21st Annual
Celebration of Undergraduate
Research and Creative Activity

2022 Abstracts

Hope
COLLEGE

Table of Contents

Dear Friends,

I am excited to welcome you to the 21st annual Celebration of Undergraduate Research and Creative Activity (CURCA) at Hope College. This event highlights more than 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, and it is a distinction that has garnered national recognition. *US News and World Report* ranks Hope College #24 in undergraduate research, among a selective list of 56 colleges and universities, such as Harvard, MIT, Princeton, Stanford, and Yale, who excel in providing 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 a Hope College a transformative and world-class educational experience.

This year's Celebration includes 153 presentations by 252 students from 22 different departments and programs working with 74 faculty mentors. Research occurs both during the academic year and summer, spans the four academic divisions, and includes independent study and course-based research. During the 2021 calendar year, Hope students made 91 conference presentations at off-campus conferences, published 27 articles or scholarly chapters, and submitted another 12 papers for publication. For the 2021 fiscal year, Hope College faculty, staff, and students received $2.9 million in external funding to support 50 research, outreach, public service, and educational awards.

Thank you for your participation in and support of CURCA 2022. To learn more about student-faculty collaborative scholarship, visit the website: **hope.edu/research**.

Sincerely,

Daryl R. Van Tongeren
Interim Associate Provost for Academic Affairs

Disability in Disney

Chloe Bartz

Mentors:
Dr. Curtis Gruenler, English

Dr. Dennis Feaster, Social Work

This research was conducted with support from the Howard R. and Margaret E. Sluyter Faculty Development Fund.

René Girard's mimetic theory emphasizes the importance of imitation in shaping all human behavior, including desire. The questions driving this project were founded with human imitative behaviors in mind: Is Disney creating characters with disabilities that are inherently desirable to imitate (attractive, popular etc.)? Is Disney creating complex, dynamic characters with disabilities? Unfortunately, the answer is no. Within the Disney canon of animated films there are 13 characters identified as having physical disabilities. By tracking the language used to refer to these characters and their foils an alarming pattern was revealed. When formal titles, the character's name, and nicknames were removed, the remaining terminology was assessed using Wordcloud technology to visually represent the frequency with which different terms were used in reference to each character. While only three of 13 characters with disabilities are characterized as villains, all of the characters with disabilities are most commonly referred to using derogatory or infantilizing terminology. On the whole, good or evil plays little role in the language referring to characters. Instead, those characters with disabilities had a high frequency of being referred to as "monster," "little," or by their disability, a trend most noticeable in Disney's adaptation of Victor Hugo's Quasimodo. Children ages three to twelve who are the target audiences of these films are most vulnerable to absorbing Disney's discrimination against disabilities. The characters with disabilities act as mimetic mediators between developing children and people with disabilities as children will retain and regurgitate the language and treatment they witness toward disabled characters. This negative mimesis is further perpetuated by the cute culture of Disney and their ostracization of characters that do not fit the ideal attractive standard. The villainization of a disabled body in Disney feeds into the scapegoating of people with disabilities and is harmful in maintaining societal stereotypes.

The Liberian Dream: Foundations of Race, Hierarchy, and Freedom in America's Quasi-Colony

Mary Kamara-Hagemeyer

Mentor:
Dr. Lauren Janes,
History

The strict racial divisions and minority rule that dominated the nation of Liberia's founding and early government have been identified as sources of later problems for the country. The foundation for the racial and ethnic separation in the colony and later republic stemmed from the White supremacy and centering of Western ideals that the colony was founded in. This paper explores the formation of the colony and early Republic of Liberia, from the development of the American Colonization Society in America to the first group of Black emigrants to arrive on Africa's West coast. It also looks at how the ideas of White supremacy, Western culture, and the notion of the civilizing mission caused the formerly oppressed group of Black Americo-Liberians to create a racially and ethnically stratified society that recreated many structures of discrimination found in the United States.

How the Sugar Industry Facilitated the Annexation of Hawaii

Kate Winter

Mentor:
Dr. Lauren Janes,
History

American interest in Hawaii began to grow in the early 1800's because of their strategic location in the Pacific. In order to gain influence over the islands, the U.S. fostered a reciprocal trade agreement which made Hawaii economically dependent on American imports. By looking at correspondence between government officials, reciprocity stipulations, and actions which defied their own welfare, we can see the methodical process in which the U.S. gained control of the Hawaiian Islands. This study illustrates the dangers of reciprocal trade between large and small countries, and how financial control can aid imperialistic motives. While "imperialism" is a term which often denotes physical aggression, the relationship between Hawaii and the United States is proof that it can be enforced without physical violence.

Dimensions of Divine Simplicity

Lydia Harrison

Mentor:
Dr. Jack Mulder,
Philosophy

St. Thomas Aquinas' doctrine of divine simplicity teaches that God is fully simple, such that there are no parts or components which comprise him. It is insufficient to say that God exists, for God himself is his existence. Similarly, it is insufficient to say that God is loving or just or wise, for God himself is Love, Justice, Wisdom, and all those other attributes which belong to him. Recent scholarship has dismissed this doctrine, claiming that it equates God's attributes to one another in a logically impossible manner. Scholars also think the doctrine places God in a category unfit for him (i.e. if God's attributes are properties, and God is his attributes, God must be a property). I argue that God's attributes should be understood as dimensions of God, so that while God is his attributes, those attributes do not equate to one another, nor do they classify God or limit his nature.

Law and Heart: Studying the Sermons on the Mount and Plain

Lydia Harrison

Mentor:
Dr. Wayne Brouwer,
Religion

Matthew 5-7 and Luke 6:17-49, known respectively to scholars as the "Sermon on the Mount" and the "Sermon on the Plain," offer two accounts and structures of largely overlapping teaching material from Jesus. Both the incredible similarities and the remarkable differences between these two passages reveal significant truths and emphases in the heart and teaching of Christ. Matthew's highly structured account, primarily targeted to a Jewish audience, highlights Jesus' concern for obedience to the law as a necessary expression of a heart oriented toward God. Luke's loose, narrative-oriented account, primarily targeted to a Gentile audience, highlights Jesus' desire for his people to enter into a worldview defined by God. These complementary emphases, framed around similar content, convey a cohesive understanding of a God who wants the hearts and lives of his people to reflect their allegiance to him.

We Are THE WOLVES: Stage Management for the 2021-22 Theatre Season

Emily Dykhouse

Mentors:
Reagan Chesnut, Theatre,

Richard Perez, Theatre

In an art form as reliant on vulnerability, communication, and connection as theatre is, a stage manager brings a sense of clarity and insight to all facets of the production process. Even amidst the intimacy of small onstage ensembles, the stage manager can and should become an important part of that ensemble. During Hope Theatre's production of *The Wolves* by Sarah Delappe, stage management was responsible for coordinating production needs before rehearsal began, serving as a point of contact, connections, and advocacy for the director, designers, and actors, and calling light and sound cues during every performance.

Stage Manager for Native Gardens

Rachel Scott
Grace Conant
Selena Capman
Danai Mandebvu

Mentors:
Reagan Chesnut, Theatre,

Richard Perez, Theatre

I was the Stage Manager for the Spring 2022 Theatre Department Production of *Native Gardens*. This play was performed in the DeWitt Studio Theatre and the rehearsal/performance process lasted 9 weeks. I was responsible for coordinating schedules of performances and rehearsals. I collaborated with the Director and the rest of the Production Team to coordinate scenery, properties, costumes, lighting, sound, and publicity. I took notes during every rehearsal, production meeting, and performance. During performances and technical rehearsals, I managed all of the actors and crew and called lighting, sound, and entrance cues.

Exploring the Relationship between Bipolar Disorder, Alcohol Use, and Obsessive Compulsive Disorder in the HCA Animal Model

Erick Alvarado
Ayanna Bailey
Sabrina Blank
Lindsey Boltz
Corine LaFrenier
Molly Poel

Mentor:
Dr. Leah Chase,
Biology and Chemistry

Funding provided by the Hope College Neuroscience Program

An estimated 4.4% of U.S. adults experience bipolar disorder at some point during their lifetime. While the prevalence of bipolar disorder is similar among males and females, it is becoming increasingly obvious that symptoms and comorbidities of the disorder can vary widely between men and women. Recent research has shown that men diagnosed with bipolar disorder are more likely to exhibit alcohol use disorders and obsessive compulsive behaviors while women have a higher incidence of panic disorder comorbidity. In order to develop effective treatment for the disorder, it is important to use an animal model that reflects these sex-dependent differences. Growing evidence suggests that alterations in glutamatergic neuronal signaling may be associated with bipolar disorder. Homocysteic Acid (HCA) is a glutamate analog and has been reliably demonstrated to induce a mixed manic/depressive state in rats when administered during a critical phase in development (P3-P21). However, the animal model has not been assessed for sex-dependent comorbidities. Given this, the present study aimed to replicate findings from previous studies of the HCA animal model, while also investigating the effects of HCA on alcohol use, obsessive-compulsive behaviors, and measures of stress in a sex-dependent manner. Collectively, this study will allow us to develop a more comprehensive understanding of the ability of the HCA animal model to replicate the complex phenotype of bipolar disorder.

Early Prenatal Exposure to Homocysteic Acid Leads to Alterations in Behavior and Gene Expression that are Consistent with Bipolar Disorder

Kelly Bosis
Gabriella Taylor
Anna Lunderberg
Stephanie Simko

Mentor:
Dr. Leah Chase,
Biology and Chemistry

This research was supported by the Hope College Neuroscience Program and Schaap Endowed Funds for Undergraduate Research.

We have previously demonstrated that early post-natal exposure of rat pups to the NMDA receptor agonist, homocysteic acid (HCA) from P3-P21 leads to the development of mixed manic/depressive behaviors following puberty. The manic behaviors are effectively reversed by lithium treatment, and the depressive behaviors are reversed by acute ketamine treatment. Thus, HCA appears to induce a bipolar-like phenotype in rats. The goal of this study was to determine whether HCA exposure also induces gene expression changes that are consistent with a bipolar phenotype. Microarray analyses were performed on tissue obtained from the prefrontal cortices of saline- and HCA-treated rats at 3 weeks and 32-weeks of age. At 3 weeks, HCA rats exhibited 132 differentially expressed genes relative to control, many of which suggest there is a delay in oligodendrocyte development. Interestingly, several genes that have been identified as exhibiting reduced expression in bipolar disorder and schizophrenia, including MBP, PLP1, MAG, MOG, ERMN, and GSN. At 32-weeks, 316 differentially expressed genes were identified, including many genes which are associated with GABAergic interneuron function or regulate excitatory/inhibitory balance including SST, PVLB, GABRB2, GABRA6, KCNA1. We confirmed several of these alterations in gene expression using qPCR. Collectively, these results suggest that HCA treatment leads to changes in gene expression that mirror those previously identified in GWAS and microarray studies in post-mortem BD patients.

The Effects of HSV-1 on Anxiety and Circadian Rhythms

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Cameron Houck
Grace Gadwood
Sacia Gilbertson

Mentors:
Dr. Andrew Gall, Psychology

Dr. Gerald Griffin, Biology and Psychology

This research was supported by the Donald W. Cordes Faculty Development Fund.

Viruses are foreign, infectious pathogens that replicate in homeostatic cells of a living being. Herpes simplex virus type 1 (HSV-1) is a prevalent virus which accounts for the infection of about 67% of the worldwide population (Looker et al., 2015). Although infection with HSV-1 tends to be lifelong, the effects may not always be visible. The virus assumes a latent stage and may be reactivated multiple times, usually prompted by stress (Arduino & Porter, 2007). HSV-1 has additionally been associated with cognitive decline in adolescents, middle aged adults, and older adults (Harris & Harris, 2015). However, this link has remained at the correlational level. Furthemore, HSV-1 has been associated with chronic fatigue syndrome (CFS), and may disrupt circadian rhythms, as implicated in other viral infections (Bond & Dinan, 2006). However, this relationship has not been established experimentally yet.

The present study aimed to enhance the literature on HSV-1 infection, cognitive decline, and circadian rhythmicity. We assessed the relationship between HSV-1 infection and circadian rhythm disruption through behavioral analyses in various lighting conditions. Additionally, we assessed the effect of HSV-1 reinfection on anxiety-like behaviors through inducing thermal stress and conducting behavioral assays. Finally, to determine whether development plays a role on the effects of HSV-1 on circadian rhythms and anxiety, we tested young and old mice on each assay.

Results indicated a developmental effect of age on anxiety-like behaviors, such that older animals demonstrated decreased anxiety in the open field test, and increased time in darkness in the light-dark box, suggesting that older animals may have lower levels of anxiety, but a stronger aversion to the light. We are continuing to analyze the circadian rhythm results, but preliminary analyses reveal that HSV-1 significantly decreases levels of locomotor activity as compared to controls 1 week post-infection, with activity levels returning to baseline several weeks later during latency. Altogether, our results reveal the impact of HSV-1 infection on behavior.

Olfactory Loss and Recovery Following Lesion of the Olfactory Bulb of Zebrafish

This material is based upon work supported by the National Science Foundation under Grant No. 1811477, the Herbert H. and Grace A. Dow Foundation, Shermain Fairchild Fellowship, and NetVuE experiential grant.

This project was an interdisciplinary endeavor between the Departments of Biology and Neuroscience. See page 19 in the Biology section of this book for full abstract.

An Evaluation of Cortical Response Symmetry to Electrically Evoked Touch

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Anna Molloy
Margaret O'Neill

Mentor:
Dr. Katharine Polasek, Engineering

This material is based upon work supported by the National Science Foundation under Grant No 1805447 and the Hope College Neuroscience Program.

Phantom limb pain (PLP) is a pain that originates from a missing limb for those with amputations. PLP is reported to be present for 50-80% of amputees and can significantly impact quality of life. This pain is presumably caused by changes along the neural pathway for pain and sensation. Due to limited understanding of PLP, treatment options are quite unsatisfactory. Previous work by the Polasek group has evaluated the use of electrical stimulation as a treatment for PLP. To better understand this treatment mechanism, we aim to increase our understanding of cortical response symmetry to electrical stimulation in able-bodied participants.

To evaluate cortical response in able-bodied individuals, 18 participants were exposed to electrical stimulation of the index and pinky fingers for both the right (RI, RP) and left hand (LI, LP). Cortical response to the electrically evoked somatosensation was measured by a 96-channel electroencephalogram (EEG) cap.The EEG data was analyzed by calculating a global field power (GFP) for each digit and compared via correlation. We expect to see symmetry across the left and right hands in response to electrically evoked touch, such that the LI and RI responses would be similar and the LP and RP responses would be similar. This would indicate a similar response in the right and left hemispheres, respectively.

Symmetry of Cortical Responses to Physical Touch

Haley Katenin
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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 and the Hope College Neuroscience Program.

Phantom limb pain (PLP), a phenomenon that affects many people following amputation, causes pain and discomfort in the missing extremity. It is believed PLP is a result of the disrupted communication from the missing limb to the somatosensory cortex. There is currently no cure for PLP, and therefore treatment is highly prioritized. The overall goal of the research group is to develop an effective at-home treatment for PLP. This specific project will allow for a greater understanding of the symmetry of cortical activity in response to physical touch. It was hypothesized that there would be a higher correlation between cortical activity in the same finger location on both hands compared to the correlation between different finger locations.

18 volunteers participated in this experiment. To measure brain activity during physically-evoked somatosensation, each subject wore a 96-electrode electroencephalogram (EEG) cap. A solenoid system randomly tapped four finger locations, the left and right index and pinky fingers. The EEG data was analyzed using Matlab. The global field power (GFP) was calculated for the average of the trials at each finger location. In order to understand the symmetry of the GFPs, correlation coefficients were calculated between each of the locations. We expect to see symmetry across the left and right hands in response to touch.

Understanding the Impact of Chronic Low-Dose GCR Particles on Behavior and Systemic Inflammation in Mice

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Ben Gleeson
Parker Friend
Paula Nolte

Mentors:
Dr. Phillip Rivera,
Biology,

Dr. Paul A. DeYoung,
Physics

Research reported in this publication was supported in part by funding provided by the National Aeronautics and Space Administration (NASA), under award number NNX15AJ20H, Michigan Space Grant Consortium.

A major component of NASA's 2018 strategic plan was to send astronauts to and beyond our lunar orbit within the next couple of decades. A potential risk to mission success is an astronauts' exposure to galactic cosmic radiation (GCR), a mixture of low-dose, high-charge ion particles (HZE). However, studies examining the impact of low-energy GCR particles on long-term mission success are scarce. Therefore, our first study examined the effects of chronic, low-dose proton radiation on behavior and systemic inflammation in mice. We tested the hypothesis that chronic low-dose proton radiation negatively impacts mouse behavior by causing lasting systemic inflammation. Mice were divided into three treatment groups: Irradiation (IRR), No-Irradiation/Constraint (No-IRR), and Home Cage (HC). The irradiation group of mice received approximately 0.17mGy/day of proton radiation on 13 non-consecutive days over a period of 50 days. Ten weeks after irradiation, all mice underwent anxiety- and depressive-like behavioral tests. Then, mice were euthanized and brain, liver, and spleen samples were extracted for molecular analysis. Results suggest that mice irradiated with a cumulative dose of ~2.5 mGy of protons exhibit an increase in overall activity and compulsive-like behavior. Our secondary study examined the impact of chronic low-dose neutrons on sociability and cognitive learning. Mice were irradiated at a dose of 0.04 mGy 33 times over 70 days, resulting in an expected cumulative dose of approximately 1.32 mGy. We expect to see a differential effect of neutron radiation on sociability behaviors and cognitive spatial learning in a sex-dependent manner. We suspect that these behavioral differences will be the result of systemic inflammation. Taken together, proton and neutron chronic low dose radiation may negatively impact long-term mission success to Mars.

Neuroinflammatory and Proliferative Responses during Recovery of the Lesioned Olfactory System of Zebrafish

This material is based upon work supported by the National Science Foundation under Grant No. 1811447, and the Anderson Award.

This project was an interdisciplinary endeavor between the Departments of Biology and Neuroscience. *See page 30 in the Biology section of this book for full abstract.*

Comparison of Cortical Responses to Physical and Electrically-Evoked Touch

Emily Lambert
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Rebekah Miller
Matthew Summerfield

Mentor:
Dr. Katharine Polasek,
Engineering

This material is based upon work supported by the National Science Foundation under Grant No 1805447 and the Hope College Neuroscience Program.

A majority of amputees experience phantom limb pain, which is characterized by pain and discomfort in the missing limb. Reorganization of somatosensory cortices is often seen in those with phantom limb pain. By investigating cortical activity in non-amputee subjects, this study looks to quantify cortical responses to physical and electrically-evoked touch. Implications of this study can be used to determine changes in cortical activity of an amputee receiving treatment for their phantom limb pain. Specifically, in order to learn more about the cortical responses of individuals without amputations, we compared the cortical responses via electroencephalogram (EEG) recordings of non-amputees to physical and electrical-evoked touch stimulations.

Cortical potentials were recorded using a 96-electrode EEG cap. Physical tapping and electrical stimulation on the pinky and index finger of each hand were performed. Physical touch was delivered first via randomized solenoid tapping at each of the four hand locations. Following this, electrical stimulation via cutaneous electrodes was delivered to the same locations with index and pinky activation alternating for each hand. The EEG data was analyzed to determine the Global Field Potentials (GFP) of each condition for every subject. Finally, a correlation analysis was used to compare the cortical responses of physical and electrically-evoked touch across conditions for each subject.

Results varied between subjects and suggested that the correlation level strongly depended on the quality of the raw data.

