Dragonfly was assigned for each participant to wear. All trials were completed on an antigravity treadmill with body support set at 100%. Participants ran three 4-minute running economy stages, and then immediately performed a maximal test to volitional exhaustion (VO_{2max}). Mean oxygen consumption for females wearing the Vaporfly shoe at 14 and 16 kph were 42.3 ± 1.4 and 47.1 ± 1.71 ml/kg/min respectively, while mean oxygen consumption for females wearing the Dragonfly shoe at 14 and 16 kph were 42.2 ± 1.7 and 45.9 ± 1.6 ml/kg/min, respectively. Mean oxygen consumption for males wearing the Vaporfly shoe at 14 and 16 kph were 43.1 ± 1.0 and 49. 2 ± 1.0 ml/kg/min respectively, while mean oxygen consumption for males wearing the Dragonfly shoe at 14 and 16 kph were 43.5 ± 1.9 and 49.3 ± 1.8 ml/kg/min, respectively. No differences were found in oxygen consumption (p=0.603 for females, p=0.930 for males), stride rate (p=0.487), or stride length (p=0.428) between shoe types. Based on the results of this study, the Vaporfly and Dragonfly shoes result in similar running economy and stride parameters. Further research should investigate the performance of the Vaporfly and Dragonfly on a traditional treadmill instead of the BOOST antigravity treadmill utilized for the present study.

Determining the Accuracy of Two Commercially Available Smart Watches

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This research was supported by the Fritzi Sennett Summer Research Fund for Kinesiology and the Donald W. Cordes Faculty Development Fund.

This was a two part study. Part I: Examine the heart rate (HR) accuracy of two activity watches among a group of athletes during exercise. Part II: Investigate the GNSS (global navigation satellite system) capabilities of these watches across two trail conditions. METHODS: Part I: Participants were outfitted with the Coros® Vertix 2 and Garmin® Fenix 6 watches along with a previously validated HR chest sensor (criterion measure). Participants underwent an incremental treadmill test where speed was increased by 1.61 km·hr-1 every 2 minutes until the participant reached volitional fatigue. Part II: Six participants completed four self-paced, one-mile trail runs. Accuracy of the watches were compared across the two trail conditions (heavy vs. light foliage). Participants were outfitted with both watches on opposite wrists, wearing each device on each wrist across all trials (2x2 design). RESULTS: Part I: Each device demonstrated a strong correlation with the criterion measure (Vertix 2 r=0.92 and Fenix 6 r =0.96) across time points. Overall accuracy of the Vertix 2 and Fenix 6 was 75.7% and 77.1% respectively. Part II: The Fenix 6 reported 0.93±0.03 miles and the Vertix 2 reported 0.94±0.02 miles for the 1.0 mile trail. Overall, no difference was detected between the two watches (p=0.43). The distance measured by the watches was significantly greater during the light coverage (0.96±0.02 miles) than in the heavy coverage (0.91±0.02 miles) (p<0.01). Additionally, the distance was significantly greater while the watches were worn on the left wrist (0.94±0.03 miles) compared to the right (0.93±0.02 miles) (p=0.04). CONCLUSION: Both watches' HR readings were fairly accurate and both watches under-reported the distance by 6-7%, which could cause much greater ramifications over longer distances.

Association of COVID-19 Concern, Psychological Well-Being, and Sport Commitment

Kayla Wolma

Mentor:
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Sport commitment is often influenced by the quality of one's sport participation (Scanlan et al., 2016). The COVID-19 pandemic led to many disturbances in athlete's abilities to engage with sport and share interactions with teammates. Recent literature suggests the pandemic led to prolonged stress and poor mental health outcomes among the general population (Prior et al., 2016). Interestingly, limited work has examined the effect of the pandemic on athletes' sporting experiences and psychological well-being. The purpose of this study was two-fold: 1) to examine whether psychological well-being (stress & mental health) is associated with sport commitment, and 2) to explore athletes' perceived threat of the pandemic on their sport season. Collegiate athletes (N = 173, M age = 19.95; 51% female) provided demographic information and completed established measures of psychological well-being indices, sport enjoyment, social support, sport commitment, and questions related to the threat of COVID-19. Canonical correlation analyses showed a significant multivariate relationship emerged between the predictor variables (stress & mental health) and criterion variables (EC & CC). Findings suggest athletes who are enthusiastically committed to sport tend to report healthier psychological well-being. In addition, athletes reported significantly higher concern for the pandemic interrupting their sport season than concern for contracting COVID-19 at the time of the survey (April, 2021). This finding is not surprising considering the unpredictability and altered nature of the 2021 season. Future research should examine the relevance important social agents (e.g., parents, coaches, peers) play in bolstering or subverting sport commitment.

The acute effects of incorporating lower limb foam rolling into a dynamic warm up for men's soccer player aerobic endurance and muscular power performance

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Mentors:
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Funding was not needed for this study. All resources were provided by Hope College.

Warming up before exercise increases muscle metabolism and reduces the risk of injury. Soccer players are prone to lower limb injuries, therefore a warm up that reduces injury and improves performance is ideal. Foam rolling is known to reduce delayed onset muscle soreness, loosen muscle fascia, and promote blood flow to muscles when utilized post-exercise. As such, the inclusion of foam rolling in conjunction with a dynamic warm up prior to exercise may further reduce injury risk and optimize performance. However, current research has not examined the relationship between combining foam rolling with a dynamic warm up on exercise performance. Therefore, the purpose of this study is to determine if foam rolling combined with a dynamic warm up will improve aerobic endurance and muscular power over that of a dynamic warm up alone. Men's collegiate soccer players will be recruited for this study. All participants will complete a familiarization trial, within which they will complete a Vertec vertical jump test, an interval shuttle run test (ISRT), and learn the foam rolling and dynamic warm up protocols. Following the familiarization, participants will complete two randomized trials scheduled one week apart: one where they will perform lower-limb foam rolling with a dynamic warm up before exercise, and one where they will complete the dynamic warm up alone. Exercise during these trials will include the vertical jump test and a modified version of their ISRT, based on their results from baseline. Data will be analyzed using a within-subjects paired samples t-test. Significant results will allow the Hope College men's soccer team to have a more effective warm up that would give them a competitive advantage during games while reducing injury risk. This study is ongoing, and results will be available during the poster celebration.

Federalism and Education: No Child Left Behind (NCLB) Implementation

Jonah Badanes-Katzman

Mentor:
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Political Science

Prior to the 1960s, the education provided to students in elementary and secondary schools throughout the United States was a local matter. While states controlled varying amounts of the funding granted to local school systems, states had relatively little control over, or perhaps even interest in, setting standards for their school systems. In the 1960s, the idea of a national educational policy first took hold, increasing over the decades until the passage of the No Child Left Behind Act (NCLB) in 2001. NCLB shifted power from the state and local government to the federal government. In exchange for funding, schools were required to submit to standardized testing and to standardize teacher qualifications and training. By interviewing various educators who lived through the implementation process of NCLB, this study highlights those aspects of the school system which changed — for better or for worse — due to the federal government taking such a large role in primary education. It does so, in part, by tracing the history of state power and the impact of the federal government on states' powers generally, then narrowing the scope to changes in the education system that occurred more recently. As the country struggles with inequality in educational opportunity and schools struggle with complying with various federal mandates, some unfunded, it is important to understand the context of these issues. The current research on Michigan schools does not consider the individual experiences of actual education professionals, what impacted them personally, their students' lives and their schools. I consider whether the balance between federal, state and local influence on education should be altered over the next few years, especially considering the impact of covid on current students, most of whom are now behind educationally and socially.