Pup Weight at Start of Homocysteic Acid Exposure Alters Behavioral Phenotype of Sprague Dawley Rats

Gabriella Taylor
Kelly Bosis
Ximena Figueroa-Enriquez

Mentor:
Dr. Leah Chase,
Biology and Chemistry

This project was supported by the Neuroscience Program, the Schaap Undergraduate Research Fund and the Koeppe-Kolean Scholars Program.

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. We found that daily injection of rat pups from postnatal day 3 through 21 (P3-P12) homocysteic acid, 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 2022. Specifically, HCA-treated animals exhibited a greater preference for drinking a saccharine solution in the two-bottle choice saccharin preference test ($F_{1, 34}$= 7.18 p=0.008), while in previous studies, HCA-treated animals showed anhedonia in the same assay. In the open field test, HCA-female rats showed a greater tendency to spend time in the center of the field, while HCA-male rats showed reduced tendency to spend time in the center ($F_{1,34}$ = 5.19, p=0.026). In past assessments, all HCA-treated animals spent less time in the center of the open field. We hypothesize that differences in weight of these pups (1.3-2.0 g heavier than previous cohorts of rat pups; $F_{1,39}$=17.1, p<0.001) and/or age of the rat pups at the onset of HCA injections may account for these differences in behavior. These data suggest that developmental events prior to P5 may be critical for the alteration of neuronal circuits that lead to increased risk for BD.

Characterization of the K37R and K43R Mutation of System x_c^-

Anna Koppin
Sophia Farbarzhevich
Amanda Gibson

Mentor:
Dr. Leah Chase,
Biology and Chemistry

This project was funded by the Schaap Undergraduate Research Fund.

System x_c^- is a membrane transport system that plays a critical role in mitigating oxidative stress and controlling the level of the primary excitatory neurotransmitter, glutamate, in the brain. As such, its careful regulation is critical for proper brain functioning. Recent work in our has shown that System x_c^- activity increases immediately during an oxidative insult, and this process is necessary to maintain appropriate levels of antioxidants within neurons and glial cells. Currently, the specific mechanism by which oxidants regulate transporter activity is poorly understood. We have shown that during the oxidative insult, System x_c^- undergoes a change in localization to the plasma membrane which allows for an increase in transporter activity, but we have yet to identify the specific molecular changes that lead to the redistribution of the transporter to the cell membrane. Previous studies have demonstrated that post-translational modifications of proteins can lead to differential protein distribution within cells. Therefore, in this study, we tested the hypothesis that ubiquitination of System x_c^- is necessary for the redistribution of the transporter to the plasma membrane. Specifically, we examined two potential ubiquitination sites on System x_c^-, lysine 37 and lysine 43, which are highly conserved across species. First, we created two novel transporter constructs, each containing a mutation of a single lysine to an arginine: K37R and K43R. Next, we expressed the constructs in cultured mammalian cells and used immunocytochemistry to examine the effects of mutation on transporter localization in the cells. In addition, we also evaluated the effects these mutations had on the tendency for these transporters to be ubiquitination. Collectively, this approach allows us to directly relate changes in ubiquitination status at K37 and K43 with changes in transporter localization so that we can better understand the specific mechanism by which oxidants regulate System x_c^-.

Transcriptional Regulation of *OLE1* by Cobalt

Natnael Belay
Abigail Gift

Mentor:
Dr. Virginia McDonough,
Biology

Research reported was supported by the National Institute of General Medical Sciences of the National Institutes of Health under Award Number R15GM132853, the Dean of Natural and Applied Sciences, and the Hope College Biology Department.

The *OLE1* gene in *Saccharomyces cerevisiae* encodes the delta 9 desaturase enzyme, a non-heme iron-binding protein that requires oxygen and is responsible for the biosynthesis of unsaturated fatty acids. The *IXR1* encoded protein (Ixrlp) functions as a transcription factor that regulates hypoxic genes in response to oxygen levels. We found that the presence of cobalt in the growth medium increased the amount of transcription of *OLE1* in wild type cells. However, in the *ixr1*Δ mutant, the increase in *OLE1* expression was significantly reduced. While this indicates that the Ixrlp plays a role in *OLE1* transcriptional regulation, it may not be direct. Using qPCR, we examined two known target genes of the Ixrlp, *AFT1,* and *AFT2,* to determine if they were the relevant target of *IXR1* in the regulation of *OLE1.* Results of those qPCR analyses are shown here. We demonstrate that Ixrlp impacts *OLE1* mRNA levels in response to cobalt, and present evidence whether the Ixrlp may be acting indirectly through other targets.

Exposure to H_2O_2 leads to a change in ubiquitination status of the glutamate/cystine exchanger, System x_c^-

Claire Buck

Mentor:
Dr. Virginia McDonough, Biology

This project was supported by the Schaap Undergraduate Research Fund and the Richard Decker Biology Summer Research Fund.

System x_c^- exchanges intracellular glutamate for extracellular cystine across the membrane of many cell types, including astrocytes. Its activity directly regulates the synthesis of the antioxidant glutathione and the extracellular concentration of glutamate in some areas of the brain. We recently demonstrated that oxidants acutely upregulate System x_c^- activity by triggering the rapid redistribution of the transporter from intracellular compartments to the cell surface. However, little is known about the mechanism by which oxidants regulate the cell surface expression of the transporter. Given that the trafficking of many transporters and ion channels are regulated by alterations in their ubiquitination status, we sought to determine if a similar mechanism may be responsible for the oxidant-induced upregulation of System x_c^-. Specifically, we hypothesized that H_2O_2 exposure may lead to a decrease in ubiquitination of the transporter, thus leading to an increased residence time in the cell membrane. To test this hypothesis, we used site-directed mutagenesis to determine if alteration of lysine residues with xCT would alter cell surface expression. There are seven highly conserved lysine residues within xCT that are located on the cytoplasmic side of the membrane. These residues are located at positions 4, 37, 41, 43, 422, 472, and 473. Using a radioisotope uptake assay and cell surface biotinylation assay, we found that mutation of three of the N-terminal lysine residues to arginine (K4, K41 and K43) increased transport activity and cell surface expression, while mutation of K37 led to a significant decrease in activity and cell surface expression. Similarly, a triple mutation of the C-terminal lysine residues (KKK422,472,473RRR) also decreased activity or cell surface expression. Collectively, these results suggest that post-translational modification of lysine residues do appear to alter trafficking of System x_c^-, but the regulation is complex. In a follow up experiment, we performed an immunoprecipitation of xCT in the presence and absence of H_2O_2. Surprisingly, we observed that the H_2O_2 led to an increase in transporter mono-ubiquitination with no observable changes in poly-ubiquitination. Therefore, we are currently assessing which lysine residue is likely the site of mono-ubiquitination. Given that the K37R and the C-terminal triple mutant exhibited decreased activity, we are focusing specifically on those residues. However, our initial results suggest that xCT monoubiquitination is associated with an increase in cell surface expression following oxidant exposure.


UP NORTH

Olfactory Loss and Recovery Following Lesion of the Olfactory Bulb of Zebrafish

Skylar DeWitt
Evan Thomas
Abigail Gray

Mentor:
Dr. Erika Calvo-Ochoa,
Biology and Neuroscience

This material is based upon work supported by the National Science Foundation under Grant No. 1811477, Herbert H. and Grace A. Dow Foundation, the Shermain Fairchild Fellowship, the NetVuE experiential grant and support from the Collaborative Research in the Sciences from Ed & Ann Anderson.

Mammals have a limited capacity to repair brain lesions and to recover function following damage. Yet, zebrafish can efficiently repair brain lesions and constantly generate new neurons, serving as an excellent study model for brain regeneration and repair. The olfactory system, which perceives chemical cues and mediates olfactory behavior, adjusts to environmental and physiological changes due to its extensive neuroplasticity. Zebrafish are able to detect odorants through olfactory sensory neurons, which activate the central olfactory bulb. Odor-mediated behaviors are crucial for animal survival, and it has been established that olfactory function is impaired following damage in both zebrafish and mammals. However, the effects of a brain lesion on olfactory behavior in zebrafish have not yet been studied. In this study, we investigated olfactory function over time following a focal lesion of the OB of zebrafish. For this, we produced a focal lesion in the right OB of adult zebrafish using quinolinic acid (an excitotoxic drug which targets glutamatergic neurons), and assessed olfactory function 1- and 21- days post lesion (dpl). We studied olfactory responses to three groups of odorants with physiological relevance: food (alanine), kinship (urea and taurocholic acid), and alarm (cadaverine). We recorded olfactory-mediated behavioral responses before and after odorant delivery in a behavioral chamber. We used an animal tracking software to assess the following swimming parameters: speed, distance traveled, preference index, erratic swimming, and freezing. We found that lesions of the olfactory bulb cause olfactory loss, as shown by hindered behavioral responses to the three odorants tested. Furthermore, we observed that olfactory function and response to all odorants is completely restored by 21 days post lesion. Our research adds to the literature of olfactory recovery, and may give insight into recovery mechanisms and possible therapeutic solutions for olfactory loss and dysfunction following damage or disease in humans.

Effects of Urbanization on House Sparrow *(Passer domesticus)* and House Finch *(Haemorhous mexicanus)* Song Propagation

Sarah Grimes
Eliza Lewis

Mentor:
Dr. Kelly Ronald,
Biology

This research was supported by funding through the Garden Club of America Clara Carter Higgins Summer Environmental Scholarship Award and the Christian Scholars Foundation Emerging Scholars Network Grant Program.

The recent surge in urbanization has increased pollution, which includes both physical pollution (e.g. exhaust) and sensory pollution (e.g., anthropogenic noise). We know 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, we aim to understand how urbanization affects the propagation of bird song by examining 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 inhabit urban areas and rely on vocal cues from conspecifics. Songs were recorded in the laboratory and also collected from the Macaulay Library and Stokes Fieldguide to Bird Songs. These songs were played back with a speaker at urban, rural, and suburban locations in Holland, MI, and recorded at a variety of 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 expect bird song in rural areas to have a larger active space compared to urban environments due to lower levels of noise pollution. Analysis of sound files to determine active space will include cross correlations of the playback against the original recorded song. The results of this study will be essential in understanding how urbanization has impacted bird communication; noise pollution may inhibit birds ability to communicate to potential mates or kin.

The Effects of Iron Oxide Nanoparticles on the Auditory Physiology and Antipredator Behavior in House Sparrows *(Passer domesticus)*

Lindsay Jankowski
Molly McLinden
Olivia Sprys-Tellner

Mentors:
Dr. Kelly Ronald, Biology

Dr. Natalia Gonzalez-Pech, Chemistry

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Increased urbanization and new infrastructure pose many problems for wildlife; one of these problems is the introduction of air pollutants into the environment. A primary component of air pollution is particulate matter (PM). Nanoparticles (PM ≤2.5 microns) are a main component of PM. Their microscopic size enables them to bypass the lung's blood-gas barrier and enter circulation, where they can accumulate in various organs, including the brain. In model species, nanoparticles have been shown to detrimentally affect auditory physiology. They also have negative effects on the anti-predator behavior of model organisms. However, the effects of nanoparticles on non-model species, such as songbirds, have not been studied. This project asks the question: are these two phenomena connected? To investigate this question, we examined the impact of iron oxide nanoparticles (IONPs) on the auditory physiology and antipredator behavior in house sparrows *(Passer domesticus)*. House sparrows were chosen since they use acoustic communication (i.e. vocalizations) to send and receive signals, and because they also inhabit human infrastructure where air pollution is often found. To examine the effect of IONPs on auditory physiology, the subjects were administered an auditory brainstem response (ABR) test pre-and post-exposure to IONPs. For examining the potential effects of hearing deficits on antipredatory behavior, we presented a predatory hawk call. The call was presented before and after exposure to IONPs. Preliminary work shows a decrease in auditory sensitivity post-IONP exposure, but no behavioral changes. This decrease in sensitivity may indicate that birds cannot hear the predators in their environment and subsequently cannot produce the appropriate response. As urbanization increases, air pollution levels will continue to rise. Increased air pollution puts songbirds at increased risk for health concerns which ultimately might lead to the decline of the worldwide avian population.

The Effect of Serotonin on Males' Neural and Behavioral Mechanisms to Female Ultrasonic Vocalizations and Urine in the House Mouse *(Mus musculus)*

Madisyn Kovacs

Mentors:
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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, the Anderson Research Award, and the Hope College Department of Biology. Data collection was supported by the NIH Training Grant.

Animals communicate with multimodal signals (e.g., a mix of auditory, visual, or olfactory information) spanning several modalities; these signals may provide receivers with more complete information to allow for more accurate behavioral decisions. Past research suggests that serotonin plays a role in encoding multimodal social information (e.g., social partner presence) during communication events. Nevertheless, to our knowledge, no experiments have explicitly tested this hypothesis. 5-HTP, a precursor for serotonin, has been shown to increase serotonin in a region of the auditory midbrain, and is affected by social context. In our experiment, we asked the question: Does an increase in 5-HTP affect the behavior and neural activity of mice *(Mus musculus)* when exposed to multimodal stimuli? Mice are known to use multimodal signals (vocalizations and olfactory signals) during communication and are therefore appropriate models for this experiment.To answer this question, we presented olfactory (female urine) and auditory (e.g. female ultrasonic vocalizations, USVs) stimuli to male mice. Prior to the behavioral experiment, mice were either given 5-HTP or saline. We then quantified the behaviors that occurred when male house mice were presented with either female USVs or both female urine and USVs together. We investigated sexual activity (e.g., grooming), anxious activity (e.g., digging), general activities (e.g., rearing and jumping), and investigative behavior. After exposure, neural activation was quantified via immunohistochemistry of the auditory midbrain. We predict that mice given 5-HTP and exposed to multimodal stimuli will have a higher degree of neural activation. The findings of this study will allow us to better understand the relationship between multimodal signal processing, serotonergic activity, and behavior.

Evaluating the Impact of Gestational Ethanol Consumption on Adult Immune Function and Addiction-like Behaviors

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In the United States, one in twenty babies are born with fetal alcohol spectrum disorder (FASD). FASD is commonly associated with maternal alcohol consumption during pregnancy that results in offspring with physiological and behavioral deficits that are mediated by immune dysfunction. Previous studies in rodents have found that gestational ethanol exposure leads to increased inflammatory responses and enhanced immune signaling can lead to an increase in addiction-like behavior in rodents. However, studies have not characterized the impact of gestational alcohol on adult addiction-like behaviors, as it relates to systemic immune dysfunction. Therefore, to assess the impact of gestational ethanol on adult immune function and subsequent addiction-like behavior, pregnant dams performed drinking-in-the-dark (DID) at gestation day (GD) 10-14. At PND 4 and 10, pups were removed from their litter to record ultrasonic vocalizations (USVs). Preliminary results suggest a sex by treatment effect in the number of USVs emitted from pups (PND4). Offspring from dams that previously consumed EtOH during GD 10-14, appear to vocalize more than water controls. Offspring matured to adulthood and addiction-like behavior was assessed via DID. Mice (PND60-70) were sacrificed 90 minutes after DID test day. Plasma and brain samples were then collected to examine systemic inflammatory cytokines in plasma via ELISAs and microglia and Fos (Iba1+) via IHC, respectively. Taken together, we hope to understand the impact of gestational EtOH exposure on physiological development, adult immune function, and addiction-like behaviors. Future experiments will replicate this process using other drugs of abuse, such as morphine.

Sex Differences in Hormone-modulated Neuroplasticity in the Songbird *(Serinus canarius)*

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In temperate zone species such as canaries *(Serinus canaria)* the neural circuitry regulating song behavior undergoes well-defined changes across the seasons. In males, increased daylengths in spring initiates an increase in gonadal volumes and circulating testosterone driving marked changes in brain morphology and song frequency. Females given exogenous testosterone in adulthood also demonstrate male-like changes in brain morphology and song behavior. More specifically, the telencephalic nucleus HVC (acronym is proper name), a key nucleus for song production, undergoes well-defined seasonal changes in neuroplasticity with a high rate of neurogenesis mediating marked changes in HVC volume. Much is known about the neural circuitry driving song behavior, however, the mechanisms underlying the morphological changes in adult hormone-modulated brain plasticity remain to be elucidated. Recently, perineuronal nets (PNN), extracellular matrix aggregations surrounding GABAergic interneurons, were shown to regulate afferent synaptic plasticity in the songbird brain. Moreover, we demonstrated that differential PNN expression could represent a key cellular mechanism mediating species variation in song behavior. In this study, we sought to investigate the density of PNNs in male and female canaries exposed to testosterone. Males were castrated and females were photoregressed and housed in our aviary on short days (8L:16D) for at least 6 weeks. Birds were surgically implanted with a 10 mm testosterone packed silastic implant or an empty implant as a control for 7 days. Brains were extracted, sectioned, and HVC volumes were quantified in Nissl stained sections. Brain sections were also double labeled via immunohistochemistry for parvalbumin and chondroitin. Both males and females treated with testosterone had larger HVC volumes compared to controls.

Genomic Analysis of the Novel F1 Mycobacteriophage Phalconet

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Twelve new mycobacteriophages were isolated from soil samples collected around the state of Michigan and parts of the United States. All phages were capable of infecting Mycobacterium smegmatis and were isolated through either enrichment at 37°C or direct plating at 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 Phalconet was chosen as one of two phages for complete genome sequencing and comparative genomic analyses. The predominant plaque produced by Phalconet after 24-48 hours at 37°C was clear with well-defined ringed edges and no tail was observed when viewed under a microscope. The complete genome sequence for Phalconet showed it was similar to mycobacteriophages of cluster F, subcluster F1, which now contains 190 sequenced members. Phalconet is most similar to the F1 phage Tootsieroll. The genome size of Phalconet is 57,648 bp, which is very close to the average size of F1 phages. The Phalconet genome contains 111 protein-encoding genes and no tRNA or tmRNA genes. Phalconet contains several interesting genomic features including two possible immunity repressor genes. One of the immunity repressor genes is similar to those found in F, F1, F4, and F5 clusters while the other immunity repressor gene is similar to those found in A, C, F, J, and K clusters. There is an opportunity to continue to explore the significance of the two immunity repressor genes through wet lab work with the use of Phalconet's lysogen and other cluster A phages. Overall, the presence of two immunity repressor genes is just one example of intriguing genomic features that the Phalconet genome contains. Continued analysis of the genome throughout the semester will reveal more of Phalconet's unique genomic qualities.

The Effects of Anthropogenic Disturbances on the Auditory Processing of the House Sparrow *(Passer domesticus)*

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This research was supported by the Dow Scholars Foundation and the Sheldon and Marilyn Wettack Summer Research Fund.

Animal communication involves a sender producing a signal (e.g., vocalizations) that travels through the environment before being detected by a receiver. Although we know how senders can vary in signal production, relatively little is known about how receivers process these signals. The recent increase in urbanization can further complicate receiver sensory processing as anthropogenic activities (e.g., noise pollution) affects the way birds communicate. This study aims to investigate the influence of urbanization on the auditory processing system of house sparrows *(Passer domesticus)*. House sparrows are an ideal model because they inhabit urban areas and rely on vocal cues from conspecifics. We collected 60 birds from urban and rural sites in Holland, Michigan, and performed auditory brainstem response (ABR) tests to examine their auditory sensitivity. 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 hypothesize that urban house sparrows will have decreased auditory sensitivity to sound compared to rural birds, as urban birds 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. Specifically, moving from rural to urban locations, we expect to observe a decrease in amplitude and increases in latency and thresholds. Results of this study will provide information on how urbanization impacts the auditory sensory physiology of the house sparrows. This will be essential in understanding how urbanization impacts bird communication, as noise pollution may inhibit ability to communicate to potential mates or kin.

Role of *YOR365C, SIP5, YMR141C, RPL13B,* and *RPS16A* in Transcriptional Regulation of *OLE1* by Unsaturated Fatty Acids

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Research reported was supported by the National Institute of General Medical Sciences of the National Institutes of Health under Award Number R15GM132853.