8th Amendment Violations of Mentally Ill Inmates

Haley Bennett

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Political Science

Dr. Lindsey Root Luna,
Psychology

In the United States, the criminal justice system fails to provide individuals diagnosed with a mental illness proper care while they are incarcerated, often offering no or insufficient help in managing symptoms. The lack of care while incarcerated likely contributes to higher recidivism rates as the effects of mental illness compounded through a lack of treatment. By examining data reported by the Prison Policy Initiative and individual state reports on problem-solving courts, this paper compares the treatment of individuals diagnosed with a mental disorder who are in traditional correctional institutions to those who are referred to a Mental Health Court instead and assess their outcomes when their sentences are up. By comparing mentally ill individuals who are incarcerated in traditional jails or prisons to those who are referred to Mental Health Court, I argue that the criminal justice system effectively violates the 8th Amendment of the United States Constitution by inflicting a cruel and unusual punishment when sentencing non-violent individuals with cases of mental illness to a local or federally funded jail or prison.

Religiosity and Conspiracy Theories

Mark Fields

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Political Science

Conspiracy theories are a popular phenomenon because they affect core beliefs and, accordingly, their actions. As prevalent as conspiracy theories are, we do not know why some people believe them and others do not, nor do we know why some conspiracy theories are more 'infectious' than others. I theorize that there is a positive correlation between belief in organized religion and belief in conspiracy theories because both religion and conspiracy theories are based on faith rather than empirical knowledge. Conspiracy theories vary in their characteristics, and therefore the variation between conspiracy theories might have an effect on the amount of believability among religious people. Because of this variation of believability, I compared four types of conspiracies; the hegemonic, intuitive, elite-driven, and aberrant conspiracy theories (as defined by Scott Radnitz), to determine if one kind of conspiracy theory is more popular among religious people than the other. I anticipate that narrative-fitting conspiracy theories will be more believed by people who subscribe to organized religion because organized religion is often built on strong, cohesive narratives.

Educating the Person: Inexhaustibility, Transcendence, and Place

Emma Hall

Mentor:
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This research was supported by the Yntema Family Faculty Development Fund.

While the American university appears successful in many respects, it also has its flaws. Higher education is plagued by hollow dogmas, misallocated affections, misdirected notions of truth, and individualistic mindsets, all of which contribute to the further fracturing of our republic. Myriad approaches to ameliorating higher education's deteriorated condition have been offered, but scholars have not resolved these issues. Perhaps ongoing failure to resolve these issues stems from misaligned priorities, which include democratic advancement and economic growth. Rather than evaluate education in terms of its social effects, I advance a philosophical examination of the person, supplemented by the insights of personalism, in order to demonstrate how a person-centered approach to education can promote individual and societal flourishing.

Partisan Media and Political Polarization

Alyssa Hrcka

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Political Science

This article will examine how the rise in more partisan media has contributed to political polarization and led the American public to support more partisan policies and candidates. Media outlets along with Congress have released more partisan messages to an ongoing distribution of mainly mainstream news, even though the attitudes of most Americans regarding politics are fairly indifferent. Evidence has shown that a greater exposure to partisan media can cause sudden, but temporary, increases in website traffic and knowledge of recent events. Therefore, there is an informal link between more partisan messages and altering attitudes or behaviors. By using a nudge-like approach to explore these effects of real-world and social science techniques, results confirm that it is possible for people to be persuaded by competing media accounts during an election campaign. However, at the same time, partisan media can cause distrust in mainstream media.

Religion's Impact in Foreign Policy

Alexis Potapczak

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Political Science

This research paper analyzes religion's involvement in foreign policy concerning the time period that the United States was involved in the Cold War. Previous contributions to the research of foreign policy show that religion does have a profound impact, and now can be applied to theories surrounding the Cold War. I theorize that Cold War foreign policy was strongly influenced by Christian rhetoric and practices. I will compare the current ways of quantifying the involvement of religion in foreign policies with decisions made by the United States' foreign policy leaders during the Red Scare. Decision makers', like congressmen and President Truman, rhetoric depicts intertwinement of religion and politics. Additionally, I will observe the influence of Christian social justice reformers like A. J Muste, and the application of what constitutes a just war.

Religious Liberty in Modern American Constitutional Law

Leah Renkema

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In its most recent completed term, the United States Supreme Court decided a number of key cases altering the placement of religious liberty in modern American constitutional law. While the Court has long struck different balances between preserving the constitutional mandates on both religious liberty and religious establishment, there has been a general consensus by those studying the Court that their interpretations over the past twenty years underneath the Roberts Court have trended towards the more accommodationist understanding of religious liberty. There is less agreement on what this newly composed Court and their recent decisions mean for the direction of constitutional understanding of religious liberty. Whether this term is a continuation of a long-standing trend in religious liberty jurisprudence, a complete overhaul by religious zealots, or simply cleaning the house of disorganized and unclear precedent, there are three cases from this last term which offer insight into the current state of religious liberty in American constitutional law. This research examines the opinions of the Court in these cases — Kennedy v. Bremerton, Carson v. Makin, and Shurtleff v. Boston — as key indicators of where the Court is now and where it may be going.

Amicus Briefs and the US Supreme Court

Zoe Ritsema

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Political Science

Each year the Supreme Court of the United States is presented with more than 7,000 cases to review, but adds fewer than 100 of these to its annual docket. Interest groups, third parties, and other individuals, are invited to participate in the process as friends of the Court through the submission of amicus curiae briefs. Since the 1990s, there has been a significant and steady increase in amicus brief participation at the Supreme Court. In this paper, I will focus on amici participation in religious liberty cases to carefully examine the motivation behind friend of the court participation. I theorize that amici participation has contributed to growing polarization among the justices of the Supreme Court and to more ideologically extreme decisions. I will show that while justices have always been motivated by their own ideological predispositions, the increase in amicus briefs has contributed to more ideologically extreme positions on the Court itself.

Campaign Strategies: How to Get Voters to Vote

Reed Rosado

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Political Science

For a government official to make policy, they need to first be elected. To be elected, a candidate needs to receive votes. Voting is the foundation of American democracy and nearly every year politicians attempt to convince their fellow citizens to cast a ballot in their favor. While campaigning strategies have constantly evolved, social media, smart phones, and the availability of data have allowed for more targeted and precise campaign communication in the last several years. I theorize that campaigns that use targeted and personalized communication will receive the highest amounts of positive votes. Currently, campaign strategy comes in the form of celebrity endorsements, rallies with politicians, text messages, media advertisements, direct mailers, emails, phone calls, and door-to-door canvassing. This study will utilize an original survey to investigate the efficacy of different political communication strategies on college age students at a small mid-western private college. In this survey it is found that data-based, personalized communication is most effective in driving out favorable votes. This study will be a resource for campaigns to do their most important job: getting voters to vote.

Fascist or Fash-ish? Using the F Word in Contemporary Discourse

Luke Ruiter

Mentors:
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Political Science

Dr. Joshua Bowman,
Political Science

Since his political rise, Donald Trump and his wing of the Republican Party have been compared to fascism, notably by President Joe Biden when he used the term 'semi-fascism' to describe "MAGA philosophy." These comparisons have engendered debate both among scholars of fascism and the general public and for good reason. As a label, fascism carries historical baggage and normative implications for voters and political actors. Politicians, scholars, journalists, and laymen alike need accurate and clear descriptive vocabulary to understand and respond to the current political moment and place it in its proper historical context. Therefore, a thorough understanding of fascism is key to understanding the current political moment. This article will assess the accuracy of the label 'semi-fascism' by comparing the political literature, rhetoric, and action of 'classical fascist' parties and regimes of the Interwar Period to those of MAGA Republicanism in the period 2016-2022. I expect to find that while the criteria for 'fascism' can be applied to contemporary American right-wing politics, key differences in ideological coherence and willingness to endorse or use violence by political elites make the 'semi' qualifier apt.

How Transnational Criminal Organizations Affect the Opportunities of the State and its People

Caleb Smith

Mentor:
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Political Science

In recent years, the growth and expansion of criminal organizations has only grown. These organizations often find niches within nation states to hide in. From these organizations we find adverse effects that the people of these nations find themselves facing. The presence of transnational criminal organizations can lead to the adoption of more authoritarian and repressive measures in order to combat their activities. Governments may increase surveillance and law enforcement efforts, and pass harsher laws and penalties to try to combat organized crime. This has the potential to lead to human rights violations and/or civil liberties being curtailed in the name of fighting crime. Transnational criminal organizations also can affect foreign policy of countries. They can disrupt international trade, finance and security, making it difficult for governments to maintain good relations with other countries. They also can make some countries, particularly those in the developing world, less attractive to foreign investment and tourism. Utilizing a case study approach, I expect to find that these organizations harm the state beyond just creating unsafe communities.

Is China Steel-ing all of the Manganese?: A Case Study of China's Belt-and-Road Initiative and the State of the U.S.'s Defense Supply Chains

Juliana Struyk

Mentor:
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Political Science

Sub-Saharan Africa is rich with critical minerals that are vital to defense forces, primarily those of the United States (U.S.) and the People's Republic of China (China). Though only a matter of luck, Sub-Saharan Africa's geological composure has made this region a desirable ally. Since 2013, China's Belt and Road Initiative (BRI) has gifted economic aid to developing countries, of which Sub-Saharan African countries are key beneficiaries. However, though well-intended, the BRI has slowly transformed into a strategic-foothold mechanism, aimed to expand China's competitive gains. Employing data that details China's diplomatic initiatives in South Africa from 2013 to the present, this study investigates just how much China's soft-power puppetry, through the BRI, enhances supply chain competition with the U.S. – especially as it relates to critical minerals, such as manganese. This study reveals that in South Africa, China has positioned itself to control the distribution of manganese by establishing sister cities, foreign direct investment projects, and additional bilateral bonds. These findings indicate that as the U.S. and China continue to compete for strategic resources, China's BRI will continue to prohibit the U.S. from accessing the materials it needs to keep its homefront safe.

Political Biases in State Supreme Courts

Jackson Uyl

Mentor:
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Political Science

The judiciary of the United States makes thousands of decisions a year that directly affect the political landscape of the United States. When judges make decisions, they purportedly make their rulings based on the rule of law presented for a given case. Judges, however, are not without biases and can be prone to make rulings that have been cultivated by their political beliefs. This study focuses on the political decision making of state Supreme Court justices and examines how they make decisions that are potentially politically motivated in cases dealing with criminal rights and economic liberties. My research examines how judges are appointed to the bench in each state and their term limits to determine how these factors could influence a judge to make a decision more aligned with their political beliefs. I expect to find that judges with more job security will make more politically motivated decisions due to the lack of political accountability afforded to them. This will be significant in potentially leading to a total reevaluation of the nomination process of judges to state Supreme Courts.

Gubernatorial and Presidential Campaign Strategies in Swing States vs Non-Swing States

Morgynn Vallieres

Mentor:
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Political Science

In this paper, I will compare campaign strategies utilized in swing states versus non-swing states for gubernatorial and presidential elections in the primary and general elections. In order to compare strategies, I will analyze how much money a candidate raised in swing states versus non-swing states, how many times gubernatorial candidates held rallies and/or speeches, as well as how many times a presidential candidate visited the state and or held a rally. After looking at this data, I will examine the outcome of the election to better understand how the candidate and their party either won or lost their election based on the strategy employed. I expect to find that campaign strategies among swing states will hold more of a presence and influence compared to non-swing states for both political parties in gubernatorial and presidential elections in the primary and general election.

Exploring the Intersection of Political Ideological Norms and a Congress Member's Criminal Justice Reform Beliefs: An EQUAL Act Case Study

Helen Weston

Mentor:
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Political Science,

Criminal justice reform remains a contentious and polarized political debate within our communities, local, state, and federal governments. The question to lower sentencing on non-violent crimes, reform cash bail, and other hot topic issues almost always falls along ideological lines. Despite convincing data and evidence that criminal justice reform has the ability to lower recidivism, strengthen communities, and save tax-payer money, many reform bills remain gridlocked on Congressional committees and caucus leaders' desks. The EQUAL Act, a federal bill eliminating the federal sentencing disparity of crack and powder cocaine offenses, posits as one such example of this gridlock. This gridlock poses an interesting analysis of the beliefs and voting behaviors of congresspeople whose party affiliation, personal ideology, interest group interference, lame duck lobbying, and looming term and session limits get in the way. To better understand this gridlock, I will examine historical voting patterns in Congress since 1986 on cocaine sentencing and mandatory minimum laws in the US House of Representatives. Additionally, I will employ Becker's labeling theory and Durkheim's strain theory as a lens to explain ideological and common sense ideological deviation in voting behavior.

*In the context of this study, I will define "deviance" as departing from norms and typical political-involvement expectations, not criminal behavior nor breaking of the law.

Once upon a dorm: A longitudinal analysis of mental health and perceptions of student housing

Brynn Anderson
Katherine Yakes
Emma Kane

Mentor:
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Psychology

The first year of an undergraduate student's college education can involve several new experiences, which may affect students' well-being. One potential means of coping with this transition is through creating particular ambiances, or emotions and perceptions they would like to evoke in themselves and their dorm room (Graham et al., 2015). In our lab's previous studies, we found that discrepancy between a student's ideal and actual room ambiance was a statistically significant predictor of depressive symptoms, negative affect, and anxiety.

We were unable to identify the causal relationship between well-being and ideal-actual ambiance congruency. This study addresses this by measuring these variables longitudinally over students' first year in college. Using a sample of first-year roommate pairs at Hope College, Luther College, and Dickinson College, we measured ideal and actual room ambiances for each roommate using a Q-sort procedure. Participants placed 23 ambiance cards (Graham et al., 2015) on a scale with seven categories based on how important that quality is in their ideal dorm room. This was repeated to describe the ambiance of their actual dorm room. They then completed an online survey assessing depressive symptoms (Eaton et al., 2004), anxiety (Spitzer et al., 2006), and perceived stress (Cohen et al., 1983). Data will be collected 4 times throughout the academic year.

We will evaluate the relationship between well-being and ideal-actual ambiance congruency using longitudinal, multilevel regression analyses. Anticipating a negative relationship over time, our analysis will test specifically whether mental health symptoms predict room attitudes and/or room attitudes predict mental health symptoms. This study will contribute to the evaluation of the association between student's on-campus living and well-being. Universities may prioritize housing, but efforts have been focused on amenities rather than aspects of the dorm room, and our findings may illustrate the importance of the dorm room.

Photo Coding of Undergraduate Students' Dorm Rooms to Predict Students' Perceptions and Satisfaction

Brynn Anderson
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Emma Kane
Tyler Kennedy
Nhi Hoang

Mentor:
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The first year of an undergraduate student's college education can involve several new experiences, such as sharing a new space with another student and living away from home. These changes may affect students' overall well-being. One potential means of coping with this transition is through one's on-campus housing. Students can personalize this space that is uniquely their own. Students vary in how they may personalize their dorm room depending on what ambiance or emotions and perceptions they would like to evoke in themselves and their space (Graham et al., 2015). The present study will evaluate what specific forms of personalization are associated with emotional ambiance.

Using a sample of first-year roommate pairs at Hope College, Luther College, and Dickinson College (n = 176), we measured perceived room ambiances for each roommate using a Q-sort procedure. Participants were instructed to place 23 ambiance cards (Graham et al., 2015) on a scale with seven categories from Strongly Disagree to Strongly Agree to determine their perception of their current dorm room. In addition to the room ambiance Q-sort procedure, photographs were taken of each roommate pair's dorm room after the participants each completed the Q-sort procedure. Our research team developed a codebook to assess how each room has been personalized, with features such as lighting, photographs, entertainment, and more. We will test whether particular personalizations are predictive of students' impressions of ambiance.

This study will help illustrate the connection between students' subjective appraisals of their dorm room to the objective features and personalizations of the room. This research could be used to show residential life staff, residence hall developers, and college bookstores what items and forms of personalization are valuable to students. Future research could also benefit from the validated codebook developed in the present study.