The *OLE1* gene in *Saccharomyces cerevisiae* encodes the Δ9 desaturase, which converts saturated fatty acids into unsaturated fatty acids (UFAs). Previous workers in the lab had used random mutagenesis to create the KH2 mutant strain which is defective in UFA regulated expression. The unknown defective gene was called *nro1* (no regulation *OLE1*). Preliminary phenotypic testing and qPCR of the mutant KH2 show defective regulation in response to UFAs as compared to wildtype. A library plasmid screening identified several possible genes that may be responsible for this phenotype: *YOR365C, SIP5, YMR141C, RPL13B,* and *RPS16A*. In preparation for phenotypic testing of the KH2 mutant, plasmids bearing *YOR365C, SIP5, YMR141C, RPL13B,* and *RPS16A* were created to identify the gene responsible for *nro1* phenotype. Using qPCR and phenotype testing, we have found that mutation in *YOR365C* affects transcriptional regulation of *OLE1* in response to exogenous oleic acid (18:1Δ9), but not palmitoleic acid (16:1Δ9) or linoleic acid (18:2Δ9, 12).

Do Trees and Shrubs Differ in Lignification? A Case Study on Hazelnuts

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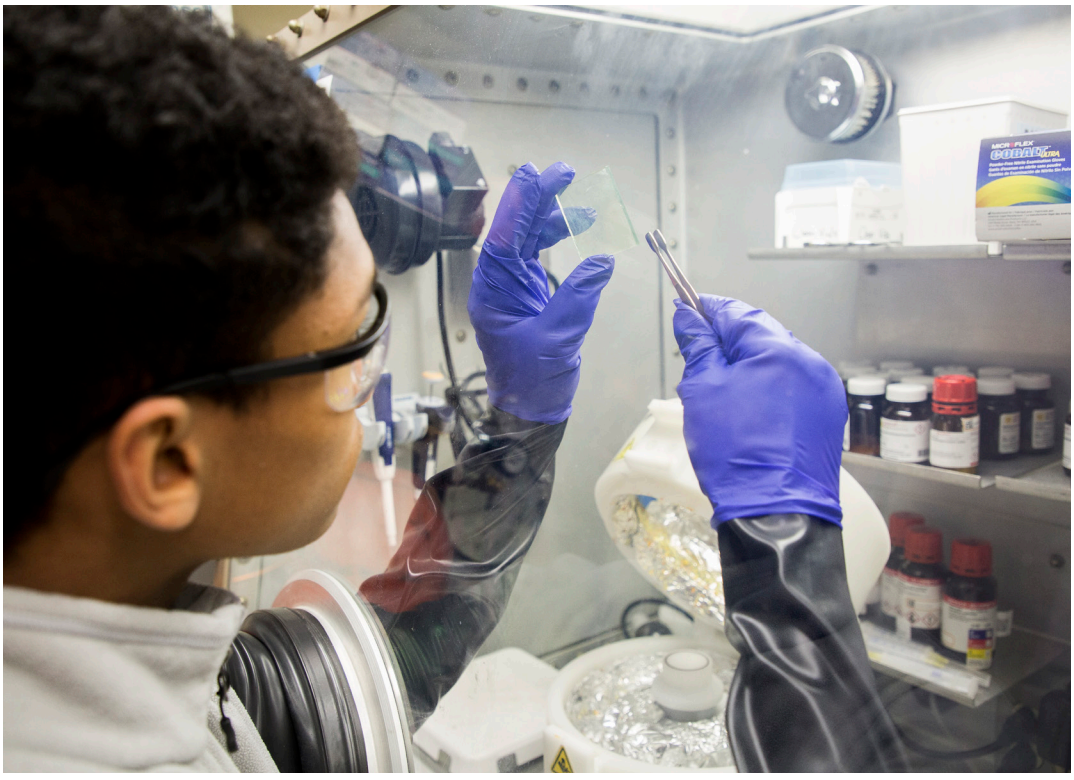
Thanks are extended to the Department of Biology for support, to the Arnold Arboretum of Harvard University for providing materials for the project, and to Drs. Maria Hledin and Michael Philben for technical assistance. This research was conducted with support from the Wichers Fund for Faculty Development.

The continuing increase of the carbon dioxide in the atmosphere largely due to fossil use and loss of vegetation to development has been causing global warming, one of the most pressing issues people are facing across the world. Biological sequestration of atmospheric carbon is a logical and sustainable approach to reducing carbon and countering climatic change. Lignins are the second most abundant natural organic compound but have made up the majority of carbon storage (e.g., coal) during the Earth's geological history due to strong resistance to decomposition. Biologically, lignins maintain the integrity of the cell wall, strengthening plant structure and resisting damages from herbivores and microbes. Lignification involving two dozen genes differs across major plant groups such as ferns, gymnosperms, and angiosperms. Lignin production is the highest in woody plants (trees and shrubs). However, little is known whether lignification differs between trees and shrubs, and whether carbon sequestration capacity varies among trees and shrubs that are close relatives. In this study, we use hazelnut (Corylus), an important nut crop in the world, to address the questions. Fresh twigs of the first year growth were collected, sterilized, and oven-dried to constant mass. Protein-free wall material was prepared from milled and lysed twig samples. Lignin was extracted using 25% acetyl bromide and quantified using a spectrophotometer at the wavelength of 280 nm. Our preliminary data show that lignin content may not change significantly across species or over the evolutionary history of Corylus, indicating that plants have set aside energy to maintain the integrity of the cell wall for their continuing survival in various environments.



Genomic Analysis of the Novel F1 Mycobacteriophage Beakin

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This research was conducted with support from the Biology Summer Research Fund and Collaborative Research in Biology.

Twelve new mycobacteriophages were isolated from soil samples collected around the state of Michigan and parts of the United States. All phages were capable of infecting Mycobacterium smegmatis and were isolated through either enrichment at 37°C or direct plating at 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 Beakin was chosen as one of two phages for complete genome sequencing and comparative genomic analyses. The predominant plaque produced by Beakin after 24-48 hours at 37°C was a clear ovular plaque in the middle with a turbid ring around it. The complete genome sequence for Beakin showed it was similar to mycobacteriophages of cluster F, subcluster F1, which now contains 190 sequenced members. Beakin is most similar to the F1 phage Tootsieroll. The genome size of Beakin is 54926 bp. The Beakin genome contains about 99 protein-encoding genes and no tRNA or tmRNA genes. Beakin contains several interesting genomic features including a gene that does not contain any matches to other genomic sequences (ORPHam gene Beakin_78). The encoded Beakin_78 protein is not found in other bacteriophages, and the gene product is currently unknown. The GC content of the ORPHam is similar to that of the overall GC content of the entire genome of Beakin. The Beakin genome also appears to contain an immunity repressor gene similar to clusters F, F1, F4, and F5 (Beakin_50). A Beakin lysogen was created that was resistant to infection by phage Beakin and other known F1 bacteriophages but not our control D29 and A2 phage. Further research is needed to determine more features of the Beakin genome, and is currently underway at Hope College.

Changes in Chromatic Contrast of Avian Plumage in Forests with Different Levels of Deer Browsing

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Visual signal propagation through the environment can be influenced by many factors, including the visual background. For example, normally camouflaged animals can appear quite salient when the environmental substrate is changed. Deer can alter this visual background by consuming the forest understory; ultimately this can have implications for species that use visual signals to attract a mate or defend a territory. We are interested in studying how deer browsing affects the chromatic contrast (i.e., how much an animal stands out from the background for a given receiver) using an avian model system. Brown headed cowbirds *(Molothrus ater)* and wild turkeys *(Meleagris gallopavo)* inhabitat the forest understory that is subject to deer browsing . We used published data on cone photoreceptor sensitivity of these species to model chromatic contrast of avian plumage against forest backgrounds. We also used a general avian eye model to investigate the chromatic contrast of plumage colors across the visible light spectrum, from the red of Northern cardinals *(Cardinalis cardinalis)* to the blue of blue jays (*Cyanocitta cristata).* To calculate chromatic contrast we used spectroscopy measurements from (1) the forest understory as the visual background, (2) plumage reflectance and (3) irradiance measures. We modeled this in both deciduous and mixed forest types and at different heights from the forest floor (i.e., low and high). We predicted that areas that allow deer will cause birds to be more conspicuous. Additionally, we expected the effects of deer browsing to be greater at lower heights because of the increased foraging and disturbance of the forest floor. In the future, we will examine if achromatic contrast (i.e., contrast based on brightness cues) are affected similarly. Taken together, this work will shed light on how different environments can drastically affect the way birds communicate.

Transcriptional Regulation of *OLE1* in Wild Type, *ino2, ino4,* and *opi1* Mutants in Response to Inositol and Unsaturated Fatty Acids

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Mentor:
Dr. Virginia McDonough, Biology

Research reported in this publication was supported by the National Institute of General Medical Sciences of the National Institutes of Health under Award Number R15GM132853.

The Δ9 desaturase, encoded by *OLE1* is the sole source of endogenous unsaturated fatty acids (UFAs) in the yeast Saccharomyces cerevisiae. As phospholipids require UFAs, we investigated the potential cross regulation of phospholipid and UFA biosynthesis. Ino2p, Ino4p, and Opi1p are transcriptional regulators known to control many phospholipid biosynthetic genes in response to inositol. UASino, a regulatory sequence found in the promoter of these target genes, is the binding site for Ino2p and Ino4p. This sequence is also found in the promoter of *OLE1.* We examined if these proteins play a role in regulation of *OLE1* expression through qPCR and electrophoretic mobility shift assays (EMSAs). While the mutants had an overall lower level of expression of *OLE1* than the wild type, analysis of mRNA levels by qPCR determined that inositol does not regulate expression of *OLE1* in the wildtype or the mutants. Using a *OLE1* promoter-*lacZ* reporter gene to measure transcriptional regulation only, we found that *ino2* and *opi1* mutants fail to down-regulate *OLE1* transcription in the presence of the UFA 16:1Δ9 while *ino4* mutants continued to down-regulate *OLE1* normally in response to 16:1. However, qPCR analysis demonstrated that in UFA supplemented medium, the mutants had an overall lower overall expression of *OLE1,* and the overall amount of native *OLE1* message was found to be down-regulated normally in wild type and mutant cells in response to 16:1Δ9 supplements, indicating that while transcriptional regulation may be aberrant in the *ino2* and *opi1* mutants, regulation of stability of *OLE1* mRNA was intact. We also tested whether these proteins bind to the UASino sequence in the *OLE1* promoter to regulate expression of *OLE1.* This was completed through electrophoretic mobility shift assays (EMSAs). These results indicate a potential cross-regulation of phospholipid and unsaturated fatty acid biosynthesis by Ino2 and Opi1 through their regulation of expression of *OLE1* in response to unsaturated fatty acids.

Identification of a Potential Fatty Acid Desaturase in the Yeast *Schizosaccharomyces pombe*

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Mentor:
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Hope College Department of Biology

We screened for potential fatty acid desaturase genes in *Schizosaccharomyces pombe* by looking for homology to a known fatty acid desaturase from the distantly related yeast *Saccharomyces cerevisiae.* Two candidate genes were identified: SPBC3B8.07c (also identified as dsd1, encoding the dihydroceramide delta-4 desaturase) and SPCC1281.06c (termed pole in our lab). Mutants in both candidate genes were screened for unsaturated fatty acid auxotrophy. The dsd1 mutant did not exhibit any growth defects when grown in the absence of UFAs, but the pole mutant did. Additional phenotype testing of the pole mutant on different UFAs was examined. In addition, the two candidate genes were isolated and screened for the ability to complement an *ole1*Δ mutant that is a desaturase deficient strain of *Sacc. cerevisiae.* Those results are presented here.

Neuroinflammatory and Proliferative Responses during Recovery of the Lesioned Olfactory System of Zebrafish

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Mentor:
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This material is based upon work supported by the National Science Foundation under Grant No. 1811447, and the Anderson Award.

Zebrafish maintain the ability to generate new neurons (i.e. neurogenesis) throughout their lifespan, thus making them an ideal model for studying mechanisms of brain recovery and regeneration. In particular, the olfactory system, which processes odors, is formed by the olfactory bulb (OB) and olfactory epithelium (OE), presents extensive neuroplasticity and repair mechanisms in response to damage. Surprisingly, inflammation following wound recovery has been shown to play a key role in repair and neurogenesis in zebrafish, unlike what has been shown in mammalian brains. Our group showed that the OB degenerates and fully regenerates by 21 days following lesion. However, the dynamics of neuroinflammation and proliferation that may underlie these regenerative processes have not been explored. In this study, we generated a focal excitotoxic lesion in the zebrafish OB to characterize the neuroinflammatory and proliferative responses throughout recovery in both the OB and the OE. We used adult zebrafish and induced damage via a unilateral focal excitotoxic lesion in the right olfactory bulb by injecting quinolinic acid, which targets glutamatergic neurons. The left unlesioned bulb served as an internal control. We then assessed markers of cell proliferation and inflammation following 1 and 21 days post lesion (dpl). Specifically, we assessed 4C4 (microglia marker), GFAP (glial fibrillary astrocytic protein; astrocyte marker), and PCNA (proliferative cell nuclear antigen; proliferation marker). To do this, we used immunohistochemical analyses of olfactory system sections. Our results show that the lesioned OB displays: (1) an increased number of activated microglial cells, associated with rostral and ventral migration routes; (2) astroglial activation; and (3) an increase in cell proliferation. We also observed (4) microglial and proliferative activity in the OE. We also show that by 21 dpl, (5) astroglial activation returns to control levels, while (6) a subset of microglial and proliferative cells persist. We propose that these three cellular mechanisms underlie recovery responses in a biphasic fashion. These results contribute to the understanding of the mechanisms of inflammation, neurogenesis and neuronal recovery following brain damage.

Evaluation of Drinking Water Quality in Peri-urban Zambia

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Lillian Droscha

Mentor:
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Biology

Drinking water quality is a continued global public health concern, especially in central African countries, parts of Asia, and many island nations. Poor drinking water leads to many physiological problems, with bacteria and heavy metals as common culprits. The goal of this study is to screen for potential bacterial pathogens and assess metal concentrations in the water samples from the capital region of Zambia, a sub Saharan African country just south of the equator. Microbes were collected on 0.1 micron hollow-fiber membrane filters and later sequenced using 16S rRNA sequencing. The microbial data were compiled and analyzed using R and the high-performance computing cluster at Hope College. Metals were collected from the filtrate of the filters on metal-chelating foam and analyzed using Inductively Coupled Mass Spectrometry after being dried and rinsed with 3% trace-metal grade nitric acid. The LOD (limit of detection) and LOQ (limit of quantification) were calculated using internal standards from the ICP, and metal presence/absence and concentrations were determined. Metals found above the LOD in the capital region include Manganese, Arsenic, Iron for some samples, and Barium for some samples. Metals found over the LOQ, and thus quantifiable, include Zinc, Copper, Aluminum, Iron for some samples, and Barium for some samples. Arsenic is of particular interest because the LOD falls very close to the WHO guideline, indicating any detection is likely over the WHO guideline. Aluminum was also found to be above the WHO guideline, but health effects are still unknown. Further testing is recommended to determine the best future course of action with regard to water quality remediation efforts.

Predicting UV-Vis-NIR Absorbance Spectra of Novel Long-Wavelength Azo Dyes

Colin Bradley

Mentor:
Dr. Jason G. Gillmore, Chemistry

This material is based upon work supported by the National Science Foundation under Grant Nos. 1919571, 1039925, and 0520704. Additional support comes from the American Chemical Society Petroleum Research Fund grant #60174-UR1, the Hope College Department of Chemistry's Undergraduate Research Fund, Schaap Research Endowment, Schaap Fellows Program and the Robert J. Motzer ' Chemistry Undergraduate Research Fund.

A decade ago Aprahamian and coworkers reported their accidental discovery (Yang, et al., J. Am. Chem. Soc. 2012) of a BF_2-coordinated azo dye which photoisomerizes at much longer (lower energy) wavelengths than conventional azo dyes. In a second paper they used electron donors on the phenyl moiety to tune spectroscopic properties of these dyes (Yang, et al., J. Am. Chem. Soc. 2014) before returning to their intended hydrazone chemistry. In these works, very brief mention of TD-DFT computation of these dyes was made.

An initial collaborative effort between the Smith and Gillmore groups at Hope College to incorporate these dyes into photoresponsive polymeric materials, unsuccessful to date, yielded improved synthetic methods, the ability to functionalize the quinoline moiety of the dye, and preliminary evidence that these changes impacted the dyes' spectra at least as much as substituents on the phenyl moiety the Aprahamian group had explored. The Gillmore group has recently launched a newly funded project to make and study a library of these dyes. We have proposed several hundred possible targets, far more than we could ever synthesize. In order to focus efforts on dyes of particular interest, we proposed to use TD-DFT computations to predict the absorbance spectra of the dyes.

However the single computational prediction of the parent dye reported by Aprahamian & Hughes was a fluke and their method is unsuccessful even for any of their own derivatives, much less our new quinoline-substituted variants. After a first fruitless year attempting to vary functionals, basis sets, solvent models, and other parameters, to achieve quantitatively accurate TD-DFT result, we have in our second year developed a method to use TD-DFT computations of known dyes correlated to experimental data to afford a fit that allows us to use a precise but inaccurate combination of functional, basis set, and solvent model to accurately predict the long wavelength absorbance maxima of both known and novel dyes. We are now applying statistical / "machine learning" methods to improve this method.

Microbial Community Composition Dependence on Season, Site, and Flow Rate in the Macatawa Watershed

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Mentors:
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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 community. 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 under certain conditions such as changing seasons (e.g. winter vs. summer) and different types of sites (e.g. lake vs. stream). These data showed stark differences in the relative abundance of some bacteria when correlated with season and site type. We also analyzed the abundance of microbes during standard flow rates compared with high flow rates. Details of these changes in microbial community structure are presented in this poster. These results ultimately tell us that there are seasonal and flow rate influences on bacterial community composition within the Macatawa watershed.

The Effect of Agglomeration on Arsenic Adsorption onto Iron Oxide Nanomaterials

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Luke George
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Mentor:
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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.

The presence of arsenic in groundwater and other drinking water sources presents a notable public health concern. Utilization of iron oxide nanomaterials as arsenic adsorbents has shown promising results both in laboratory and field conditions. This study compares the performance of nanomaterials for arsenic absorption based on their synthesis method and degree of agglomeration. Poly (acrylic acid), polyethylene glycol, polyethyleneimine were used to stabilize iron oxide nanoparticles prepared by thermal decomposition to an aqueous solution. The effect that each polymer has on the nanomaterials was evaluated in batch experiments, and PEG was found to provide the best performance. Even when surface coatings are required to prevent nanoparticles from agglomerating, further efforts to deposit nanoparticles on a supporting material are required. To implement the nanoparticles in the field, a continuous flow column study was carried out by depositing the nanoparticles on sand. A batch isotherm study was also conducted to determine the effectiveness of iron oxide nanomaterials for arsenic removal with and without silica presence as an interference. Our results show that the use of clusters of nanoparticles, synthesized by solvothermal synthesis, are a promising solution for the use of nanomaterials in real water remediation applications.

Small Scale, Large Impact: The Tribology of Energy Conservation

Claire Dwyerr

Mentor:
Dr. Meagan Elinski, Chemistry

This research was supported by the Hope College Chemistry Department Undergraduate Research Fund, the Division of Natural and Applied Sciences and the Roger L. Mulder '61 and Beverly Mulder Chemistry Fund.