Scared Toward the Sacred? Existential Fear and Religious Residue

Isabella Brady
Chloe Swanson
Carmen Casper
Hannah Fuller

Mentor:
Dr. Daryl Van Tongeren, Psychology

Religion often helps address existential concerns. But what role does it play among religious dones (longer identify as religious)? Recent research has begun to investigate the "religious residue effect," which refers to the observation that formerly religious individuals often more closely resemble currently religious individuals in terms of their cognitive, emotional, and behavioral processes than never religious individuals (Van Tongeren, 2021). That is, religion persists after deidentification. The effects of religious deidentification are understudied. We look more in depth at this topic by considering how existential confrontation may affect religious attitudes across religious identities. We expect that when provided with an existentially unsettling stimulus, religious dones will cling to former beliefs, demonstrating a residual religious effect.

Procedure. Participants were recruited from a fear inducing event (e.g., watching a horror movie, a haunted experience) voluntarily attended. After providing consent and before the experience, participants took an anonymous pre-survey with Likert-scale-based questions regarding religious beliefs, and demographic questions. After the experience, participants completed an anonymous post-survey with the same questions in scrambled order. Both surveys took approximately 5 minutes to complete. Participants were debriefed and provided a candy bar for participation.

Results. Data collection for this study is ongoing and we anticipate completing data collection before April and plan to analyze results soon after, prior to the celebration.

Conclusions and implications. It is anticipated that any association found will advance a scientific understanding regarding religious deidentification and the role existential fear plays in the persistence and maintenance of religious beliefs among religious dones. We will be able to see the extent to which fear might cause people to change their thoughts towards religion or a god in order to reduce fear. Findings for this study could motivate future researchers to seek to replicate our study with other existential crises.

Do we desire partners who resemble our parents? An exploration of parent-preference

Kyra Carlson
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Mentor:
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Psychology

Previous research on sexual imprinting has shown that offspring use their parents' physical characteristics as a template for mate choice. Although most of this work has focused on animals, extensions to human partnering have found that individuals tend to be attracted to partners who have similar physical characteristics to their parents (e.g. ethnicity, physique; Heffernan et al., 2019). Only a handful of studies have examined whether people prefer partners who resemble their parents on non-physical traits (e.g., intelligence, honesty), and this work has produced mixed results (Akao et al., 2017; Gyuris et al., 2010). One limitation of these studies is that they examine parent-preference correlations for individual traits. Because potential partners are evaluated as a whole, this approach may miss broader patterns of correspondence between people's preferences and their parents' overall set of traits. Our study addresses this issue by examining how the compilation of traits people desire in a partner reflects the compilation of traits their parents possess. We also examine whether this association is moderated by age and relationship experience.

Data were collected from 645 unmarried participants (190 men, 453 women). Participants completed an online questionnaire in which they rated their preferences for 18 traits commonly desired in a partner; they also rated themselves and their parents on these same characteristics. To test our hypothesis that participants' overall pattern of mate preferences will reflect their parents' overall pattern of traits, we will compute profile correlations between participants' preferences and each parents' set of traits. We also will examine the distinctive similarity of these profiles after controlling for normative bias (Rogers et al., 2018). Finally, we will use regression analyses to test our hypothesis that the link between parent characteristics and mate preferences will be more pronounced among participants who are younger and have less dating experience.

Can't escape Hell: Negative religious beliefs persist among religious dones

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Previous research on deidentification from religion explores the residual effects of religion (i.e., religious residue; Van Tongeren et al., 2021). We sought to understand religious residue effects, and predicted that although currently religious individuals would report the highest degree of religious cognition, religious dones would report greater religious cognition than never religious individuals. We examined negative religious beliefs, taboos, pattern detection, and superstitious thinking. A total of 925 participants from the United States and the United Kingdom were recruited through Prolific; 300 currently religious, 298 religious "dones" and 327 never religious (236 male, 578 female, 4 transgender, 1 other, 4 prefer not to say, 92 no response). Participants were majority white/caucasian (88%) with an age range of 18-77 (average 36.94). Participants responded to a survey regarding the examined topics. A significant main effect was found for religious identity for negative religious beliefs, $F(2, 839) = 228.94$, $p < .001$, $eta^2 = .35$ (.30-.40). As predicted, currently religious individuals reported the highest level of religious belief ($M = 3.42$, $SD = .93$); significantly more than religious "dones" ($M = 2.07$, $SD = .86$) and never religious individuals ($M = 1.87$, $SD = 91$; both ps $< .001$). Religious "dones" also reported significantly greater religious beliefs than never religious individuals ($p = .028$). We also examined the residual associations of beliefs on other target variables when comparing religious "dones" and never religious individuals across 5,000 bootstrapping iterations using PROCESS. Results indicated a significant indirect effect of negative religious beliefs on pattern detection (*estimate* = .03, SE = .02, 95% CI .01 to .07) and superstition (*estimate* = .11, SE = .04, 95% CI .03 to .19). As religious "dones" reported greater negative religious beliefs, they also were more likely to perceive an erroneous pattern and endorse superstitious beliefs—suggestive of a religious residue effect. This research provides evidence for persistent religious residue on religious cognition, and the centrality of persistent negative religious beliefs.

Sex or Attachment? Examining the Influence of Same- Versus Opposite-Sex Parents' Traits on Partner Preferences

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Psychology

It is widely assumed that people are drawn to romantic partners who resemble their parents on key traits. This popular belief has its roots in studies of sexual imprinting in animals, and extensions of this research to human partnering have shown that individuals tend to be attracted to and choose partners who have similar *physical* characteristics to their parents. However, only a few studies have examined whether people prefer and choose partners who resemble their parents on non-physical traits like kindness or intelligence. Existing work in this area also has focused almost exclusively on the influence of opposite-sex parents. Although this makes sense based on an evolutionary account of human imprinting, attachment perspectives suggest that same-sex parents should also play a major role in shaping people's schema of a romantic partner and that closeness to a parent may matter more than parent sex in determining parental influence. Our research explores these competing perspectives by examining the link between people's mate preferences and both their opposite- and same-sex parents' traits and testing the influence of parent sex versus parent-child relationship quality on these associations.

Data were collected from 645 unmarried participants (190 men, 453 women). Participants completed an online survey where they rated their preferences for three dimensions of traits that people commonly desire in a long-term partner (attractiveness/vitality, status/resources, warmth/trustworthiness). Participants also rated themselves and their parents on these same characteristics and completed several measures assessing the nature of their relationship with each parent. We hypothesize that parental characteristics on the three trait dimensions will be positively correlated with participants' mate preferences for those traits. Using multilevel modeling, we will test the influence of parent sex (same-sex or opposite-sex) versus indicators of parent-child closeness/relationship quality on the strength of these hypothesized associations.

I love you, I'm sorry, please forgive me: Relationship closeness and the tendency to apologize as predictors of forgiveness-seeking intentions

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Mentor:
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Previous research on forgiveness has concentrated on granting forgiveness and its benefits for victims (Fehr et al., 2010). Few studies highlight transgressors' forgiveness-seeking intentions. Riek and colleagues (2010, 2014) found the severity of the offense and relational closeness predicted greater levels of guilt and shame in transgressors. The current study will replicate past findings regarding relational closeness on seeking forgiveness. Additionally, we will examine whether forgiveness-seeking intentions are impacted by (a) apologizing proclivity and (b) whether forgiveness is granted or withheld.

Undergraduate participants will complete a two-part questionnaire online. Part 1 includes the tendency to apologize (Proclivity to Apologize Measure; Howell et al., 2011) and empathy (Interpersonal Reactivity Index; Davis, 1983). Then, they read a scenario about revealing an embarrassing story, manipulated for relational closeness (modified from Rye et al., 2001), and indicate levels of guilt, shame, and forgiveness-seeking intentions (Riek et al., 2014). In Part 2, participants read a randomly assigned outcome scenario, in which forgiveness is either granted or withheld and complete the same measures.

We plan to complete data collection in March 2023. Hayes' PROCESS will be utilized to examine whether apologizing proclivity moderates the impact of relationship closeness on forgiveness-seeking intentions. We will run a 2x2 ANOVA to evaluate the effect of closeness and being forgiven on final forgiveness-seeking inclinations. We predict (1) closer relationships will result in stronger forgiveness-seeking intentions; (2) higher empathy and apology tendency will result in greater guilt, shame, and forgiveness-seeking intentions; (3) withheld (vs. granted) forgiveness will result in greater guilt, shame, and further forgiveness-seeking attempts in transgressors; and (4) in a close relationship, transgressors with a greater apologizing tendency will report greater guilt, shame, and forgiveness-seeking intentions.

Relationships enhance well-being but also result in offenses. The present study may contribute to understanding the situational and individual factors motivating forgiveness-seeking.

Adherence to COVID-19 Guidelines and Negative Associations with Sleep Health and Socialization

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Mentors:
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Social isolation created by social distancing guidelines has had negative impacts on mental, social, and emotional well-being (Kohls et al., 2021) along with sleep health (Kocevska et al., 2020). Importantly, there is a wide range of adherence to COVID-19 guidelines among individuals; heightened adherence has been associated with anxiety and worry (Mevorach et al., 2021), but also empathy and compassion for others (Morstead et al., 2022). These relationships between the extent to which individuals adhered to COVID-19 guidelines and sleep health, socialization, and well-being have not been systematically examined.

The present study addressed how college students adherence to COVID-19 guidelines, social life, student well-being, and sleep health were related. We predicted that adherence to COVID-19 guidelines would be significantly higher in 2020, at a time when many restrictions were enforced at colleges and universities, as compared to 2022, at a time when most restrictions had been lifted. In addition, we predicted that adherence to COVID-19 guidelines would be negatively associated with sleep health, socialization, and life satisfaction.

Adherence to COVID-19 guidelines significantly decreased from 2020 to 2022, whereas elements of sleep health improved from 2020 to 2022, supporting our hypotheses. In addition, we found significant negative relationships between adherence to COVID-19 guidelines and sleep health and socialization, such that heightened adherence was associated with poorer sleep health and less socialization. Importantly, no significant relationships were found between adherence to COVID-19 guidelines and happiness or life satisfaction.

Sleep health is crucial to our overall well-being (Worley et al., 2018). While adherence to COVID-19 guidelines has been associated with anxiety, which aligns with poorer sleep health (Ramsawh et al., 2009), it is important to note that adherence to guidelines also has clear benefits for protecting oneself and others, and was not shown to be associated with happiness or life satisfaction in our sample.

Home is Where The Heart is: The Perceived Benefits of the Home

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Sara Kraus
Kendahl Miller
Erin Moran

Mentor:
Dr. Benjamin Meagher, Psychology

The home has profound impacts on the mental health of its occupants. Graham and colleagues (2015), found that the various ambiances a home provides can enhance certain emotional states of an individual through the manipulation of a space. Another study found a multitude of psychological benefits through analyzing community member's responses while researching place-attachment theory (Scannell & Gifford, 2017). While the home can provide many benefits, there are more questions left unanswered with regard to how the perceived benefits of a home may encourage particular traits and behaviors for certain people. Some personality traits and behaviors have been thoroughly studied in relation to other human behaviors and beliefs, however, there is little research on how these personality differences may correlate to benefits of the home environment.

Participants (n = 316) were gathered via online crowdsourcing websites. Each participant completed multiple questionnaires investigating place-attachment measured by the Home Attachment Scale (Nartova-Bochaver et al., 2022), hospitable behaviors measured by the Interpersonal Hospitality Scale (Meagher et al., 2022), and personality traits measured by the Big Five Personality traits scale (John & Srivastava, 1999). Participants responded to three open-ended questions about the perceived benefits of their home. We used an inductive approach for content analysis on the responses. Logistic regressions were conducted to analyze if personality traits could predict benefit themes identified by participants. Extraversion had a marginally significant effect for participants being less likely to name privacy as a theme. Openness had a significant effect for participants being more likely to name indoor activities as a theme. A series of linear regressions were conducted to see which benefits participants listed would predict greater place attachment. Participants with highly restorative homes showed greater attachment to their home. Our study found a link between some personality traits and predicting whether certain benefits in the home would be desirable.

First Connect: Open Hearts and Open Minds through Racial Healing Circles

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This material is based upon work supported by the Association of American Colleges and Universities (AAC&U) Truth, Racial Healing and Transformation (TRHT) Campus Centers, and the Hope College Psychology Department.

The U.S. has many racial wounds that have led the people of our democracy to be less engaged and less cooperative in shared interests. These wounds must be healed before people relearn to work together in love. The Truth, Racial Healing & Transformation framework includes narrative change, racial healing and relationship building, separation, law, and economy (Christopher, 2022). Racial Healing Circle (RHC) methodology engages relationship building via individual, collective, and societal processes of unlearning bias and human hierarchy with awareness, appreciation, and the belief that humans are interconnected and interdependent. Research suggests experiential group interaction and sharing experiences can increase confidence and relational skills (Banach, et al., 2019; Meyer, et al., 2009). The RHC methodology utilizes an experiential format, connecting with a group of people sharing individual narratives and personal stories in a structured series of empowering segments. Racial Healing Circles encourage participants to discover, respect, and honor each person's experience. Creating an affirming and safe space provides an opportunity to heal together. RHCs may include race-based stories and also narratives about various identity elements, allowing for connection over any lived experience. To gain insight into people's feelings prior to and following a circle, undergraduates, faculty, and staff completed pre/post surveys regarding prior circle participation and feelings of emotional and physical safety, feeling heard and understood, comfort engaging in group settings, connection to community, and developing cultural competency skills. People who have not participated in a circle were surveyed to compare with circle participants. We anticipate that people who have participated in a circle experience will report better relational skills, engage in their community more, and express greater feelings of having an impact on their communities. A Racial Healing Circle experience has the potential to support relationship building, attitude change, and shift the ways individuals engage in their communities.

Infants' Ability to Associate Objects and Their Names

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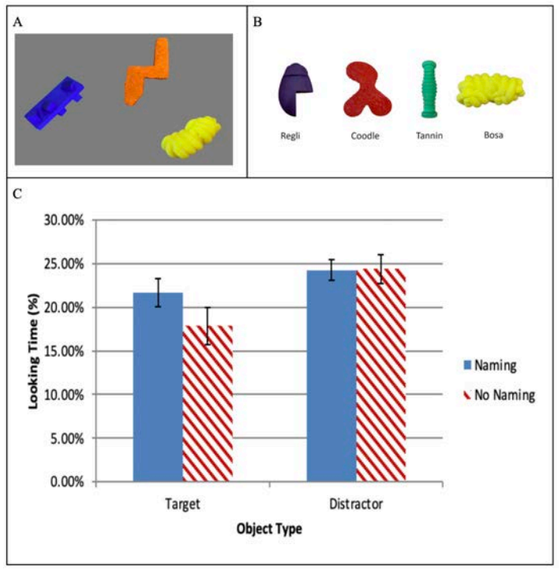
This research was supported by the Department of Kinesiology at Hope College.

Language learning is a complex, dynamic process (Kaplan, 2008). Nevertheless, research indicates that infants as young as 6 months can learn the names for common objects (Bergelson & Swingley, 2012). Learning to associate objects and their names is a difficult task. However, research demonstrates that when infants see objects and hear their names simultaneously across multiple settings, they can begin to associate word-object pairings (Yu & Smith, 2008). This process is called "cross-situational learning." The present study uses eye-tracking to examine how infants accomplish cross-situational word learning. Infants are randomly assigned to one of two conditions: a naming condition where object names are heard (experimental) and a no-naming condition where they are not heard (control). Participants see 12 novel objects on a screen across 80 trials. During each trial, three of the 12 objects are shown (one "target", two "distractors"). In the naming condition (experimental), one object per trial ("target") is named (figure A). In the no-naming condition (control), the target is not named. The eye tracker records where participants are looking on the screen. Thirteen infants have participated thus far. We computed the percentage of time infants looked to the target objects compared to distractor objects. If infants in the naming condition are learning to map the novel words to the correct objects, we expect them to look *more* to the *target* objects compared to participants in the no-naming condition, but *not more* to the *distractor* objects. This is precisely what our preliminary data demonstrates (figure C). This pattern suggests that even when infants see several objects while hearing one object's name, they can learn to link the names to the correct objects over time. Our next steps include gathering more infant data and doing a trial by trial analysis to better understand *how* infants are accomplishing this cross-situational word learning.