Establishing greater energy efficiency is a critical issue for industry due to the many economic and environmental impacts. In balancing the energy produced with the energy used, a large amount of energy is wasted through friction and wear in materials and machinery. Tribology–the study of surfaces in relative motion–allows us to analyze the effects of friction and wear in order to design better lubrication schemes that minimize energy loss. One route is to take advantage of the sliding forces to control chemical reactions that form protective, antiwear films (tribofilms). Prior work has investigated such mechanochemical processes with allyl alcohol and other (PAOs), however these materials are limited in use due to low boiling points. Therefore, we are using 8-nonen-1-ol and 1-decene. With longer hydrocarbon chains, these materials should be able to withstand higher temperatures and still produce tribofilms. To examine antiwear and lubricating behavior, the rate of tribofilm growth is measured during in situ (in a fluid environment) atomic force microscopy (AFM) sliding studies. This will provide a foundation for further understanding mechanochemical reactions in order to reduce wear and enhance lubrication techniques, leading to solutions for greater energy efficiency.

Analysis of Iron Oxide Nanoparticle Synthetic Pathway

Luke George

Mentor:
Dr. Natalia Gonzalez-Pech, Chemistry

This research was conducted with support from the Dr. Bernard J. DeWitt Chemistry Research Fund.

The past research of the GOCH group has focused on the synthesis and characterization of multifunctional nanoparticles that can be used for a variety of applications. Currently, research has been focused on environmental purposes such as water remediation as well as looking forward to future work in CO_2 recycling and energy. Now that methods for the synthesis of iron oxide nanoparticles have been completed and the resulting nanomaterials have been characterized, this research will focus on the analysis of the synthetic pathway in order to understand the chemical reactions that are occurring at each step of the synthesis. This analysis will be done using gas chromatography to determine the gasses that are given off at each stage of the reaction, eventually developing a framework of knowledge for the entire synthetic method that has been previously designed. The results of this study will be used to systematically adjust and optimize the synthetic pathway so that we will have greater control over the synthesis and obtain repeatable results. Eventually, this same technique will be applied to the other synthetic methods that are employed in the GOCH group, including the synthesis of titanium oxide and zinc oxide nanoparticles.

Nanoparticle Interactions in Cartilage-Mimicking Hydrogels

Griffin Gleeson

Mentor:
Dr. Meagan Elinski, Chemistry

This research was supported by the Dow Scholars Program.

Tribology is the study of friction, lubrication, and wear, and it has major implications in terms of joint movement in the body. When the articular cartilage degrades in the joints during osteoarthritis there could be greater friction within the joints causing pain and inflammation. Past research has looked into the use of nanoparticles as drug-delivery systems in the joints, but these are temporary measures that do not fix the source of the problem. Further, there is little known about the surface interactions of the nanoparticles in cartilage and their potential to repair degraded cartilage. To research the surface interactions between nanoparticles and cartilage, cartilage-mimicking hydrogels were used to test the effect of nanoparticles on the surface of the hydrogels. The nanoparticles were applied through two different methods: direct polymerization with the hydrogels vs. intercalation into pre-formed hydrogels. Attenuated total reflectance Fourier-transform infrared spectroscopy (ATR-FTIR) was used to evaluate the composition of hydrogels comparing the two synthetic methods. Atomic force microscopy (AFM) was used to both assess surface structure and conduct sliding studies with a controlled single-point of contact *in situ* (in a fluid environment). Preliminary results indicate successful control over hydrogel composition, stiffness (Young's modulus), and nanoparticle integration. Future work investigating the subsequent impact of these material parameters on sliding behavior will help further understand the potential of nanoparticles as a possible method for repair of articular cartilage in patients with osteoarthritis.

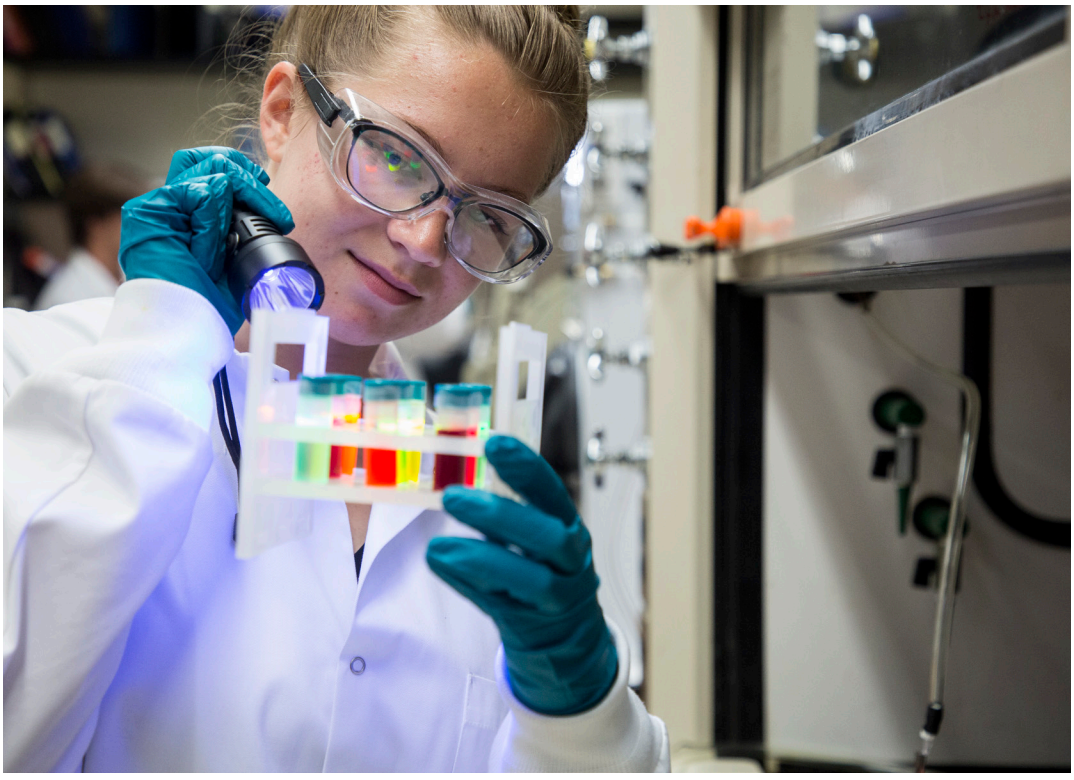
Carbon-Carbon Bond Activation: Optimization of Decarbonylation-Exchange Reactions of Diortho-Fluoro Pyridyl Ketone with Boronic Acids

Therese Joffre
Luke Shoemaker
Eric Salisbury
Erik Schoonover
Jacob VanderRoest

Mentor:
Dr. Jeffrey Johnson,
Chemistry

This material is based upon work supported by the National Science Foundation under grant No. 1764118, the Herbert H. and Grace A. Dow Foundation, and the Schaap Endowed Funding for Undergraduate Research.

Rhodium-catalyzed decarbonylation reactions have been shown to 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 testing the unreactive ketone, a reaction was found with boronic acids that leads to an aryl ring exchange and subsequent decarbonylation. This decarbonylation-exchange reaction was further optimized by evaluating three promising sets of experimental conditions. The 2,6-diortho-fluoro ketone was reacted with a series of boronic acids to assess the scope of this transformation using these sets of experimental conditions.



Even More Electron-Rich BF_2-Azo Dyes

Madeline Kokmeyer
Thomas Cygan
Claudia Bouma
Alison Bache
Jane DeGroot

Mentor:
Dr. Jason G. Gillmore
Chemistry

This project was supported by the American Chemical Society Petroleum Research Fund grant #60174-UR, the Hope College Chemistry Department's Schaap Research Endowment, Schaap Fellows program and the Cupery Chemistry Student Research Fund.

Aprahamian and coworkers have reported (Yang, Y.; Hughes, P.; Aprahamian, I. J. Am. Chem. Soc. 2012, 134, 15221-15224; 2014, 136, 13190-13193) a series of BF_2-coordinated azo dyes which photoisomerize at much longer (lower energy) wavelengths than conventional azo dyes. Aprahamian's group was able to tune the spectroscopic and photophysical properties of these dyes with electron donating substituents on the phenyl moiety of the dyes. In an initial attempt to incorporate these dyes into polymeric photomechanical materials, the Gillmore group discovered ways to functionalize the quinoline moiety as well. Moreover it appeared that substituents on the quinoline ring might be at least equally good at tuning the dye. Thus recent efforts have focused on building a library of quinoline-functionalized analogues of these dyes for further study. This poster will showcase in particular our ongoing efforts toward even more electron-rich dyes with electron donating groups on both the quinoline and phenyl moieties.

Novel Directing Groups for Metal-Catalyzed Acylation and Decarbonylation Reactions

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Claire Benedict
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Mentor:
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Chemistry

This material is based upon work supported by the National Science Foundation under Grant No. 1764118 as well as the Camille and Henry Dreyfus foundation and the Schaap Endowed Fund for Undergraduate Research.

Transition metal-catalyzed carbon-hydrogen and carbon-carbon bond activation reactions are useful in constructing and simplifying synthetic pathways. Often, a starting material containing a directing group, such as a lone pair-containing nitrogen, is required to direct metal coordination and molecule reactivity. To broaden the scope of the reaction and increase generalizability, this work seeks to discover novel directing groups and explore their efficacy in Pd-catalyzed acylation and Rh-catalyzed decarbonylation. A variety of 5- and 6-membered nitrogen-containing aromatic compounds were screened as directing groups. Novel directing groups were found and compared with two previously reported directing groups for both the acylation and decarbonylation reactions. The efficiency of these directing groups was evaluated based on isolated yield and via in situ IR kinetic studies. These new molecular scaffolds could be utilized in applications from pharmaceuticals to materials.

Multifaceted Surface Coatings from Composite Dry Lubrication Schemes

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Halle McGuire

Mentor:
Dr. Meagan Elinski,
Chemistry

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.

Two-dimensional (2D) solid materials are at the forefront of dry lubrication research due to their surface compatibility, unique structural-chemical properties, and potential to function as multifaceted coatings with specialized mechanical, electronic, and optical properties for emerging technologies such as space-based lubrication needs. Moreover, when specific 2D materials are combined with nanoparticles, the composite system facilitates superlubricity (ultra-low friction). Other nanoparticles can independently form tribofilms, protective surface coatings that build up from friction in situ (during sliding). Bringing together distinct optoelectronic properties, superlubricity sliding behavior, and film-forming surface protection into a tailored surface coating, however, remains challenging due to the lack of predictive capabilities for composite lubrication schemes. To better understand composite film formation, this work focuses on determining the impact of interfacial parameters on tribofilm properties. Interfacial chemistry was controlled through self-assembled monolayers on silica. Interfacial roughness was controlled through spincoated silica nanoparticles. A series of nanomaterials (molybdenum disulfide, phosphorene, and nanodiamonds) were deposited onto the controlled surfaces, comparing dropcasting vs spincoating methods. The composite interfaces were then both imaged and subjected to high-stress sliding tests in an atomic force microscope (AFM). Preliminary results suggest scrolling of the 2D materials is one possible film formation mechanism. Future work will continue to isolate what surface parameters are needed for controlled tribofilm formation, ultimately leading to the design of tailored multifaceted surface coatings.

Synthesis and Characterization of Iron Oxide/Iron Oxide Multifunctional Nanoparticle Collectors

Andrew Reiffer
Anna Molloy
Lindsey Boltz
Luke George
Steven Davenport
Tristan Porter
William Diephuis

Mentor:
Dr. Natalia Gonzalez-Pech, Chemistry

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, the James H. and Marion Klassen Zwemer Chemistry Fund and the Donald W. Visser Summer Research Fund

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.

Characterizing the Product of Rhodium-Catalyzed Alkene Amidation

Eric Salisbury
Joseph Cornell
Dr. Connie B. Anderson
Claire L. Muckian

Mentor:
Dr. Jeffrey Johnson,
Chemistry

This material is based upon work supported by the National Science Foundation under Grants Nos. 1148719 and 17164118, the Hope College Department of Chemistry, and the Arnold and Mabel Beckman Foundation.

Carbon-carbon bonds are inherently stable and thus difficult to modify. This project aimed to use removable amide-linked directing groups to enable rhodium insertion into carbon-carbon bonds in order to develop new synthetic routes. After closer analysis, including 1D, 2D, and temperature variant NMR spectroscopy, it was revealed that carbon-carbon bond activation and insertion chemistry are not proceeding as originally expected. A new reaction was proposed in which a secondary amide acts as a Michael donor to Micheal acceptors. Work to generalize this reaction is ongoing.

A Kinetic Study: Mechanism of Rhodium-Catalyzed Decarbonylation

Grace Stalions
Julia Loula

Mentor:
Dr. Jeffrey Johnson,
Chemistry

This research was supported by the National Science Foundation under Grant No. 17164118 and the Schaap Endowed Funding for Undergraduate Research.

This kinetic study investigates two potential rhodium-activated intermediates in the proposed mechanistic pathway of rhodium-catalyzed decarbonylation. A better understanding of this intermediate would allow for the exploration of new synthetic pathways using metal-catalyzed insertion chemistry. By utilizing Nuclear Magnetic Resonance (NMR) spectroscopy, starting material concentrations are tracked over time, allowing the rate of reaction to be assessed. The differing pyridyl ketone starting materials contain various R group substitutions that change the electronics of the molecule. Through kinetic analysis, initial rate constants are used to compare the reaction rate between these pyridyl ketone starting materials and provide a better understanding of which intermediate is primarily involved in the mechanistic pathway.

Machine Learning Applications using SciKit-Learn and TensorFlow

Trevor Palmatier
Kenneth Munyuza

Mentor:
Dr. Omofolakunmi Olagbemi, Computer Science

We acknowledge the support of the office of the Dean of Natural and Applied Sciences and the Computer Science department, both of Hope College, in funding this study.

Machine learning (ML) is a powerful tool with vast applications in pattern-recognition and identification tasks. Our goal was to explore different applications of machine learning and develop a working understanding of the processes required for the effective application of ML models to problem-solving. Using SciKit-Learn for traditional ML models and TensorFlow for neural networks, existing techniques were explored for two major categories of ML tasks: Regression and Classification modeling. This knowledge was then applied in a biomedical engineering pilot research study (in collaboration with Dr. Brooke Odle, Engineering) analyzing manual patient-handling tasks using data from inertial measuring units (IMUs) and force plates. These tasks are linked to low-back pain and injury in caregivers. The use of IMUs in biomedical engineering enables flexible and mobile data collection both within and outside the laboratory. However, the force plates which are used for measuring the ground reaction forces (GRFs) are not as amenable to being transported for data collection outside the lab. Thus, our proof-of-concept study aims to develop and validate an artificial neural network (ANN) that estimates the ground reaction forces resulting from tasks performed by participants which simulate those that might be performed by a caregiver performing patient-handling tasks. Using data obtained from two subjects, a neural network was constructed and optimized. This model achieved a score of 0.9263 (92.63%), indicating that GRFs can be reasonably estimated with the use of an ANN. Future work would include expanding the study to involve more participants and include a wider variety of tasks, thereby improving the capacity of the ANN to generalize to fit more scenarios.

Algoraph but in C++

Adam Czeranko
Dre Solorzano

Mentor:
Dr. Charles Cusack, Computer Science

This research was supported by the Department of Computer Science at Hope College and the Dershem Computer Science Summer Research Fund.

Given a configuration of "pebbles" on a graph G, a pebbling move removes two pebbles from a source vertex and one pebble is added to an adjacent vertex. A vertex is reachable if there is a sequence of pebbling moves that places one pebble on that vertex; a graph is solvable if every vertex is reachable. The pebbling number of graph G is the smallest integer $\pi(G)$, such that any configuration that uses $\pi(G)$ pebbles is solvable. A graph satisfies the two-pebbling property if for any configuration of more than $2\pi(G) - q$ pebbles, where q is the number of vertices in G with at least one pebble, two pebbles can be moved to any vertex. Through heuristics and algorithms, Algoraph is a program that allows a user to run multiple permutations of pebbles on a graph and determine the reachability, solvability, and satisfaction of the two-pebbling property. Algoraph was originally coded in Java by Dr. Cusack and previous research students and was translated into C++ by Adam James Czeranko and Andres Solorzano. Through proper data management and parallelization of code, the team developed a new, more efficient version of Algoraph.

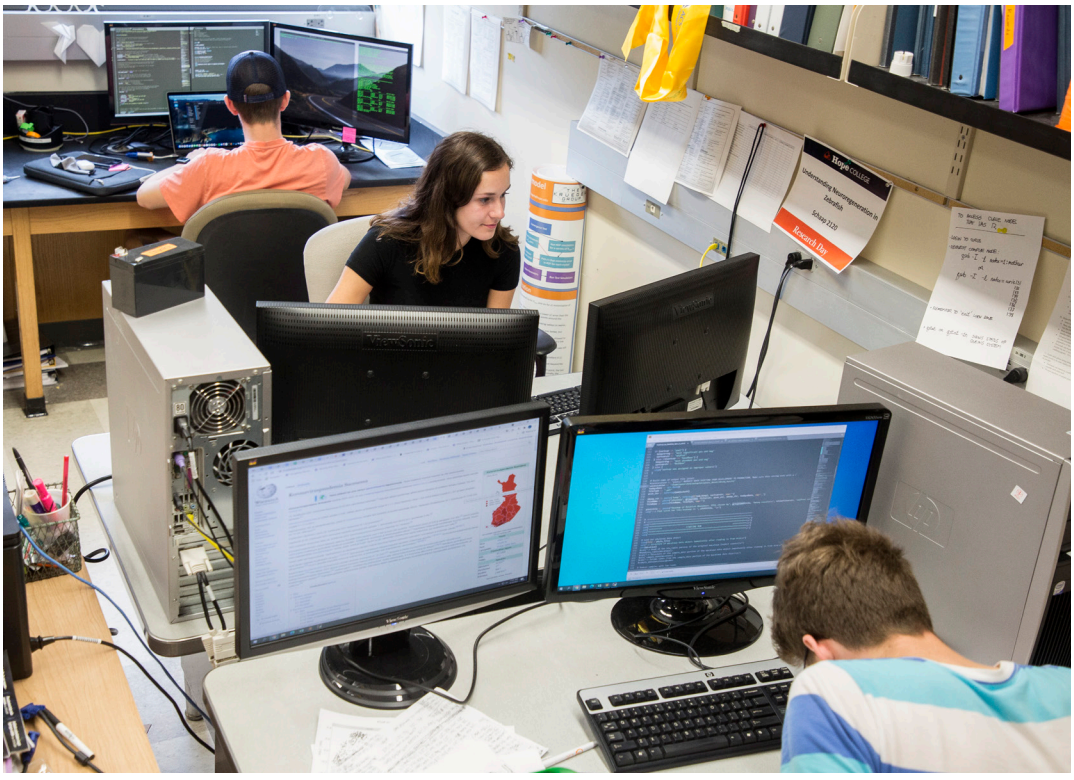
Tennis Event Detection with Machine Learning

John VerMeulen III
Kaley Wilson

Mentor:
Dr. Ryan McFall,
Computer Science

This project was supported by the Clare Boothe Luce Program of the Henry Luce Foundation.

Machine learning and computer vision are changing the way sports footage is analyzed. Already, it has countless applications in the sport of tennis. We extracted over 50,000 frames from footage of amatuer tennis matches and converted them into three distinct data sets. The three data sets were then used to train our models and assess their accuracy and precision. Our models included various convolutional and non convolutional neural networks. We used our data to train both binary and multi-class classifiers to classify different tennis events. These networks showed the potential for motion detection and classification to be used in analyzing the sport of tennis.