Keywords: cross-situational, word learning, novel objects, infants



(Figure A) Example of what one trial looks like from a participant's point of view. There were 80 trials.
(Figure B) "Target" objects used in the study.
(Figure C) Percent looking time to targets compared to distractors in the naming and no naming conditions.

A Review of the Predictors of Place Attachment

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What makes places special to us? Place attachment as a broad concept is the "bonding that occurs between individuals and their meaningful environments" (Scannell & Gifford, 2010). There has been a considerable amount of research done on place attachment and its many dimensions and intersectionalities with other disciplines. Place attachment is important, as people find great physiological and psychological benefits from being attached to a place. Places, especially those in close proximity to one's residence, can provide a sense of safety and security and help with the regulation of emotions. Attachment to places can also provide restorative qualities that help residents relax and rejuvenate. It is possible for people to be attached to many dimensions of places including homes, cities, neighborhoods, and even countries. The purpose of this literature review is to investigate place attachment and its many dimensions and complexities. We are interested in identifying the specific qualities, constructs, and measures, specifically at the neighborhood level, that are predictive of place attachment. We will be looking into both subjective and objective predictors of place attachment, such as neighborhood walkability, proximity to neighbors, and physical aspects of the home or residential space. This literature review will be utilized to help construct and conduct a summer research study investigating the physical qualities of one's neighborhood and if they are predictive of attachment.

Infant Object Transference and Play Preference

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This study investigates the link between virtual object learning and physical object play. This concept is relevant for today's digital culture where infants are routinely exposed to online educational programs (Barr, 2010). Research is unclear, however, about if and how what infants learn about objects on screen (visual preferences) applies to play choices — primary contexts for early learning.

The ability to recognize that an object's image on a screen is the same as the physical object is referred to as object transference (OT). For example, OT would be the ability to see an image of a cow on a screen and recognize that cow in real life. Prior studies demonstrate that infants at least 15 months old possess OT (Soska, 2010; Barr, 2010) with some studies suggesting that OT could occur as young as 6-9 months (Jowkar-Baniani, 2011; Rose, 1977).

In this ongoing study, infants participate in two tasks. First, infants watch for six minutes as 12 objects appear on screen in sets of three for 3.5 seconds at a time *(Figure 1A-B)* while researchers record how long infants look at each object through eye tracking. Second, infants are given 6 minutes to play with the 12 physical objects off-screen *(Figure 1C)* while researchers record how long they play with each object.

Preliminary data from 5 infants aged 8-21 months indicates a weak, positive correlation between visual and play preferences (mean r=.10; *Figure 1D*), however a larger sample size is needed before any conclusive results can be drawn. Future research will clarify conflicting studies on when OT develops and how infant age influences visual and play preferences. Enhancing knowledge about the correlation between infant visual preferences and play preferences can provide insight into the effectiveness of infant virtual education.

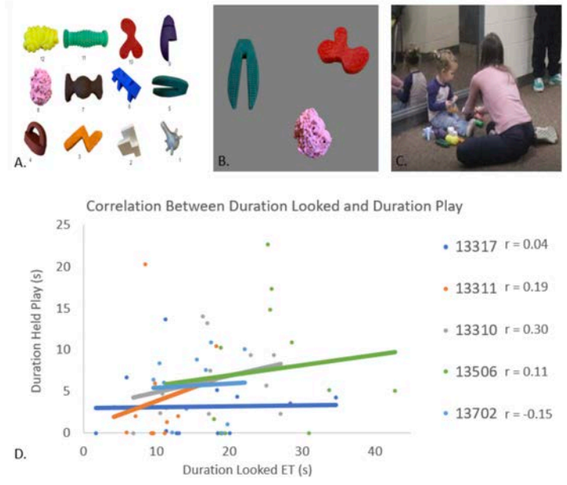

Figure 1. Experimental Play Procedure and Results.
A) Images of physical objects used during play sessions.
B) Image of objects displayed in sets of three as seen by infants during eye tracking sessions.
C) Photo of play session in progress with participant and experimenter.
D) Scatterplot of relationship between infant visual preference and physical play preference. Each point represents the amount of time the infant spent looking at a single object during eye tracking (x-axis; ET) and the duration of play with that same object (y-axis), for a total of 12 points per infant. A trend line was graphed for each participant (N=5) as shown by participant ID number and r value.

Conceptualizing Hope as a Virtue

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The purpose of this study is to develop a quantitative measure for conceptualizing hope as a virtue while expanding on the psychological framework of hope theory. Hope has predominantly been studied in positive psychology under Snyder's Hope Theory framework (Snyder, 2002). However, its current definition does not encompass a virtuous definition of hope, something that is inherently good. Hope Theory predominately studies hope as a personal trait that promotes individual success and well-being (Schornick et al., 2022). Virtues are a target of much scientific focus and a theoretical framework has recently been proposed to further its empirical study (Fowers et al., 2021). This study follows a qualitative study of moral exemplars of hope and operationally defines virtuous hope as the following: Virtuous hope involves the ardent pursuit of realizing a particular vision of the common good with intention and action, often growing out of adversity, and shaped in relation to other people and the transcendent. Its definition is built on qualitative interviews with moral exemplars of hope. 33 quantitative items were drafted and piloted with an undergraduate sample in the United States, as well as a paid international sample sourced through Prolific. Factor analysis, cronbach's alphas and invariance analyses will be conducted to test and hone the scale.To determine construct validity, the items were piloted alongside measures of hope theory, eschatological hope, depression, justice sensitivity, and flourishing. We hypothesized a mild to moderate positive correlation between virtuous hope, eschatological hope, justice sensitivity, and hope theory and a negative correlation with depression. We anticipate that both eschatological hope (hope from God) and justice sensitivity will be more closely related with virtuous hope compared to hope theory. This study would provide a quantitative measure that is consistent with virtue science and broadly usable to study hope as a virtue.

Social/Emotional Knowledge in Patients with Ventromedial Prefrontal Cortex Damage

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Ashley Trainor

Mentor:
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Psychology

Previous research suggests that social/emotional cognition in patients with ventromedial prefrontal cortex (VMPFC) damage is intact. However, there seems to be significant deficits in behavior, which could suggest a diminished ability to retrieve such knowledge. Therefore, we used more sensitive measures to detect any deficits in social and emotional semantic memory n that may be present within this group. In this study, VMPFC patients (N = 5) as well as healthy participants (N = 16) were given a features task and a senses task in order to assess their semantic richness and depth of knowledge of the social/emotional words provided. In the features task, participants were given two minutes per word to verbally list as many features as possible (*bank:* loans, accounts, tellers, etc.). In the senses task, participants were told that each word had multiple meanings, and were given one minute to list as many senses as possible (*bank:* financial institution, land next to a river). The number of features and senses VMPFC patients provided was significantly less than the healthy participant group. Our results therefore suggest that VMPFC patients may have impairments in their social/emotional knowledge. This is an important finding because it informs us that the ventromedial prefrontal cortex most likely plays a role in semantic memory and cognition.

Home is More Than a Place: Personality and the Psychological and Emotional Costs of the Home

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Katie Donahue
Aliana Alvarez-Gomez

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The home is a fundamental aspect of life as a source of shelter, rest, and social interaction. Past literature explores the emotional and psychological benefits of the home which is often conceptualized as a safe haven and place of renewal (Korpela, 1992; Mallett, 2004). Conversely, the home can also be a place lacking freedom, space, or privacy (Smith, 1994).

There is little research regarding the impact of personality traits on the perception of home. Our increasingly fast-paced and technology-filled world makes it essential for individuals to have a quiet and comfortable place that provides restoration. The connection between the home and well-being suggests that a harmful home environment can deteriorate mental health (Smith, 1994). The current study explores which psychological and emotional costs of the home are most commonly identified and how the Big Five personality traits, hospitality, and home attachment relate to these costs.