Mechanistically Studying the Degradation of Cesium Lead Iodide Perovskite Phases due to Temperature and Humidity

Rory Campagna
Zachery Wylie
Jonathan Outen
Peter Ruffolo

Mentor:
Dr. Jeffrey Christians, Engineering

Research reported in this publication was supported in part by funding provided by the National Science Foundation under Grant No. 2128632, National Aeronautics and Space Administration (NASA), under award number 80NSSC20M0124, Michigan Space Grant Consortium. Additional support was provided by the Howard R. And Margaret E. Sluyter Faculty Development Fund, the Hope College Dean of Natural and Applied Sciences and the Ernest Haight Summer Research Fund in Engineering.

Halide perovskites offer exciting potential as photovoltaic materials and simply as semiconductors. Perovskites' ever-increasing efficiency, stability and lowering manufacturing costs is making them even more attractive as a competitor to silicon solar cells. The focus of this research was on halide perovskites which have the formula ABX_3, and more specifically on cesium lead iodide ($CsPbI_3$). A major drawback of $CsPbI_3$ is its limited stability in the perovskite crystal phase, the colored phase with desirable optoelectronic properties. The source of this instability is a size mismatch between the cesium cation and the lead iodide octahedra. Cesium is somewhat too small of a cation to stabilize the perovskite structure and in the presence of outside factors, such as increased humidity and temperature, the metastable perovskite structure changes to the thermodynamically favored, mostly colorless orthorhombic phase. Most work has centered on improving the stability of the perovskite phase whereas less has been done to mechanistically study the phase change process. In this study, a home-built system was constructed to analyze the absorbance of a $CsPbI_3$ film over time while controlling humidity and temperature. Absorbance data collected was converted to phase fraction data and the phase transformation was modeled by the JMAK model, $x(t) = \exp(-kt^n)$, where n is the growth coefficient, k is the rate constant and t is time. It is found that relative humidity increases the phase transformation rate exponentially, indicating a first order process; however, increasing temperature leads to a monotonic decrease in the rate constant. We hypothesize that the decrease in phase transformation rate with increasing temperature is the result of surface water desorption. Experiments are also consistent with the phase transformation rate being nucleation rate limited where individual grains transform very rapidly once a non-perovskite phase nucleates, but neighboring grains do not influence one another.

Wireless Sensors for Monitoring Urban Noise

Mason Daleiden

Mentor:
Dr. Courtney Peckens, Engineering

This work was supported by the Hope College Department of Engineering and the Dean for the Natural and Applied Sciences.

Noise pollution has proven to have negative effects on both human health and productivity. Thus, better quantifying noise in urban areas, which are most prone to this form of pollution, can help city planners and architects develop solutions. Wireless sensors are a viable platform for collecting noise data because they can run autonomously and consume minimal power. A wireless acoustic sensing unit was considered, consisting of a microcontroller, radio, and peripheral board. The peripheral board housed the microphone, voltage regulator, and an A-weight filter that modeled frequency scaling experienced by a human ear. Despite being very energy efficient, a traditional finite energy supply, such as a battery, has a limited lifespan and a renewable energy source is more attractive. This project focused on integrating a solar panel with a battery charger and a lithium ion polymer battery with the wireless sensor node. With adequate sunlight, the nodes were able to run autonomously and even if they shut off due to a low voltage supply from the battery, they would turn back on when the battery voltage surpassed a required supply voltage of 3.3V. However, it was observed that when the node was in low-power mode, the microphone data appeared corrupted. These modifications demonstrate immense potential for a completely autonomous acoustic sensing system.

Bio-Inspired Sensing and Actuating Architectures for Feedback Control of Civil Structures

Valerie Dien

Mentor:
Dr. Courtney Peckens, Engineering

This material is based upon work supported by the National Science Foundation under Grant No. 1662655.

Due to increasing construction of complex structures such as skyscrapers in growing urban areas, the importance of system monitoring has increased. This project studies the effectiveness of a bio-inspired control algorithm as compared to a more traditional control algorithm, the linear quadratic regulator (LQR). In the bio-inspired control algorithm, a novel sensing node that performs real-time frequency decomposition is used to streamline the control law. Due to this up-front signal processing, the control law becomes a simple weighted sum of these frequency components which is easily executed. This proposed control algorithm system was validated on a small-scale four-story shear structure and compared to a more traditional control algorithm, LQR. To quantify the control effectiveness of the uncontrolled versus controlled results for both control scenarios, the reduction in displacement and acceleration metrics were calculated.. For the LQR model, the absolute maximum displacement ratio, averaged across all floors, was 0.9503, the averaged displacement time history ratio was 0.9413, the averaged absolute maximum acceleration ratio was 0.9272, and the averaged acceleration time history ratio was 0.9503. For the bio-inspired model, the averaged absolute maximum displacement ratio was 0.9717, the averaged displacement time history ratio was 0.9280, the averaged absolute maximum acceleration ratio was 0.8343, and the averaged acceleration time history ratio was 0.8159. Further research incorporating scalar values and more accurate weighting matrix values could produce more conclusive results.

Validating the Use of an IMU-based System to Capture Patient-handling Tasks

Bridget Gagnier
Reese Moschetta
Yeageon Song

Mentor:
Dr. Brooke Odle, Engineering

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.

Manual patient-handling tasks are associated with low back injury. Computational musculoskeletal models may provide insight on injury prevention. Advances in wireless inertial measurement unit sensor technology enables data collection in more realistic environments. This study aims to validate the use of inertial measurement units(IMUs) to capture simulated patient-handling tasks. Three able-bodied male participants, ages 20-21, completed simulated tasks while wearing reflective markers and inertial measurement units (IMUs). Retroreflective markers were placed on the bony prominences of the whole body and seven IMUs were placed on the pelvis and bilaterally on the thigh, shank, and foot. The subjects stood with each foot on a force plate. The subjects performed three simplified patient-handling tasks: a squat, a squat with an arm curl, and a reaching down motion. The knee and hip joint angles were calculated in the sagittal plane using the marker data, IMU system, and OpenSense. Joint angles from the IMU system were compared to those from the marker data (Comparison 1) and OpenSense (Comparison 2). The average root mean squared error (RMSE) for Comparison 1 is 8.20° and 11.05° for the knee and hip, respectively. The average RMSE for comparison 2 is 1.56° and 1.08° for the knee and hip, respectively. The results are consistent with previous sample data that were collected before subject recruitment, except for the higher knee angle error for Subject 2. High hip angle error, though, is consistent with previous sample data. With respect to the IMUs, OpenSense knee and hip flexion-extension angles are very comparable; and those from the marker data are fairly comparable. Future work will explore the feasibility of IMU and modeling approaches to understand low back injury risk with patient-handling tasks.

Cortical Responses to Physical and Electrically Evoked Somatosensation

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Peter Ruffolo
Grace VanDellen

Mentor:
Dr. Katharine Polasek, Engineering

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

Phantom limb pain is characterized by pain and discomfort in a missing extremity after amputation. This pain may be caused by altered electrical signals coming from the severed nerves, possibly changing how the brain processes information coming from that missing limb. It is hypothesized that phantom limb pain may be reduced by restoring sensation in the amputated extremity through electrical stimulation. The overall goal of our group is to develop an at-home therapy that consists of electrically evoking somatosensation in the amputated extremity to promote neural changes within the brain. The goal of this project is to quantify cortical changes from therapy.

This project compared cortical responses from electrical stimulation of the median nerve to responses from physical tapping on the hand. A 96-electrode electroencephalogram (EEG) cap was used to measure cortical activity in the somatosensory cortex in response to the following conditions: 1) Stimulating a tapping-like sensation in the hand through electrical stimulation of the median nerve at the elbow; 2-3) Tapping at the location matching where the stimulated sensation was perceived with a robotic tapping assembly with and without visual feedback. The EEG data was analyzed by calculating the global field power (GFP) of the cortical activity and cross-correlating the GFP of each condition. The lag at which the maximum cross-correlation coefficient was measured was used to shift the GFP vectors, and the correlation coefficients between conditions were then calculated using the shifted GFP vectors.

It was expected that the correlation would be the highest between trials tapping on the matching location, with and without visual feedback, and this was true in four of eleven subjects. These trials were also expected to be highly correlated with the trials where sensation was evoked through stimulation. This was true in eight subjects. Further research is needed to explain these results.

Manipulating Methylamine Deintercalation in 2D Halide Perovskites via an Organic Spacer

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Josephine L. Surel
Elizabeth V. Cutlip

Mentor:
Dr. Jeffrey Christians, Engineering

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, the Clare Booth Luce Research Scholar Program, and the Hope College Dean of Natural and Applied Sciences.

The need for renewable power has driven the search for new spaces to implement photovoltaic technologies. One such space is photovoltaic windows. A desirable functionality for photovoltaic windows is the ability to change transparency. Halide perovskites have demonstrated such color changes in addition to high photovoltaic performance. Halide perovskites, when exposed to methylamine gas, form a clear phase and return to a dark phase when the gas is driven out. Methylamine intercalation/deintercalation causes morphological changes which lead to photovoltaic performance loss. 2D Ruddlesden-Popper phase halide perovskites with the formula A2PbI4 are explored for methylamine intercalation/deintercalation. The length of the A-site organic spacer was varied to gain insight into appropriate design rules using phenylalkylamines with alkyl carbon chain lengths of 0, 2, and 4 between the phenyl ring and ammonium head group. With varying chain lengths, there are differing molecular forces. It is found that 2D perovskites with weak intermolecular interactions retain significant amounts of methylamine and show greater structural changes upon methylamine intercalation/deintercalation. A better understanding is gained of how differing A-site organic spaces can template the 2D halide perovskite structure and lead to more reproducible intercalation/deintercalation of MA gas.

Feasibility of the Lifting Full-Body Model to Simulate Squatting Tasks

Reese Moschetta
Yeageon Song
Bridget Gagnier
Barry Bait

Mentor:
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Engineering

Research reported in this publication was supported in part by funding provided by the National Aeronautics and Space Administration (NASA), under award number NNX15AJ20H, Michigan Space Grant Consortium and the Ernest Haight Summer Research Fund in Engineering.

Lower back pain is one of the most common injuries involving healthcare workers who perform manual patient-handling tasks. Currently, no freely available subject-specific model to explore internal joint loading during these tasks exists. A proof-of-concept study to simulate squatting tasks with the OpenSim Lifting Full-Body (LFB) Model is presented. Thirty-nine reflective markers were placed on bony landmarks of the upper and lower body of a 20-year old able-bodied female volunteer. Ten electromyography (EMG) sensors were placed bilaterally on the following muscles; lumbar erector spinae, thoracic erector spinae, rectus femoris, rectus abdominis, and the external obliques. Position (100 Hz), ground reaction forces (1000 Hz), and muscle activity (1000 Hz) data were synchronized and captured while the subject performed five squats for four trials. Kinetic data were down-sampled to 100 Hz. Kinematic, kinetic, and EMG data (after rectification) were filtered with a fourth order Butterworth filter with a cut-off frequency of 6 Hz. EMG signals for each muscle were normalized to its average maximum peak value across all four trials and resampled to 100% of the squat. Scaling, Inverse Kinematics, Inverse Dynamics, and Static Optimization were performed in OpenSim. The left lumbar erector spinae and bilateral rectus femoris were the most active during the exercise, which suggests quadriceps should be included in the model. Reserve actuators were added to the model to help the static optimization simulations to converge. The values for each joint coordinate of the reserve actuators are less than 5 percent which suggests the reserve actuators did not contribute too much to the movement and these results are acceptable. Pilot results suggest that the LFB Model may be used to simulate simple squatting tasks. After some modifications, the LFB Model may ultimately be used to simulate patient-handling tasks and provide insight on low back loading during patient-handling tasks.

Exploration of the Use of a Proportional-Integral-Derivative Controller for Mitigation of Seismic Base Excitation in Civil Structures

Mary C. Ngoma

Mentor:
Dr. Courtney Peckens,
Engineering

This material is based upon work supported by the National Science Foundation under Grant No. 1662655.

Civil infrastructures are susceptible to damage due to external forces such as winds and earthquakes. These external forces cause damage to buildings and different civil structures. To prevent this, active control systems are executed. These systems use sensors to measure the displacement of the infrastructure, then actuators are utilized to provide a force that counteracts that displacement. In this study, a Proportional Integral Derivative (PID) controller was used to minimize the impact of an earthquake disturbance on multi-story structures. The proportional, integral, and derivative gains of the controller were obtained using Particle Swarm Optimization (PSO). This PID controller was validated on a simulated five-story structure based on the Kajima Shizuoka building with five ideal actuators. The effectiveness of the PID controller in reducing the seismic response of the structure with regards to interstory displacement and acceleration was compared to the uncontrolled response of the structure. It is found that the PID controller with PID parameters obtained from the PSO algorithm offers effective control for the simulated five story structure.

Understanding the Role of Iodide Vacancy Passivation in Cesium Lead Iodide Perovskite Phase Stability

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Rory Campagna
Zachery Wylie
Peter Ruffalo

Mentor:
Dr. Jeffrey Christians, Engineering

Research reported in this publication was supported in part by funding provided by the National Science Foundation under Grant No. 2128632, National Aeronautics and Space Administration (NASA), under award number 80NSSC20M0124, Michigan Space Grant Consortium, the Howard R. and Margaret E. Sluyter Faculty Development Fund, and the Hope College Dean of Natural and Applied Sciences.

Over the last decade, photovoltaic cells made using halide perovskite absorbers have shown rapid and consistent increases in efficiency. However, there is a desire to improve thermal stability of halide perovskites by using cesium lead iodide ($CsPbI_3$); however, crystal phase stability for $CsPbI_3$ based perovskites is poor, the materials change from the desired perovskite crystal structure to a non-perovskite crystal structure which does not absorb light well. One suspected factor influencing the stability of the perovskite phase in $CsPbI_3$ is that during high temperature thermal annealing, defects form on the crystal surface where, it is hypothesized, nucleation sites for the non-perovskite phase begin the phase transformation. In this study, using two methods of film formation, to show the generalizability of results, $CsPbI_3$ perovskite film solutions were post-treated with increasing concentrations of iodide, using CsI and CdI_2, to reduce the concentration of surface iodide vacancies. The phase transformation from perovskite to non-perovskite phases was monitored at constant temperature and humidity to control film conditions and monitor absorbance. From this, we find that reducing iodide defect concentrations using both CsI and CdI2 treatments directly leads to improved phase stability, providing strong evidence that iodide vacancies are nucleation sites for non-perovskite phase formation in $CsPbI_3$ perovskites. This insight has important implications for materials design for phase stable halide perovskite materials.

Exploring Halide Perovskite Structural Tunability to Design Materials for Dynamic Photovoltaic Windows

Josephine Surel
Elizabeth Cutlip
James Mandeville

Mentor:
Dr. Jeffrey Christians, Engineering

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Halide perovskites offer exciting potential as photovoltaic materials and simply as semiconductors. Specifically, their structural tunability has become of greater interest as researchers begin to search for novel ways to tune the materials to achieve improved solar cell stability or to target new applications. One potential technology which halide perovskites could enable is dynamically switchable photovoltaic windows: windows which can transition between photovoltaically active (dark) and non-photovoltaic (transparent). We build toward this goal in this work by investigating the intercalation and deintercalation of methylamine gas into 2-dimensional Ruddlesden-Popper (R-P) phase halide perovskites of the type A2PbI4. As has been shown with 3D methylammonium lead iodide films, the intercalation of methylamine into the halide perovskite lattice results in a color change to a clear crystalline phase. We find that in some 2-D perovskite systems, deintercalation of the methylamine gas is incomplete, resulting in the formation of secondary phases including n=2 R-P and 3D perovskites, as well as lower dimensional materials; however, other 2-D perovskite phases show reversible intercalation/deintercalation with methylamine, indicating stronger binding between the long-chain ligand and the lead halide octahedra of the 2-D perovskite sheet. This work reveals the relative affinity of various R-NH3+ molecules, specifically R-C8H9-NH3+ materials such as 4-hydroxy phenethyl ammonium, for the halide perovskite lattice and indicates that templating the 3-D CH3NH3PbI3 structure with carefully selected long-chain cations could lead to better reversibility in dynamic photovoltaic windows. Work continues to develop improved guidelines for the design of 2D/3D halide perovskite materials for an array of applications.

Modeling Selective Activation of the Median Nerve

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 experimentally has been found to be difficult and time consuming. Our goal is to design an electrode array to be placed over the cubital fossa area, and have the ability to adjust the voltage combinations used for stimulation until a good referred sensation is achieved even when used with different people. To achieve this, 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 [1]. This data was used to test every axon in every fascicle and determine which axons fired, giving the percentage activation for different voltage combinations used as stimulus. The results were ranked using a quality of activation metric. The key contributors to quality of activation are: reachability (distance from fascicle center to the skin and resistivity of the perineurium), type of selectivity (singular, dual, group of 3), and delta of activation between the lowest selective fascicle and the next highest non-selective fascicle. Out of the 3,442 simulations run this summer, 2,003 unique results and 1,011 unique and selective results (selectivity >= 25%) were obtained. Out of the selective results, 16% produced activation of a single fascicle, 57% a pair of fascicles, and 27% groups of 3 fascicles. These simulations suggest that selective activation is possible and maybe even similar across differences in anatomy. Further investigations are underway to develop general techniques that can produce selective activation in all people and experimental testing of these predictions is planned.

[1] Gaines JL, Finn KE, Slopsema JP, Heyboer LA, Polasek KH. A model of motor and sensory axon activation in the median nerve using surface electrical stimulation. J Comput Neurosci. 2018 Aug;45(1):29-43. doi: 10.1007/s10827-018-0689-5.

Optimization of Bio-Inspired Control: Four-Story Shear Structure

Clara Voskuil

Mentor:
Dr. Courtney Peckens, Engineering

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.

Due to environmental factors such as strong winds and earthquakes, buildings are often at risk of structural failure or deformation. Feedback control systems can be implemented to combat such destructive effects. This study uses a bio-inspired control algorithm to streamline the control efforts. A bio-inspired sensor is used to decompose the structure's displacement into frequency components in real-time. A centralized node receives information from the sensors and calculates the desired counteractive force as a weighted sum of the inputs, using the equation $F = WN$, where F is the calculated force, N is a vector of the displacements of the structure, and W is a weighting matrix, determined using the particle swarm optimization method. As the sensing node decomposes the input signal into numerous components, the weighting matrix can quickly become very large. To further eliminate extraneous information and minimize computational power, several pruning mechanisms were explored, including Optimal Brain Surgeon (OBS), threshold pruning, and minimum error. This algorithm, and subsequent pruning methods, were applied to a small-scale, four-story structure, which used two actuators to mitigate the effect of base excitations. To quantify control effectiveness, cost functions were used that compared the control scenario to the uncontrolled scenario for the four floors for maximum displacement, average displacement, maximum acceleration, and average acceleration. These were averaged together and summed across all four floors to obtain a single value (smaller values are ideal, and any value below four indicates some control has been achieved). Simulation results of the four-story shear structure showed that the minimum error method of pruning was most effective. The baseline average cost function (before pruning) was 2.74; however, after minimum error pruning, the average cost function was 2.61, indicating improved system control.

Effects of Drug Adsorption on the Settling of Very Fine Particles in Aqueous Suspensions

Seth Almquist

Mentor:
Dr. Jonathan Peterson, Geological and Environmental Sciences

This research was made possible through support by the Hope College Geology Summer Research Fund and the Nicholas Ver Hey '75 Geology Summer Research Fund.

Pharmaceutical & personal care products (PPCPs) such as antibiotics and antivirals have been identified in wastewater effluents in a multitude of studies, and their impact on the environment is of growing concern. Considering the recent SARS-CoV-2 pandemic, understanding the fate and transport (FT) of antiviral drugs has gained attention. Drugs in natural aqueous systems often adsorb to fine suspended particles (FSPs). Understanding the FT of FSPs, which act as substrates for dissolved PPCPs, is fundamental to predicting the spread of drug contaminants. In this study, interactions between two PPCPs and a substrate of FSPs were investigated by batch mixing and timed settling experiments. The question investigated was if PPCP adsorption to sub-micron size particles (~ 1000-10 nm) affects the rates of settling and subsequent size distribution of FSPs over time. NIST-SRM 1978 ZrO_2 was used as a substrate. Experimental sample solutions consisting of a 1:1 volume ratio of SRM 1978 and various concentrations of ofloxacin (antibiotic) or amantadine (antiviral) solution were mixed for 24 hours in the dark at room temperature. After mixing, attendant solutions were analyzed with LC/MS/MS techniques to determine the amount of drug adsorbed. Duplicate samples of substrate-drug solutions were homogenized by sonication and particle size distribution was measured by dynamic light scattering (DLS) techniques every 15 minutes over a 13-hour settling time. Preliminary results indicate a difference in grain size distribution (d_{50} and d_{10}) between the drug-attached particles and drug-free particles at some settling times. At times 15 and 32 minutes, the d_{50} and d_{10}, respectively, of the drug-free sample and the amantadine drug-attached sample match the certified value within error. Contrarily, the ofloxacin drug-attached sample is significantly larger at comparable settling times. It is uncertain whether differences are significant over the duration of the settling. Ongoing investigations include experiments on various PPCP-nanoparticle substrate combinations.

Carbon Storage and Methane Production from Interdunal Wetlands in Saugatuck Harbor Natural Area

Grace Behrens

Mentor:
Dr. Michael Philben,
Geological and
Environmental Sciences

This research was made possible through support by the Nicholas Ver Hey '75 Geology Summer Research Fund.

Wetlands have a dual impact on the climate: a cooling effect caused by organic matter accumulation in anoxic sediments (removing carbon dioxide from the atmosphere); and a warming effect caused by methane emissions from these sediments. In this study, we analyzed the relative importance of both processes in interdunal wetlands in the Saugatuck Harbor Natural Area (SHNA). The SHNA wetlands are a unique ecosystem, dependent on high water levels in Lake Michigan. Thus, carbon accumulation in the wetlands may be ephemeral as the lake level falls. Our goal in this study was to evaluate the extent of carbon accumulation in the wetland sediments and to determine their potential methane emissions. To measure carbon accumulation, we collected sediment cores from seven slack pools within the wetland complex. The cores were split into 1-cm slices and their carbon and nitrogen content were determined using an elemental analyzer. Four of the five pools within the established wetland complex exhibited significant carbon accumulation (>25 g C m^{-2}). Two incipient slacks with little established vegetation contained only minimal sedimentary carbon. We then measured the methane production potential of the slacks by incubating sediments from each pool in sealed bottles under an atmosphere of N_2, to ensure anoxic conditions. Surprisingly, we detected methane production in sediment from all seven pools. *In situ* methane production at the incipient slacks is currently unlikely due to high oxygen concentrations but our results indicate that microbial communities in these sediments maintain the capability of methane production if oxygen is depleted. Ongoing research in these wetlands includes characterizing the microbial community

Selective Preservation of Structural Carbohydrates during Peat Formation

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Research reported in this publication was supported in part by funding provided by the National Aeronautics and Space Administration (NASA), under award numbers 80NSSC20M0124 and NNX15AJ20H, Michigan Space Grant Consortium. It was also made possible by the John and Eleanor Dwyer Fund for Summer Research in Chemistry, Smallegan Undergraduate Chemistry Research Fund and the John R. Soeter Student/Faculty Research Fund.

Previous studies have shown that the structural carbohydrate "sphagnan" plays a role in slowing the degradation of Sphagnum moss, and therefore plays a key role in the accumulation of peat. 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 two hundred and seventy 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 of 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, accumulating over degradation. Overall, our results show that sphagnan is selectively preserved during litter decomposition and can persist over the course of long-term decomposition.

Terrestrial Trash Taphonomy: Characterizing Roadside Litter as Potential Sources of Plastic in Waterways

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Kelly Gotham

Mentor:
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This research was made possible through support by the Nicholas Ver Hey '75 Geology Summer Research Fund.

We collected and characterized roadside litter from 300 m transects along 4 streets in Holland, Michigan that included stream crossings or storm drain inlets. Opposite sides of 3 roads were collected as separate sampling sites, and 4 of these were resampled after ~30 days, yielding 11 different collections. Litter was unevenly distributed within single transects, with some concentrations of litter (e.g., car parts, styrofoam) apparently resulting from single, localized releases of material. Despite such idiosyncratic occurrences, factor analysis of collected items placed associated sites (opposite sides of roads and resampled sites) in non-overlapping domains. Of 11,223 items analyzed, 83.2% were varieties of plastic (38.5% undifferentiated, 37.5% cigarette butts, 7.1% styrofoam), 12.1% were paper, 3.2% metal, and 1.5% glass. Overall, 88.2% of items floated in freshwater, suggesting that most roadside litter is susceptible to rapid transport into and through waterways. Samples from a residential street grate and storm drain catch basin yielded little litter (1 and 10 pieces, respectively), suggesting that once roadside litter enters the storm drain system it is rapidly flushed to the outfall. Experiments with a car and lawnmower examined how plastic and styrofoam break when run over. Mowing resulted in extensive, rapid fragmentation, yielding small pieces of styrofoam, thin, pointed fragments of plastic cups, and miniscule, shattered fragments of plastic utensils and drinking straws. Contrastingly, running over items 3 times with a car traveling at 40 km/hr yielded larger, quadrilateral fragments of styrofoam and plastic cups, while plastic utensils showed little damage and straws showed lengthwise splits but remained essentially whole. These differences may help identify the origins of plastic in water bodies as roadside versus lawn debris, and suggest that removing litter near streams and storm drains before mowing may reduce plastic input into watersheds.

Presence or Absence of Microcystins within the Lake Macatawa Watershed

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Mentor:
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This research was made possible through support by the Smies Summer Research Fund.

Cyanobacteria, commonly known as blue-green algae, are freshwater aquatic microorganisms that are important indicators of climate change. They also release microcystins: toxins that can cause sickness, organ failure, or even death in plants, animals and humans. Studies have monitored microcystin presence and concentration in large-scale Cyanobacterial blooms, such as in Lake Erie, but often omit smaller scale instances. This project determines whether or not microcystins are present in the Lake Macatawa Watershed and identifies important conditional factors associated with microcystin presence to conclude if harmful algal blooms like those of Lake Erie are plausible locally. Six sample locations along the shoreline and at river convergence points were sampled twice, with six days between sampling sessions, and analyzed to determine whether cyanobacteria and microcystins were being supplied to the lake or cultivated within it. YSI water quality sonde analyses and resulting correlation coefficients highlighted four conditional factors: temperature, pH, dissolved oxygen (DO), and nitrates. These data were paired with an Envirologix QuantiPlate Kit for detection of Microcystins Enzyme-Linked ImmunoSorbent Assay (ELISA) of the water samples taken at each site. In all, the concentration of microcystins was higher in the first, warmer temperature samples. The relationship between temperature and concentration yielded the highest correlation coefficient value at 0.5986. A weak correlation of 0.3453 was found between pH and concentration. Relationships involving DO and nitrates both yielded extremely weak correlation coefficients. We conclude that microcystins are present within Lake Macatawa. While present, their concentration was not determined to be harmful at any of the sample locations. Outliers within sonde readings supported theories of conditional factors ideal for Cyanobacteria development yet indicate a low likelihood of harmful Cyanobacterial blooms happening within Lake Macatawa.

Connecting Chemical Composition and Methane Production in a West Michigan Peatland

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Mentor:
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The future net radiative forcing of peatlands will depend in large part on changes in methane emissions. However, current climate models lack a mechanistic representation of methane production. We conducted an anaerobic incubation experiment using peat from various depths in five cores collected from a West Michigan peatland in order to connect methane production to observable differences in the chemical composition of peat and peat pore water. We hypothesized that less decomposed peat may have a larger supply of fermentable sugars that can thus produce more methane than more decomposed peat. C:N, hydrolyzable amino acids, and neutral sugars were analyzed to evaluate the "quality" of the peat. Our results indicated that surface peat produces more methane and carbon dioxide than samples taken from greater depths. Surface peat had higher yields of arabinose and xylose, indicating higher availability of relatively labile hemicelluloses compared to deeper peat. This coincided with a higher amino acid yield in comparison to total nitrogen and a higher C:N, indicating less extensive decomposition in these samples. This is consistent with our hypothesis that methane production potential is correlated with peat quality. These results suggest that analysis of the chemical composition of peat can be used to assess methane production potential and predict the future radiative forming of peatlands.

Investigating Gravity Driven Shale Tectonics: Results from Clay Models

Charles Soucey

Mentor:
Dr. Sarah Dean
Geological and
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This research was made possible through support by the Wichers Fund for Faculty Development.

Shale Tectonics are critical to understanding the deformation and structures on gravitational spreading passive margins for shale dominated systems. Updip extension and downdip compression are linked through the deformation of mobile and overpressured shales, structurally observable in the Niger Delta, Port Isabel, and the Mexican Ridges fold belts in the Western Gulf of Mexico. Notably, these margins are proven hydrocarbon basins, with the diapirs, faults, and folds in the compressional domain acting as traps and seals. While the modeling of salt tectonics has been extensive, few studies have attempted to recreate shale tectonics with analogue modeling techniques. Scaled analog models using wet kaolin allows for both qualitative and quantitative observations of mobile shales in offshore gravity-driven margins. By changing the water content of wet clay, the desired rheological properties can be achieved to create a scaled model of the native feature. Clay slurries of about 50-55% water content by mass were ideal to investigate shale tectonics, as the native shale feature includes water as a pore fluid. In all experiments, linked extension expressed through listric normal faults occurred in and below the delta layers,and compression expressed through folding occurred beneath and beyond the toe of the delta. The delta loading patterns form listric normal faults with regional dip, and some normal faults with counterregional dip. In the compressional zones, anticlines and popup structures form at and just beyond the toe of the delta.Thickness changes are most dominant in the upper 2 pre-delta layers, with minimal deformation occurring at the bottom of the model due to increased friction with the base of the model. Models designed with a mechanically weaker basal layer showed a greater degree of deformation within the lower units. These deformation patterns are similar to the structures observed in the Mexican Ridges Foldbelt.

Constructing Digital Elevation Models from Lake Michigan Dune Imagery

Blake Harlow
Jack Krebsbach

Mentors:
Dr. Darin Stephenson, Mathematics and Statistics

Dr. Brian Yurk, Mathematics and Statistics

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.

Lake Michigan dune complexes evolve as winds and waves move the sand, causing major topographic changes over time. The Hope College Dune Group has been using remote sensing data from drone imagery to model various aspects of these dunes. In order to better understand the dune dynamics, a digital terrain model (DTM) is desired. A DTM is an elevation map of the dune's bare ground surface which excludes ground obstructions such as trees and bushes. We have attempted to use traditional methods that have been developed for processing LIDAR data in order to construct these DTMs from our drone imagery, although these perform poorly. In order to improve the quality of our DTMs, we have developed a new approach and have performed initial testing with this technique. This approach uses an artificial neural network to classify the ground elevation of small 1-meter by 1-meter tiles within the drone imagery. This neural network is given the elevation of all points within the tile, including points that are positioned on nonground objects such as tree canopies and bushes. Preliminary results have shown promise from this technique, although more work needs to be performed in order to further fine-tune the model.

Automatic Alignment of Remote Imagery for Use in Sand Dune Modeling

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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 and by the Jay Folkert & Charles Steketee Mathematics Summer Research Fund.

The Hope College Dune Group has been studying West Michigan sand dunes for over twenty years. The group's interests include observing the mechanisms and effects of sand transport, as well as learning how sand movement and resident dune vegetation affect one another. One of the fundamental tasks of this group is to use machine learning algorithms to create accurate ground-surface and vegetation models from drone imagery in an automated way. A key step in this process is the identification of various types of surface coverage–such as sand, live grass, trees, and other vegetation–automatically from images. An eventual goal of this work is automatic land cover classification at the complex-wide scale.

The scale of the images ranges from high-resolution photos taken with digital cameras to orthomosaics of entire dune complexes taken remotely from a height of around 120 meters. This gives rise to the need for automated alignment and accurate coregistration of multiple images. One technique for image alignment involves using artificial neural networks to identify key points in two or more images and match sets of key points between images. In this poster, we will report on our work on land type classification using a variety of image classification techniques. We produce detailed classifications of high-resolution, low-altitude images and use this as a template for creating similar classifications from high-altitude, lower-resolution imagery. We also report on early attempts to align images from multiple perspectives and sources. If automatic image alignment is successful, multiple images can be used together in network training and prediction, and some field-based data collection workflows can be streamlined.

Intervention to Support Physical Activity Independence and Routine Everyday: Preliminary Efficacy of the INSPIRE Pilot Project for Inactive Adolescent Girls

Marisa Guidone
Claire Magnuson
Johanna Emmanuel

Mentor:
Dr. Vicki Voskuil,
Nursing

This project was supported by the Howard R. and Margaret E. Sluyter Faculty Development Fund, a grant from the Office of the Dean of Natural and Applied Sciences, the Dr. Lorraine Hellenga '60 Toji Nursing Faculty-Student Research Fund, and the Department of Nursing Debbink Faculty Development Grant.

Physical activity (PA) guidelines for adolescents recommend 60 minutes of moderate to vigorous physical activity (MVPA) daily. However, only 20% of adolescent girls report meeting these recommendations. Few studies have incorporated wearable activity trackers among youth but there is some evidence these devices may motivate adolescent girls to become more active. The purpose of this study was to explore the preliminary efficacy of the INSPIRE intervention among inactive adolescent girls. The Information Motivation-Behavioral Skills model was used to develop the intervention. This model includes the following concepts: 1) information, which represents knowledge about a health behavior; 2) motivation, including personal and social motivation; 3) behavioral skills, represented as objective skills and self-efficacy to perform a health behavior; and 4) health behavior. This study used a single group pre-posttest design involving inactive adolescent girls in the 6th, 7th, and 8th grades (N=15) recruited from 2 middle schools in West Michigan. Girls were excluded if they were involved in sports ≥ 3 days a week or had a health condition that compromised their PA. The 6-week summer intervention took place at a Midwestern undergraduate college twice a week for 3 hours. Participants were given a Fitbit Inspire activity tracker and instructions on how to access the Fitbit application by computer or phone. MVPA was measured using the Patient Centered Assessment and Counseling for Exercise (PACE) questionnaire. Resting heart rate (RHR) was measured using the Fitbit Inspire tracker. The Progressive Aerobic Cardio Endurance Run (PACER) measured cardio-respiratory fitness (CFR). Data were analyzed in SPSS Version 27 using descriptive statistics and paired t-tests. The days participants reported performing 60 minutes of MVPA in a week increased from baseline to post-intervention (MD=1.33, p=.006) and 2 weeks post-intervention (MD=1.08, p=.024). RHR decreased (MD=-6.08, p=.005) from baseline to post-intervention. However, CRF did not differ significantly (MD=1.93, p=.171). Limitations included participant involvement in other summer activities, missing Fitbit data, self-reported data for MVPA, lack of a control group, and small sample size. The INSPIRE intervention indicated preliminary efficacy. Results demonstrate the need for a pilot randomized controlled trial.

Intervention to Support Physical Activity Independence and Routine Everyday: Feasibility of the INSPIRE Pilot Project for Inactive Adolescent Girls

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Mentor:
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Nursing

This project was supported by the Howard R. and Margaret E. Sluyter Faculty Development Fund, a grant from the Office of the Dean of Natural and Applied Sciences, the Dr. Lorraine Hellenga '60 Toji Nursing Faculty-Student Research Fund, and the Department of Nursing Debbink Faculty Development Grant.

Physical activity (PA) guidelines for adolescents recommend 60 minutes of moderate to vigorous physical activity (MVPA) daily. However, only 20% of adolescent girls report meeting these recommendations. Few studies have incorporated wearable activity trackers among youth but there is some evidence these devices may motivate adolescent girls to become more active. The purpose of this study was to evaluate the feasibility of the INSPIRE intervention among inactive adolescent girls. The Information Motivation-Behavioral Skills model was used to develop the intervention. This model includes the following concepts: 1) information, which represents knowledge about a health behavior; 2) motivation, including personal and social motivation; 3) behavioral skills, represented as objective skills and self-efficacy to perform a health behavior; and 4) health behavior. This study used a single group pre-posttest design involving inactive adolescent girls in the 6th, 7th, and 8th grades (N=15) recruited from 2 middle schools in West Michigan. Girls were excluded if they were involved in sports ≥ 3 days a week or had a health condition that compromised their PA. The 6-week summer intervention took place at a Midwestern undergraduate college twice a week for 3 hours. Each session included an educational component in a classroom setting, 30-60 minutes of MVPA, a stretching routine, and snack. Participants were given a Fitbit Inspire activity tracker and instructions on how to access the Fitbit application by computer or phone. Feasibility measures included mean attendance rate, attrition rate, mean minutes of MVPA for intervention sessions, and participant satisfaction, measured using the 8-item Client Satisfaction Questionnaire (CSQ-8). Data were analyzed in SPSS Version 27 using descriptive statistics. Mean attendance rate was 83.42% (SD=10.49%) with no attrition, mean minutes of MVPA for intervention sessions was 62.11 (SD=15.96), and the mean CSQ-8 score was 28.87 (SD=3.00) with 13 (86.7%) participants indicating being satisfied or very satisfied. Limitations included participant involvement in other summer activities, missing Fitbit data, and lack of a control group. The INSPIRE intervention proved to be feasible among this sample of inactive adolescent girls. Results indicate the need for a pilot randomized controlled trial.

Provision of Maternal Breastmilk in the Neonatal Intensive Care Unit: A Grounded Theory Analysis

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Samrawit Kelkay

Mentor:
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This research was supported by Medela and Rush University Golden Lamp and the Marion R. Van Dyke Clark Nursing Summer Research Fund.

Despite the importance of providing hospitalized extremely preterm (EP, < 32 weeks gestation) very low birth weight (VLBW, < 1500 grams) infants with mother's own milk (MOM), a low percentage of neonates are discharged receiving MOM. The purpose of this study was to explore the experience of mothers of EP VLBW infants and related breastmilk provision in the neonatal intensive care unit (NICU) to develop a general theory of maternal breastmilk provision. This grounded theory study implemented classical qualitative methods. Transcribed maternal interviews were analyzed using the web-based data management and analysis platform of Dedoose. A total of 30 mothers, recruited within a large Midwestern hospital's NICU, were included in this study. Ten participants provided longitudinal data, while 20 provided data at one-time point. Participants were primarily 22-25 years old (30%, n=10), Black (61%, n=20), multiparous (55%, n=18), living with the father of the baby (36%, n=12), and gave birth via Cesarean section (70%, n=23). Interview analyses yielded three core constructs: maternal psychosocial experiences, maternal cognitive experiences, and infant health. We hypothesized that these core constructs impact maternal breastmilk provision through the mediating factor of maternal health. The psychosocial construct encompasses relationships, responsibilities, resources, bonding, and control. The construct of cognition was categorized into knowledge level and initial breastfeeding intentions. Individual theme co-occurrence, chronological distribution of thematic influence, and general conclusions are pending, as they will be derived from code co-occurrence findings and a chronological understanding of the themes. Limitations include the use of a single hospital site for data collection and the hospital's high level of support for lactating mothers. Future research should explore prominent themes that emerge from this study and their chronological impact on MOM provision. Nurses should implement evidence-based interventions related to these themes to support breastfeeding mothers of EP VLBW infants.