Adult participants from the United States completed the Interpersonal Hospitality Scale (Meagher et al., 2022), the Home Attachment Scale (Nartova-Bochaver et al., 2022), and the Big Five Inventory (John & Srivastava, 1999). Participants answered open-ended questions describing their home, the negative aspects of their homes, what makes them want to leave their home, and the emotional and psychological costs of being at home.

We performed content analysis to identify the key themes in participant responses and logistic regressions to determine which traits predict perceived costs of home. This study expands the literature regarding personality influences on perceptions of the home and how the home relates to well-being. Future directions for research include examining the long-term costs of the home and conducting separate analyses for different types of homes.

Relationships in the Aftermath of Suffering: Evaluating Social Support, Perceived Control, and Coping as Predictors of Resilience in Individuals with Trauma History

MacKenna Shampine

Mentor:
Dr. Lindsey Root Luna, Psychology

Individuals with trauma history often lack resilience and experience decreased life satisfaction and mental well-being (Krause, 2004). Resilience is the physical and psychological recovery from adverse experiences (Ryff et al., 2012). A component of resilience is psychological flexibility, or adapting to new demands, values, and goals (Kashdan & Rottenberg, 2010). By understanding the mechanisms through which trauma relates to psychological flexibility, we can promote resilience by advancing post-traumatic therapeutic interventions.

Social support, coping, and perceived control are factors that play a role in psychopathology after trauma (Trickey et al., 2012). Current literature indicates that perceived control mediates the relationship between social support and well-being (Alonso-Ferres et al., 2020). Research also demonstrates that social support is related to coping (Kim et al., 2010) and that coping mediates the relationship between perceived control and distress (Frazier et al., 2005). To our knowledge, no existing research explores whether perceived control and coping sequentially mediate the relationship between social support and resilience.

The current study includes 560 individuals who reported physical or sexual assault in the National Survey of Midlife Development in the United States II (MIDUS II), a longitudinal project examining physical and mental well-being. We will utilize the MIDUS Social Support Scale, the Sense of Control Scale, a subscale of the Coping Assessment (problem-focused coping), the Emotion Regulation Questionnaire, the State-Trait Anxiety Inventory, the depressive symptom subscale from the Mood and Anxiety Symptom Questionnaire, and heart rate variability (HRV). Emotion regulation, HRV, and decreased anxiety and depression are common markers of psychological flexibility (Sætren et al., 2019).

We expect social support will predict resilience, sequentially mediated by perceived control and coping. We will use Hayes' PROCESS in SPSS to evaluate perceived control and coping as mediators. We anticipate this work will underscore the importance of social support as a therapeutic intervention following trauma.

Humbly More Religious: The Role of Humility in Religious Change

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Hannah Fuller
Carmen Casper
Isabella Brady

Mentor:
Dr. Daryl Van Tongeren, Psychology

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Recent polls indicate that rates of individuals in the United States who identify as *currently religious* are declining (Twenge et al., 2016). Events such as COVID-19, presidential elections, and personal adversity affect religious change, likely because such events threaten one's religious worldview. One understudied area of religious change is intellectual humility. Religious change may be more welcome and less destabilizing. We seek to better understand religious change by examining the critical role of humility. In this study, individuals who attended a ex-vangelical conference participated in a year-long longitudinal study where they answered surveys in both 2019 and 2020. These surveys focused on religious affiliation, intellectual humility about existential issues (IH-E), and religious deconstruction. In total, 240 individuals (85.8% women, 11.2% men, 2.4% gender-nonconforming, and .6% transgender) participated. Additionally, the majority of participants were white/caucasian (57.9%). Of this population, there were individuals who have always been religious (45.6%), were formerly non-religious but now identify as religious (5.9%), left religion but have reidentified (12.4%), are formerly religious (33.1%), and who were never affiliated with religion (3%). Results revealed a significant interaction between religious change (moving toward religion) and intellectual humility (IH-E) around existential concerns on change in religious well-being (b = .77, SE = .27, t = 2.82, p = .006). Specifically, for those low in IH-E, religious change predicted less religious well-being one year later (p = .061), whereas for those high in IH-E, religious change predicted greater religious well-being (p = .027). Having humility when undergoing religious change seems critical for religious well-being. Specifically, moving toward religion humbly results in greater future religious well-being, whereas doing so arrogantly impairs future religious well-being. In the future, we look to advance our research by investigating the relationship between humility and religious deconstruction more broadly.

Social and Emotional Knowledge in Hippocampal Amnesia

Ashley Trainor
Olivia Onderdonk

Mentor:
Dr. Nate Klooster, Psychology

The hippocampus has been found to play a role in general semantic knowledge, but it is unclear if it plays a role in social and emotional semantics. This study seeks to evaluate the role of the hippocampus in social and emotional semantics through the study of patients with hippocampal damage and severe amnesia. Although previous literature has shown that individuals who have damage to their hippocampus show deficits in neutral words, we predict that the hippocampal amnesic group should show the same social-emotional knowledge as the healthy control group. For this study, we investigate this by using more sensitive measures to determine if individuals with damage to their hippocampus show similarities in their social and emotional knowledge as compared to healthy individuals. Participants from the amnesic (n=5) and healthy control (n=16) groups completed feature (*bank:* loans, accounts, tellers, etc.), and sense-listing tasks (*bank:* financial institution, land next to a river). Within these tasks, responses for social and emotional words were noted. For the features task, the amnesic group produced significantly fewer features compared to the healthy group. For the senses task, the amnesic group produced significantly fewer senses compared to the healthy group. These findings suggest that patients with hippocampal amnesia show deficits in social and emotional knowledge. Further, this indicates that the hippocampus may play a role in social and emotional knowledge and memory. These findings are relevant for other patient groups with hippocampal abnormalities, and deficits in social and emotional behavior, such as patients with autism or Alzheimer's Disease.

Does visual dominance influence looking patterns in adults?

Erin Vokal
Lars Overos
Lauren Tocco

Mentor:
Dr. Lauren Slone,
Psychology

Language acquisition begins with learning names of common objects by discovering the link between the word and the object. Yet even this is difficult because many objects are often in view when an object's name is spoken. Research shows that children hold objects close to their faces, making them larger in view than other objects, which we call "visual dominance". Infants learn names of objects better when the object named is visually dominant (Yu & Smith, 2012). We want to test if visual dominance aids word learning even when objects are not being held. We will test this by displaying images of novel objects on a screen and testing whether adults learn their novel names. In 80 training trials, we presented images of three objects at a time, and named one object. For participants in the Dominant condition, the named object ("target") was always larger than the non-named objects ("distractors") and for participants in the Equal condition, the target was equal in size to the non-named objects. We hypothesize that adults will look faster and more often to target objects in the Dominant condition. Additionally, we hypothesize that greater looking to the target object will aid in learning the target's names. We examined object name learning based on which object they looked at and/or pointed toward when asked "where is the [novel name of the object]?" at the end of the study. Preliminary data from 34 undergraduates supports our first hypothesis that participants in the Dominant condition looked more to the target object than the distractors during training trials. Future analyses will investigate whether participants learned more words in the Dominant condition, and how their looking during training relates to their word learning.

Evaluating hope as a virtue in participants from Brazil, South Africa, and Hope College

Katherine Yakes
Nhi Hoang
Erin Moran

Mentor:
Dr. Kendra Thomas,
Psychology

Previously, hope has been measured predominantly as a success variable in goal-oriented thought through Hope Theory. In Hope Theory, Snyder et al (1991), hope is broken down into two parts, agencies and pathways. Agencies measure a person's willpower to attain their goals and pathways measure how a person plans to reach their goals. Given this, hope has never been quantitatively measured as a virtue in the field of Psychology. We believe that it is important to measure hope as a virtue because there is a gap in how hope is conceptualized in non-WEIRD cultures, especially those in adversity.