β-decay intensity function of ^{54,52} Co

Gabriel Balk

Mentor:
Dr. Paul DeYoung,
Physics

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The p process is responsible for the formation of proton rich nuclei in the universe. Because the nuclei are short lived, the specific properties of the reaction and decay paths are difficult to measure. This work deals with the decays of two nuclei, 52,54 Co. 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, I β+ was derived with Total Absorption Spectroscopy. Energy 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 decay. Refined results when compared to theory will provide insight and help to improve the human understanding of the formation of p-process elements.

Analyzing the Role of Stable Eigenmodes in the Plasma Tearing Instability

Julie Timperman
Matthew Dickerson

Mentor:
Dr. Zachary Williams,
Physics

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The sun is composed almost entirely of plasma, a superheated ionized gas. Plasma dynamics have extensive applications to many areas of research. Tearing modes, a specific type of plasma instability, play a significant role in understanding solar flares and plasma confinement. This instability in plasma magnetic field lines can result in field lines of opposing directions interacting and breaking (or "tearing"). This "tear" results in the release of plasma particles once bound by that field with large amounts of thermal and kinetic energy.

Mathematical models that describe tearing modes are nonlinear and thus computationally expensive to analyze. In order to feasibly study the behaviors of tearing modes, the nonlinear model is well-suited to a simplified approach to describe the system. A linearized version of the nonlinear model was analyzed using the Dedalus project, a open-sourced python package designed to solve differential equations. The equations describing the nonlinear system were linearized and solved, producing a set of functions called eigenmodes. Each eigenmode's weight or magnitude was characterized by its overall contribution to the nonlinear solution. An exact solution to the nonlinear system can be made from a linear combination of all the eigenmodes. However, doing so is cumbersome and expensive. Rather, a few of the most significant eigenmodes were chosen based on their corresponding weight. Initial results indicate that keeping a few of the most significant eigenmodes still produced an effective representation of the nonlinear system.

Developing Efficient Algorithms to Compute the Exact Widths of the QED Cyclotron Resonance of Compton Scattering in Strong Magnetic Fields

William Vance

Mentor:
Dr. Peter L. Gonthier,
Physics

Research reported in this publication was supported in part by funding provided by the National Science Foundation under Grant No. 1813610 and the National Aeronautics and Space Administration (NASA), under award number 80NSSC20M0124, Michigan Space Grant Consortium.

We are working on developing correct QED Compton scattering near magnetars, neutron stars with a strong magnetic field for Monte Carlo simulations. Hence efficiency is essential. The scattering of relativistic charged particles can boost photons to higher energies. Largest scattering occurs near resonance requiring the spin-dependent width of the resonance. To calculate the total width, the differential width must be integrated over the scattered photon angle. This integral can be approximated using Simpson's method, a time-consuming method. Our colleagues at Rice University have derived an expression (forthcoming) for this integral involving a series of Legendre polynomials of the second kind. This method was compared to Simpson's and found to be three times faster than Simpson's for the same level of accuracy. The next step is transitioning to multiprocessing computing.

Developing Spin and Polarization Analytical Expressions for Compton Scattering in Strong Magnetic Fields

Kamaron Wilcox
Michael Silvestri

Mentor:
Dr. Peter Gonthier,
Physics

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Compton scattering is the relativistic extension of Thomson scattering. Within the magnetospheres of magnetars, magnetic fields are high enough (10^13 – 10^15 G) that quantum electrodynamics is required. Inverse Compton scattering of relativistic leptons is believed to be the principal mechanism that results in the high-energy tails observed in the X-ray spectra of many magnetars. The Johnson & Lipmann (JL) and the Sokolov & Ternov (ST) wave functions are solutions to the Dirac equation with the JL wave functions being eigenfunctions of the kinetic momentum operator and the ST wave functions being eigenfunctions of the magnetic moment operator. Given that the cross section is developed in the rest frame of the electron, Lorentz boosts are required to go into the Laboratory frame. It has been shown in the study of Baring, Gonthier & Harding (2005) that the JL wave functions mix the spin states under Lorentz boosts while the ST wave functions do not and therefore prove to be the suitable eigensolutions to the Dirac equation since they preserve spin. In the work of Gonthier et al. (2014), the simple, correct analytical expressions were obtained for the special case of ultra-relativistic scattering. We now seek to develop spin and polarization analytical expressions for the general case of an arbitrary angle of incidence of the photon scattering with an electron in the ground state excited to an arbitrary final Landau state. Given that the lifetimes of synchro-cyclotron emission are extremely short, the initial electrons are expected to be in their ground state prior to scattering. We have successfully obtained elegant expressions for the differential cross section and have established the low magnetic field correspondence to the magnetic Thomson form of Herold (1979). We are seeking to establish the connection to the Klein-Nishina form of the cross section.

Frontline Health Heroes? Healthcare Providers' COVID-19 Tweets Suggest Another Story

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While frontline healthcare providers were named "2020 Guardians of the Year" by *Time Magazine* and placed on a variety of society's pedestals, they lived more of a nightmare than a dream. Frontline healthcare providers worked extended shifts with direct exposure to the virus, slept in cars and hotels, and remained distanced from family while listening to misinformation and witnessing its real consequences. They knew the hardest truths of the virus were hidden behind hospital walls—intubated patients in prone position, literally voiceless as they suffered, and families unable to say face-to-face goodbyes. Twitter became an extension of the frontline battle against COVID-19 where healthcare providers could share their stories with the public in hope of saving a few more lives. For this qualitative project, we harvested publicly available Twitter posts written by frontline healthcare providers from March 13, 2020 through March 12, 2021 which is recognized as the first year of the pandemic in the United States. We also interviewed frontline healthcare providers who engaged in social media during the pandemic. Through narrative analysis of tweets and interviews, we identified three prominent themes suggesting that frontliners' lived experiences felt far from heroic. Specifically, they used Twitter to reveal the hardships they endured: sacrificing their well-being, caring without adequate resources or support, and challenging misinformation within contentious social media spaces.

Does Money Buy Neighborliness? The Effect of Household Income on Neighbor Relationships

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Across the United States, neighborhoods may tend toward homogeneity for several reasons—affordability, amenities, historical population patterns—and in several dimensions including income levels, housing values, and other socioeconomic indicators. This research examines the relationship between household income and the extent to which an individual engages with her neighbors. Inspired by Becker's (1973) model of marriage, this research models the choice to be neighborly as the result of a utility maximizing calculation within which a household's income has implications for potential costs and benefits associated with neighborliness. The National Longitudinal Survey of Adolescent to Adult Health (AddHealth) provides information on roughly 20,000 adolescents over five waves and includes detailed data on household income, neighborhood characteristics and neighborly activities (e.g., talking with neighbors, knowing neighbors, and looking out for neighbors). This research complements the literature on neighborhood effects for child wellbeing by examining the underlying mechanisms that produce supportive neighborhoods, namely the neighborly outreach of community members.

Compassion Fatigue: Do Special Education Pre-Service Teachers Display Signs?

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Compassion fatigue is a new area of tension developing in education. Teachers showing compassion fatigue seem to care "too much" for their students. A recent survey through Research and Development and the American Teaching Panel found that three out of four teachers (75%) found their work to be frequently stressful (Steiner and Woo, 2021). When does compassion fatigue start, and can it be avoided for those in the teaching profession? Do individuals who are learning how to become teachers experience compassion fatigue during their university years when they participate in field placements with this hands-on preparation? I was interested in studying if pre-service special education teachers showed compassion fatigue during their third year in the teacher preparation program. For this research, the Professional Quality of Life Scale (ProQOL) was given. The ProQOL is a 30 item self-report questionnaire using a Likert scale ranging from "never," "rarely," "sometimes," "often," or "very often." Fourteen pre-service teachers were asked to answer the ProQOL questions based on the previous 30 days in their field placements and respond to each statement with how frequently they have experienced each statement. Results show that the pre-service teachers' highest satisfaction levels are with their ability to make a change with students in terms of academic or behavioral areas during their field placement work. However, some responses show that these pre-service teachers already feel worn out from their work as helpers and instructors for students with exceptionalities. The results of this current study can help guide future research on pre-service teachers and compassion fatigue and what teacher preparation institutions can do to help prepare future teachers for this challenging field.

Taking an Active Approach to Enhance Authentic Connections and Increase Student Motivation in STEM

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Recently, the demand for students in STEM fields has increased disproportionately to the number of students going into STEM. In an effort to determine if attitudes and motivations toward STEM could be improved, researchers investigated student-driven inquiry (SDI) experiences at three high schools in West Michigan. The SDI experiences involved students working with portable air quality monitors as they created their own research questions and developed individualized experiments to answer those questions. Using a convergent mixed-methods approach and self-determination theory, researchers collected data electronically from students and teachers. Students filled out pre-post attitudes surveys that were analyzed using a Wilcoxon signed-rank test. Students also completed a post-only motivation survey that was analyzed using a Spearman's rank test. The same students provided qualitative responses about the positive and negative aspects of the project. Responses were coded thematically using grounded theory methodology. Teachers answered Likert-based questions related to the effectiveness of the SDI experience on the implementation of their instructional goals. These responses were compared descriptively. Findings showed that students' perceived value of the SDI experience was significantly correlated with their interest, competence, and effort. However, the SDI experience did not significantly change students' attitudes, which is likely due to the short length of the intervention. Rather, students' demonstrated interest, competence, and effort were presumably due to the novelty of the experience and possibly the authentic connections the SDI projects had to their own lives. The projects seemed to meet the needs of teachers, as their main goal was to provide opportunities for students to plan and carry out investigations. Although statistical analysis did not reveal significant changes in student attitudes, trends in the data along with past literature suggest that a longer intervention and a greater number of participants in the SDI experiences could produce more positive outcomes.

The Examination of the Physical and Psychological Impact of Wearable Fitness Trackers on Running Performance in College Athletes

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

As technology continues to advance and become more prominent in daily life, the fitness industry has seen a noticeable shift in individuals' use of wearable fitness trackers (WFT) to measure and track fitness and exercise behavior. Previous research has shown a positive association between WFT use and increased satisfaction and motivational capacity during individuals' workouts. In the sports realm, WFTs are used to track athletes' objective measurements of fitness and guide training, however to date, little has been shown regarding how WFTs impact athletes' exercise experience or satisfaction. Therefore, the purpose of this study was to examine how the presence and absence of WFTs affects collegiate runners' performance and experience with exercise. For this study, 30 Division III track and field athletes took part in two running trials. In the first trial, participants ran a timed mile at a pace set 60 seconds slower than their self-reported personal record (PR) mile time while utilizing their WFT to accurately pace themselves. One week later, they repeated this trial without the use of their personal WFT, relying only on their personal physiological perceptions to self-pace. Blinded heart rate monitors were used to track physiological changes over time during both trials, while periodic ratings of perceived exertion, mile time, and pace were recorded at every quarter-mile interval. Following each trial, participants indicated their exercise satisfaction using an online survey platform and were asked to explain their experience via a single open-ended question. It is hypothesized that participants' psychological satisfaction, perceived exertion, and running performance will decrease with the absence of a WFT. Significant results would indicate the dependency on recent technological advancements within athletics for training and feelings of satisfaction among athletes. The study is ongoing, and results will be available during the poster celebration.

Peer Relationships, Social Media Use, and Sport Commitment

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This work supported by the Julia Van Raalte Reimold Faculty Study Award at Hope College.

Extant work suggests peers play a vital role in shaping athletes' positive and negative sporting experiences. Recent descriptive work has explored the importance of peers in sport by examining friendship quality and relevant motivation constructs (Weiss & Smith, 2002). Although evidence suggests quality sport friendship can foster sport participation, limited work has examined social interactions through social media. The primary purpose of this study was to provide a descriptive account of social media use and satisfaction among youth sport athletes. A secondary purpose was to examine social media use and satisfaction as predictors of sport friendship quality dimensions (positive friendship quality and friendship conflict). Youth athletes (N = 163; Mage = 15.51 years; 73.6% male) provided demographic information, completed an established measure of friendship quality, and reported on frequency and satisfaction of social media use. Descriptive data suggest Texting, Instagram, and Snapchat were the top used mediums for communication. Positive friendship quality shared a positive association with Texting and Snapchat use. Friendship conflict shared a positive relationship with Instagram and Snapchat use. No social media medium shared a significant relationship with social media satisfaction. Multivariate multiple regression analysis showed greater use and satisfaction of Texting, Instagram and Snapchat to predict stronger friendship quality dimensions. This study helps add to the existing literature base by showing how social interactions that take place outside of the typical sport setting may play a role in shaping athletes sporting experiences.

COVID-19 and Sport: Examining the Role of Leadership on Sport Commitment and Psychological Well-Being

Ryan Flynn

Mentor:
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Previous research has shown that coach leadership plays both technical (training athletes and developing game strategy) and interpersonal roles (supporting and motivating athletes) in maximizing athletic performance of athletes (Fletcher & Roberts, 2013). In a similar vein, extant literature suggests that coaches heavily influence athletes sporting experiences (Horn, 2008). Interestingly however, no study to date has examined leadership dimensions with the updated sport commitment model, which conceives commitment to exist in enthusiastic ('want to') and constrained ('have to') forms (Scanlan et al., 2016). The primary purpose of this study was to examine coach leadership dimensions as predictors of enthusiastic and constrained commitment. A secondary purpose was to explore the role of the COVID-19 pandemic on psychological well-being (stress and well-being). University athletes (N = 195; Mage = 19.56 years; 62.1% male) provided demographic information and completed established assessments of coach leadership quality, sport commitment, stress, and well-being. Participants also responded to questions related to the COVID-19 pandemic. Multivariate multiple regression analyses showed greater reported training and instruction, democratic behavior, positive feedback, and social support from coaches was associated with higher enthusiastic commitment and lower constrained commitment. Lower reported autocratic behavior was associated with higher enthusiastic commitment and lower constrained commitment. In regards to our secondary purpose, we found that athletes reported lower stress levels and higher reported levels of well-being (lower scores represent better well-being) relative to the response set options available on the survey. Our findings suggest that positive coach leadership dimensions predict stronger enthusiastic commitment. In addition, athletes appeared to utilize their involvement in sport to deal with the uncertainty and complexity of the COVID-19 pandemic, as they reported lower stress and healthy well-being scores. Our work helps advance knowledge on the importance of effective leadership and the benefits of being involved in organized sport.

The Comparison of Physiological Demands in Experienced Climbers When Climbing Top Rope Versus Lead Rope

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This study was supported by the Department of Kinesiology.

Rock climbing is an up and coming sport that was recently added to the Summer Olympics. There are different variations of rock climbing and this study focused on the comparison between lead rope and top rope. Previous research has compared the physiological demands while climbing routes at different inclines. Additionally, many studies have observed changes in heart rate while climbing, but few have studied breathing rate and caloric expenditure. Therefore, the purpose of this study was to compare the physiological responses (heart rate, respiratory rate and caloric expenditure) and rate of perceived exertion of experienced rock climbers when climbing top rope vs. lead rope. Ten experienced climbers were recruited from Scrapyard Climbing Collective LLC. A preliminary testing session was held at DeVos Fieldhouse where the participants were fitted for a Hexoskin smart shirt and had bodily measurements taken. The Hexoskin Smart Shirt has been validated to measure physiological changes during exercise. Participants then met at the Scrapyard Climbing Collective LLC and completed a climbing sequence using two different routes while wearing the Hexoskin shirt. The order of climbing was as follows: Route 1: top rope, lead rope, Route 2: top rope, lead rope. Participants rested for eight minutes between each climb. It was hypothesized that the lead rope courses would elicit a higher heart rate, breathing rate, caloric expenditure, and rate of perceived exertion than the top rope climbs. Results will allow experienced climbers to have a better understanding of the demands that are required with lead rope and top rope climbs which can benefit their training and climbing technique. The study is ongoing, and the results will be available during the college-wide research celebration.

Examining the Relationship Between Heart Rate and Perceived Exertion during a Division III Women's Basketball Season

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BACKGROUND: "Internal load" represents the physiological and psychological stress experienced by athletes during training and competition. The ability to accurately monitor and assess an athlete's internal load can be valuable for both training purposes and injury prevention. Advances in wearable technology provide the ability to objectively quantify an athlete's internal load via the continuous measurement of heart rate (HR). This HR data can be used to determine an athlete's training impulse (TRIMP) which is a validated measure of internal load. An athlete's ability to self-monitor their perceived exertion during practice (sRPE) might also prove helpful in assessing internal load. However, despite the technological advances and widespread use of wearable devices to monitor physiological responses to exercise, there is a lack of research examining the internal load female athletes experience over the course of a collegiate season. Additionally, it is important to understand how an athlete's sRPE correlates to their TRIMP scores. Such information may inform aspects of training to improve performance and avoid injury or burnout.

METHODS: Members of the Hope Women's Basketball team wore HR monitors during practice. HR data was collected continuously throughout each practice. At the end of each practice players rated their level of exertion (sRPE). RESULTS: Using this data we aimed to examine the changes in TRIMP and sRPE scores over the duration of the 2021-2022 season. Additionally, we examined these two measurements to see how the athletes' subjective experience (sRPE) would correlate to the objective assessment (TRIMP) of their internal load. Final data will not be available until after the women's season. Results will be presented at the Celebration for Undergraduate Research.

Effects of a Four-Week Stretching Program on Shoulder Range of Motion and Throwing Velocity among Collegiate Baseball Players

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

Chronic static stretching programs have been reported to increase shoulder range of motion (ROM), but no study has examined how this increase may affect throwing velocity in overhead athletes. It was hypothesized that a 4-week stretching program would increase the ROM of the glenohumeral joint and also increase throwing velocity among collegiate baseball players. Baseline shoulder ROM and overhand throwing velocity were assessed before participants were matched into either a control group (CON, n=7) or an experimental group (STRETCH, n=8). The STRETCH group then performed two sets of two stretches (the cross-body stretch and the sleeper stretch), 30 seconds each, four times per week for a duration of four weeks. Results revealed that horizontal adduction ROM for both active (A) and passive (P) measures increased significantly in STRETCH compared to CON over time (STRETCH: Pretest: A=39.8 ± 8.8°, P= 42.5 ± 5.2°; Posttest: A= 43.3 ± 3.5°, P= 45.4 ± 3.1°; CON: Pretest: A= 41.6 ± 10.6°, P= 45.3 ± 11.2°; Posttest: A= 36.3 ± 5.7°, p=0.018, P= 40.0 ± 6.1°, p=0.020). Passive extension ROM also had a significant interaction (p =0.023), while external rotation increased more in STRETCH than in CON, but this interaction failed to reach significance (p=0.054). There were no significant differences between internal rotation, flexion or throwing velocity over time or between treatment groups. Despite the lack of change in throwing velocity with the stretching program, the correlation between the change in horizontal adduction and the change in velocity showed a significant positive relationship (R^2= 0.518 , p=0.005). More research is needed to solidify the possible relationship between range of motion and throwing velocity in collegiate baseball players.

The Psychological and Physical Effects of Power Posing on Running Performance

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Extant literature suggests that body positioning prior to a high stakes event can influence performance (Cuddy et. al, 2012). Participants who performed a high-power pose (an open and expansive position of dominance) before a mock job interview were rated significantly higher on perceived confidence by the interviewer when compared to the participants performing a low power pose (a closed and constricted body position). Participants who engaged in the higher power pose reported higher feelings of preparedness and self-confidence. As a result, these individuals tended to have stronger presentation and speech quality. High power posing has also been found to decrease state anxiety through a decrease in cortisol (stress hormone, Carney et. al, 2010). While high power poses have been suggested to increase self-confidence and decrease state anxiety during a high-stakes event, they have not yet been studied in relation to sport performance. The purpose of our study was two-fold: 1) to examine how different body poses (high, low, neutral) will affect self-reported levels of confidence and anxiety, and 2) to assess the relationship between the psychological variables (confidence and anxiety) to sport performance measured through a 400-meter time trial. Male and female collegiate soccer players each completed three 400-meter time trials following a power pose regimen of either high, low, or no power posing. Participants were then asked to complete an established questionnaire in the Competitive State Anxiety Inventory which measures self-confidence and state anxiety. Directly after completing the questionnaire, participants were asked to complete a 400-meter time trial from a standing start. We hypothesized that participants who engaged in high power pose positions prior to the time trial would run faster 400-meter time trials compared to low and no power posing conditions. In addition, we hypothesized that higher reported scores of confidence and lower reported scores of anxiety would be associated with faster 400 meter times. Our work is important as it may provide a strong evidence for potential benefits of the mind-body connection specific to sport. This study is ongoing and results are pending.