This study uses the term "Ithemba,"the word for "hope" in Isizulu to define virtuous hope. Ithemba hope has been previously analyzed and broken down into cognitive, behavioral, and motivational dimensions using Exemplars in South Africa (Thomas et al., 2022). With these prior categories, we use Ithemba hope as the basis for our virtuous hope scale.

This study addresses the measurement of virtuous hope by creating a new measured scale of virtuous hope including a 9-item scale in which Ithemba Hope is broken down into further categories based on adversity, visions of the future, encouragement of others, and pursuit of the common good. Using a sample of participants from Brazil, South Africa, and Hope College, we administered a survey measuring virtuous hope given the 9-item scale, hope in Hope Theory (Snyder, 2002), justice sensitivity, well-being, and flourishing. We then analyzed and evaluated the associations between Ithemba Hope and these other variables as well as tested for gender and racial differences in each group. In all three samples, Ithemba hope was positively correlated with flourishing. In both the Brazillian and Hope College sample, Ithemba hope was negatively correlated with depression.

Evaluating the Differences in Empathy of Nursing Students and Pre-Health Students: A Prospective, Cross-Sectional Study

Callalily Britt

Mentors:
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Sociology & Social Work

Dr. Anita Esquerra-Zwiers,
Nursing

Empathy is an important trait for healthcare professionals to have. Little research has been done assessing the differences between nursing and pre-health undergraduates and degree of empathy. The purpose of this study is to evaluate the degree of empathy between nursing and pre-health undergraduates and assess any trends that impact degrees of empathy. Jean Watson's Human Caring Model informs this analysis explaining that nursing is an application of science through caring. Caring and empathy go hand and hand. Caring promotes growth and enhances nursing practice. This longitudinal prospective study follows three consecutive cohorts from nursing and pre-health undergraduates at a small Christian liberal arts college in the Midwest. This study only uses data from wave 2, which cohort one completed in spring of 2020, and cohort three completed by 2022. Surveys were only distributed to students who identified as pre-health or pre-nursing upon college admission during their first year of undergraduate education. Follow-up surveys were sent to undergraduates who completed the previous survey. There were 531 undergraduates who participated in the study. An ordinary least squares regression test was completed using SPSS (version 27). The results from this test showed that gender and social support are significant predictors of both perspective taking and empathic concern. There was no significant difference between nursing and pre-health undergraduates. Limitations include samples obtained from a single institution and lack of sample diversity. The results of this study may inform educational practices at undergraduate institutions. As social support was a predictor of empathy, it is important to encourage people to surround themselves with more supportive people in their lives.

Who Cares About Their Friends? The propensity to emphasize protection of self or protection of others during the Covid-19 Pandemic

Paige Buckberry

Mentor:
Dr. Aaron Franzen,
Sociology & Social Work

During the pandemic, behavioral guidelines often became contentious and took on a meaning beyond the actual behavior. This study focuses on understanding why a population of undergraduate students followed Covid-19 health protocols. Was the motivation primarily to protect one's self, to protect others, or a combination of both? Additionally, did the behaviors and motivations change throughout the semester? We hypothesized that an increased perceived threat of infection and one's communal norms would shape motivations for behavior. We find that as one's perception of threat increases, so does the motivation to act in defense of the self, and stronger communal Covid-19 precautions increase the motivation to protect others. The results from this study provide evidence that the perceived threat of Covid-19 and the behaviors of those within one's community influence background motivations for why people engage in protective measures, which may in turn be connected to communal infection risks.

Ideal Professional Self Descriptions in Nursing and Pre-Health Undergraduate Students

Allison Graver

Mentors:
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Sociology & Social Work

Dr. Anita Esquerra-Zwiers,
Nursing

This research was supported by the David And Carol Cole Faculty Development Fund.

Professional identity is the sum of the attitudes, values, knowledge, beliefs, and skills shared with others within a profession. It is a concept that can influence students' perceptions of their profession and their intention when entering a profession. The purpose of this study was to analyze initial and subsequent ideal professional self-data from pre-health and nursing undergraduate students at a Christian liberal arts institution to determine what factors influence professional identity. This analysis was informed by Roy's Adaptation Model, which views humans as biopsychosocial adaptive systems who cope with environmental change (undergraduate education) through the process of adaptation. This prospective longitudinal study surveys the undergraduate students (N=531) with follow-up surveys sent one year later for comparison. Survey data recorded demographic characteristics as well as open-ended questions regarding professional self that were categorized thematically into nine groups (medical professional, non-medical professional, helpful, character, character/medical professional, helpful/medical professional, helpful/character, success, and other). Data were analyzed for descriptive statistics, bi-variate correlations, and crosstabs using the IBM SPSS Statistics software (version 28.0.1.1). Results found that 11% of students changed their ideal professional self after one year and most commonly identified their ideal professional self in relation to a characteristic such as kind, thoughtful, and caring. Significant correlations for demographics and professional identity were found between female and helpful (0.23), female and character (0.125), female and medical professional (0.165), and white and helpful/medical professional. Conclusions of the study determined that very few undergraduate students changed how they described their ideal professional self by wave two and first-year nursing students idealized themselves as helpful/character more often than pre-health undergraduate students. Limitations include single location, only pre-health and nursing undergraduate students, self-reported data, and missing follow-up data. This data may provide support for undergraduate educators helping students develop their ideal professional self.

Exploratory Study of Undergraduate Pre-health and Nursing Student Differences in Development

Bergen Johnson
Grace Rellinger

Mentor:
Dr. Aaron Franzen,
Sociology & Social Work

This research was supported by the David And Carol Cole Faculty Development Fund.

There is a great deal of research on how the professionalization and work of medical students, physicians, and nurses affect them, including burnout, stress, and empathy loss. We are interested in the earlier development of these trends and whether they already begin among undergraduate students pursuing health or nursing professions. There is a substantial knowledge gap in the differences and commonalities between pre-health, nursing, and students who have left health professions already. This research explores some of these commonalities and differences that begin developing quite early in nurses' and physicians' education. We look specifically at aspects we have labeled as stressors and others we have labeled as part of students' identity. Using one-way ANOVAs and Tukey's multiple comparisons we identified numerous differences between pre-health, left-health, and nursing undergraduate college students. Notable differences were seen in baseline confidence, humility, boredom, first-generation status, and religious identity. Future research should continue to uncover and understand these differences, perhaps at more undergraduate institutions with larger, more diverse sample sizes.

Effects of Religion and Health on Humility in Undergraduate Pre-health and Nursing Students

Bergen Johnson

Mentor:
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Sociology & Social Work

Physicians who display greater humility tend to have better communication with patients, who then self-report as having better health (Ruberton et al. 2016). Research shows that older adults with increased humility have better self-rated health (Krause 2010). Religiosity also relates to humility in older adults, with more religious individuals scoring higher in humility (Krause 2010). Due to the benefits of humility for patients and physicians, the early character development of humility in undergraduate pre-health and nursing students is of interest — especially as this is a time of rapid character change and development (Clydesdale 2007). This study investigates whether the same relationships are present for undergraduate pre-health and nursing students. We found that students who identify as religious have less humility than students who are not religious. Also, students with better overall health have increased humility while students with bad mental and physical health have higher humility.

The Beyond Ethnicity Project

Corri Zimmerman
Rita Kagaju

Mentor:
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This research centers on Latina/o/x students' perceptions of their racial identity in light of issues related to privilege, racism, colorism, and belonging as they navigate the social and racial dynamics of a Predominantly White Institution. Focusing on the lived experience of 23 U.S. and foreign-born Latina/o/x, this ongoing research seeks to understand how skin color and place of origin play a role in understanding and interacting with these themes. Initial findings reveal that white-identifying students feel like outsiders in spaces that are predominantly white and in spaces that are predominately Latina/o/x. International students in this study faced ignorance about their place of origin but expressed feeling secure in having the privilege of being a member of the majority group in their home countries. Darker-skinned Latina/o/x students were more likely to experience discrimination. Interviews will continue during the spring semester. Interviews will continue during the Fall 2023 and Spring 2024 semesters.

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