Effect of Caffeine Supplementation on Tennis Serve Velocity and Accuracy during Simulated Match Play

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Funding provided by the Department of Kinesiology at Hope College.

The purpose of this study is to determine the acute effects of caffeine ingestion on serve velocity and accuracy in collegiate tennis players during simulated match play. Previous research has shown some effect of caffeine on serve performance in later stages of a simulated match, but little research has been completed on the acute effects of caffeine in a shorter match. Further, there is limited research on realistic tennis play involving serves interspersed with rallies. Participants will include 8 male and female tennis players from the Hope College tennis team. The study will incorporate a double-blind design. Each participant will have weight and blood pressure measurements taken and will be familiarized with the protocol on the first visit of three. On the second and third visits, participants will consume either a caffeine or placebo capsule 1 hour prior to the start of the protocol, and the order of capsules will be randomized for each participant. Caffeine capsules will contain 3 mg per kg of body weight and placebo capsules will contain unflavored gelatin. All participants will perform a standardized warm-up before starting the protocol. The protocol will be composed of seven games, alternating between a serving and returning game. Each serving game will have six points, and each point will consist of a first serve, a second serve, and between 4-8 feeds from the ball machine. Each returning game will have 4 points, and each point will consist of between 5-7 feeds from the ball machine. It is hypothesized that accuracy and velocity will be greater in the caffeine trials compared to the placebo trials. Significant results would allow caffeine to be suggested as a way of improving serve performance in Division III tennis athletes. This study is ongoing and results will be revealed during the research celebration in April.

The Relationship between Anthropometry, Upper Body Muscular Strength, and Flexibility with Indoor Bouldering Performance in Novice Climbers

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Bouldering is a type of rock climbing that utilizes lower and shorter climbing walls compared to top rope climbing, which uses a rope and harness and often utilizes different physiological requirements for success. Current research on rock climbing and bouldering mainly focuses on advanced and elite climbers. Our study contributes to the existing knowledge gap on novice climbers as few studies examine novice level climbers and their physiological traits during bouldering. Therefore, the purpose of this experiment was to examine the correlations between anthropometric, upper body muscular fitness, and flexibility measures on perceived difficulty of bouldering and bouldering performance in novice climbers. Finding strong correlations between any of these factors and bouldering performance may help provide physiological rationale for training programs designed for novice climbers. 25 student volunteers with little to no experience climbing were recruited and assessed for health concerns for exercise. Participants' demographic information, anthropometric data (i.e., height, weight, wingspan), and body composition were collected at a baseline measurement session. Measurements of their upper body strength and endurance (i.e., lateral pull down, handgrip strength, partial curl up, straight arm dead hang test), as well as shoulder flexibility (Apley scratch test) were also conducted. At least 72 hours after the completion of these tests, participants were familiarized with climbing and safety at a local off-campus climbing establishment. They then completed three different bouldering routes at three varying difficulties (VB, V0, V1) and were assessed during these routes for perceived ease of the route, speed of completion, halfway zone reached, and completion of the route. This study is ongoing, and results will be available during the final poster celebration.

Kohler Effect: 200-Meter Freestyle Performance in Collegiate Swimmers

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Previous research on the Kohler Effect has shown that a less-capable member of a group tends to perform better when performing a task with others, as opposed to individually (Baron & Kerr, 2003). Despite this evidence, no study to date has examined the phenomenon of the Kohler Effect utilizing a sport-specific context. The primary purpose of this study was to examine whether collegiate swimmers are faster in a relay (group) versus individual setting. A secondary purpose was to explore whether the slowest swimmers would show the greatest change in time compared to the fastest swimmers, from individual to relay performance. Lastly, we examined whether swim self-efficacy and competitiveness would predict swim time. Collegiate swimmers (N = 20; Mage = 20 years; 60% male) completed a total of three 200-meter freestyle swims. Session 1 was completed individually and the latter two sessions were completed in randomly assigned relay groups of four. Sessions were set up to mimic a typical collegiate level post-season swim meet. T-tests were run to address the primary and secondary purposes showing: 1) no significant differences between an individual swim and relay swim, and 2) slower swimmers (in a relay group) did not show a significant change in time from individual to final relay swim compared to the fastest swimmer in a relay group. Hierarchical regression analysis addressed the third purpose and showed that self-reported self-efficacy and competitiveness predicted swim time. The current study helped address how the Kohler phenomenon functions in a real sport-specific context. Findings suggest that an athlete's task- specific confidence (freestyle swim) and competitiveness play a role in predicting swim performance. These findings will help advance knowledge on how psychological constructs relate to objective performance in sport.

Effects of Mobo Board and Rocker Board Training on the Dynamic Balance of Recreational Runners

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Dynamic balance is important for preventing injuries and potentially improving running performance. A new balance board called the Mobo Board includes a unique cut-out for the smaller four toes in order to specifically target and strengthen the muscles of the hallux. The aim of the study was to examine dynamic balance among recreational college runners who completed a balance training program split into three groups: 1) Mobo Board group, 2) standard rocker board group, and 3) control group (no equipment). Our primary hypothesis was that participants in the Mobo Board group would show the greatest improvement in dynamic balance compared to the standard rocker board and control groups. A secondary hypothesis was that the progressive balance training protocol would improve dynamic balance of all participants. College-aged recreational runners were recruited (n=12) to participate in a four-week, progressive, single-leg balance program in which they completed three 10-minute sessions per week, as well as dynamic balance pre- and post-tests. These participants were matched using their pre-test scores and randomly assigned into one of the three experimental groups. The pre-test Y-balance scores were 89.61 ± 13.21 for the Mobo group, 85.60 ± 10.08 for the standard rocker board group, and 86.18 ± 4.66 for the control group. The post-test Y-balance scores were 94.49 ± 10.55 for the Mobo group, 91.04 ± 11.90 for standard rocker board group, and 90.73 ± 6.73 for the control group. Following training, improvements were seen in all three groups over time ($F(1, 9) = 23.351$, $p < 0.001$). In addition, there were no significant differences in Y-balance scores between board types ($F(2, 9) = 0.064$, $p > 0.05$). Our work suggests a progressive 4-week balance training protocol was effective in improving dynamic balance regardless of condition. There exists strong evidence that balance training helps improve balance. Therefore, a potentially fruitful line of research would be to explore unique and immersive training programs that ensure long term adherence (e.g., balance training through exergames).

Effects of Yoga-Based Training on Balance in College-Age Students

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Ryan Baek
Jordan Reasoner
Ryan Young

Mentor:
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Balance training has been found to reduce fall risk. Benefits from yoga include decreased blood pressure, muscle tone, flexibility, postural support, and balance. Strength training can increase balance and flexibility. Different types of exercise can improve muscular strength and endurance to improve balance. However, there is limited literature surrounding the effects of weight-based balance programs on balance. Yoga, specifically, has been found to have substantial positive effects on balance. To bridge the gap between yoga balance training and weight training, the purpose of our study specifically examines the effects of a weight-based yoga program, as well as a non-weighted yoga balance program, on college-age students. Participants were recruited from a college yoga club. After completing the Y-balance pre-test (which consists of an anterior right/left leg push, posterior lateral right/left leg push, and posterior medial right/left leg push 3 times), participants were matched based on performance and assigned to either the weighted or non-weighted group. The weighted (outfitted with a 10 pound backpack) and non-weighted groups participated in yoga sessions 3 times per week for 4 weeks with each session lasting approximately 30 minutes. After completing training, participants completed the Y-balance post-test which was an identical procedure to the pre-test. We hypothesized that participants in the weight-based group would significantly improve their balance compared to the non-weight based group. Evidence for benefits of weighted balance may be useful information in light of elderly populations and potential physical therapy programs (reducing fall risk). The research is ongoing, and results will be available during the research poster celebration.

Validation of the COROS VERTIX Adventure GPS Watch during Exercise in Collegiate Female Soccer Players

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Support in part by the Department of Kinesiology at Hope College.

Many athletes use tracking devices to assess and improve training. One tracking device is the COROS Vertix GPS Adventure Watch (CV), a new watch utilizing five satellite systems to measure distance. This study was designed to validate the CV by assessing its accuracy in tracking distance during exercise in athletes in stop-and-go sports, compared to two other previously validated devices, the Omron HJ-720 pedometer and Polar V800 GPS. Seventeen female collegiate soccer players ran two 800-meter (0.497-mile) tests while wearing all three devices. One test was performed on a standard 400m track, while the other was a stop-and-go test on a standard-sized soccer field with multiple direction changes. The results showed the Omron tracked distance poorly (0.250±0.009 miles), causing the data to be skewed. Therefore, the Omron data was removed to properly assess the CV and the Polar. The Polar recorded 0.512±0.011 miles at the track and 0.483±0.008 miles on the soccer field, while the CV recorded 0.503±0.01 miles at the track and 0.485±0.012 miles on the soccer field.There was a significant difference in the distance measured on the track compared to the soccer field when comparing the two devices to each other ($p = 0.000$). Given that both tests covered the same distance, the nature of each test caused the devices to track distance differently ($p = 0.000$). When looking at the mean distance measured at both locations, the CV was more accurate at tracking 800m than the Polar ($p = 0.006$). Overall, the CV was found to be more accurate in tracking distance covered in various styles of running than the previously validated Polar device. The CV is recommended to athletes of any sport in order to better track distance covered during exercise.

A Biomechanical and Physiological Comparison of the Nike Vaporfly and Nike Zoom Rival D10 Spikes

Anastasia Tucker

Mentor:
Dr. Mark E. Northuis, Kinesiology

This research was supported by the Coach Mark Northuis Kinesiology Summer Research Fund and the Constantin Kinesiology Student Research Fund.

PURPOSE: To compare the biomechanical and physiological response of highly trained collegiate distance runners wearing the Nike VF and Nike Zoom Rival D 10 (RD) spikes during a 1500m time trial (TT).

METHODS: Sixteen (9F, 7M) highly trained collegiate distance runners (20±2 yrs) completed a randomized crossover testing protocol utilized during three laboratory sessions. Session one included collection of baseline metabolic measures and establishing VO2peak. The second and third sessions assessed the participants' biomechanical and physiological responses at 14 and 16 kph and 1500m-time trial performance in each footwear in a randomized counterbalanced manner. Seven days separated each of the three testing sessions. For baseline measures, participants completed a continuous treadmill test consisting of 3-min stages beginning at 11 kph for females and 12 kph for males set at a 1.0% gradient and increasing at 1 kph increments until volitional exhaustion. Running economy (RE) at 14 and 16 kph and 1500m-TT performance in VF and RD were assessed on the second and third visits following a force plate assessment. Footwear comparisons were made via paired T-Tests utilizing both effect size and p values.

RESULTS: RE (VO2 for 1km in ml*min-1) at 14 and 16 kph were less in the VF than RD (189±9 vs 195±8 ml*min-1 (ES .778) and 190±10 vs 195±11 ml*min-1 (ES .501), respectively, $p<0.05$). Stride length during the TT was greater in the VF than RD by 12 cm (3.19±0.36 vs 3.07±.37, ES .930, $p<.05$). 1500m TT was faster with VF than RD (299.2±42.4 vs 305.2±41.0 s, ES .530, $p<0.05$). CONCLUSION: The use of the VF resulted in improved (2%) 1500m TT performance compared to RD primarily due to improved RE values and longer stride length for VF trials.

Hope4Athletes: Examining Sport Commitment, Motivation and Neuroticism in Collegiate Soccer Players

Meriya Zalma

Mentor:
Dr. Olufemi A. Oluyedun, Kinesiology

Sport can provide athletes with opportunities for development across a range of achievement domains (physical, cognitive, social, and moral; Ewing & Seefeltd, 1996). The present study aimed to explore the role of sport motivation dimensions on psychological commitment (enthusiastic and constrained forms of sport commitment). A secondary aim was to examine whether athletes who play less (e.g., benchwarmers) differ significantly from starters in sport motivation and neuroticism. University soccer players (N = 104; Mage = 19.32 years; 54.8% female) provided demographic information and completed established measures of sport commitment, sport motivation, and neuroticism. Multivariate multiple regression analysis showed greater intrinsic, integrated, and identified motivation to predict greater enthusiastic commitment. Less reported extrinsic motivation and amotivation predicted greater enthusiastic commitment. A second root was also significant showing greater integrated, identified, and introjected motivation to predict greater constrained commitment. These findings are in line with extant literature on sport motivation and sport commitment. Findings related to our secondary aim suggest benchwarmers report significantly higher amotivation scores compared to starters. No significant differences were evident between benchwarmers and starters in neuroticism scores. Overall, this study provided evidence that 1) athletes sport commitment is a function of sport motivation, and 2) benchwarmers and starters report relatively similar levels of sport motivation and neuroticism, except for amotivation. These data highlight the importance of sport motivation to sport commitment and address the role of playing time on athlete motivation.

States Rights vs. Federal Rights

Jonah Badanes-Katzman

Mentor:
Dr. Virginia Beard,
Political Science

Federal incentivization can impact the policy and program outcomes at the state level. When the federal government uses stronger incentives, there is often resistance from state governments. Research indicates that there are many examples of the federal government using its power to influence the states' policies, such as withholding funds until a state cooperates with certain federal goals or policies. Any revealed trend of federal government power increases may indicate that the states are losing their rights to govern. As the federal government strives to standardize state actions on certain issues, it potentially creates chaos, conflict and an accountability gap. This research explores the federal government's use of its power over states, asking whether or not such use of power reflects the federal government's *manipulation* of the states. I will use a series of state-federal policy interaction case studies. Factors influencing how states respond to federal power include variation in state geography, real estate, cost of living, demographics, populations, poverty, and education. I hypothesize that my findings will show an increasing trend of the federal government overpowering states, leading to a long-term increase in state reliance on federal government funding for certain programs.

Unemployment Causes Crime

Reid Budd

Mentor:
Dr. Virginia Beard,
Political Science

The presence of crime in communities undermines the ability of citizens to live full lives. While official crime statistics from many countries show that unemployed people have high crime rates and that communities with high levels of unemployment experience significant rates of crime, this cross-sectional relationship is very often not found in time-series studies of unemployment and crime. I will examine this possible correlation between crime rates and unemployment at a micro-level within the United States. I will consider types of crime, motivations for crime, economic issues, as well as the role of such global health crises as the ongoing COVID-19 pandemic. I will highlight a number of local case studies as well as the context of the experience of unemployment and crime rates across the country.

Effects of Gun-Control and Gun-Free Zones on the Safety of American Communities

Owen Claar

Mentor:
Dr. Virginia Beard,
Political Science

Gun control regulations have long been an issue of hot debate across the U.S. Many believe we should adopt extremely strict gun regulations in order to mitigate the effects of gun violence. Those with such beliefs claim that countries like Japan- who experience very low levels of gun violence- should be the desired model for America. Others claim the right to bear arms is absolutely necessary to protect ourselves from criminals and from a potential tyrannical government. They believe second amendment rights to be at the core of American principles, and to hinder those rights is to be un-american. This project investigates large cities, school zones, specific gun free zones, and other portions of the U.S with different gun control policies to see the effects they have on the safety of their respective communities. Is a mass shooter less likely to open fire with an armed security guard present? Do counties with higher proportions of conceal carry license owners see decreased crime rates? Are gun free zones more or less dangerous to live in? This project will attempt to provide some practical solutions to rampant gun violence in the U.S, and how we can advise our legislators to all be more well protected.

The Social Context of Populism

Katelyn DeReus

Mentor:
Dr. Jeffery Polet,
Political Science

Prior research has focused heavily on the political and economic contexts preceding populist movements, excluding the social contexts that may also have contributed to the development of populism. Multiple populist movements of recent years will be examined to determine whether or not there are certain social common factors that indicate a shift towards populism, paying special attention to social media as an indicator. The social context of populism is of particular interest because, unlike political and economic climates, the nature of human interaction is visibly accessible and identifiable by everyone. The dangers and pitfalls of populism will also be discussed, showing the importance of being able to identify conditions that are ripe for the creation of populist movements.

Prison Overcrowding in the U.S.: An Analysis of the Most Incarcerated Nation in the World

Cassidy Folkert

Mentor:
Dr. Virginia Beard,
Political Science

Currently, the United States is the nation with the highest number of incarcerated individuals, as well as the highest incarceration rate, in the world. Between the years of 1977 and 2000, every state's incarceration rate more than doubled. Now, in almost every state, the prison population exceeds the capacity for which the prison system was designed. Due to this capacity issue, the United States penal system receives a large amount of scrutiny regarding its practices and much of the American public believes that this system needs reform. Prison overcrowding has caused major concerns regarding the design of the U.S. penal system to arise, such as questions regarding sentencing guidelines, the cost to taxpayers, the impact on the goal of security in society, and the effects on people and their humanity experiencing the prison system. Due to these and other concerns that I will explore, the issue of prison overcrowding has garnered more public attention in recent decades, as prisons continue to exceed capacity. Prison overcrowding can be linked to several key factors, which will be discussed in this research. Additionally, this research will analyze policy initiatives regarding the issue of prison overcrowding and propose a few viable options for how to manage the issue.

The Electoral College in the Twenty-First Century

Andrew Gibson

Mentor:
Dr. Jeffery Polet,
Political Science

The purpose of this paper is to evaluate the Electoral College and the role that it plays in United States presidential elections. In order to evaluate the system, the history of the Electoral College was examined as well as the conditions that led to its creation. Additionally the changes made to the system since its creation were examined. With the history of the system established, the function of the Electoral College was examined and the role it played in past elections was looked at. Comparisons between the Electoral College's previous role prior to the Twelfth Amendment and its role after the passing of the amendment were made in an attempt to see how the role of the Electoral College has or has not changed since its creation. Finally, all of the previous work detailed here was then viewed in its relation to American democracy in order to try and determine if the Electoral College as an institution in its current form is democratic and if so, how democratic it is.

Global Water Act

Noah Hedrick

Mentor:
Dr. Virginia Beard,
Political Science

The United Nations must step up to the faucet if they would like to prevent World War III. The global water crisis is only rising by the day and more and more individuals are getting sucked into "water-stressed" areas. To be specific, "roughly 780 million people around the world lack access to clean drinking water, and an estimated 2.5 billion people (roughly 40% of the world's population) are without access to safe sanitation facilities." Many NGOs, IGO's, and nonprofits are doing their best to combat this crisis and prevent conflict. The United Nations (UN) is one of these organizations. The UN, started as an international organization in 1945 after the Second World War by 51 countries, is committed to "maintaining international peace and security, developing friendly relations among nations and promoting social progress, better living standards and human rights." Social progress and better living standards require clean drinking water. However, few scholars have explored the possibility of the General Assembly and the Security Council creating a Global Safe Drinking Water Act. A seemingly related accord, the Paris Climate Agreement, was signed in 2016 by 175 countries. Given the primacy of the water crisis within climate concerns, why has there not been a Global Safe Drinking Water Act signed? This research examines why the United Nations is the ultimate actor and what a Global Safe Drinking Water Act would look like and why it is necessary.

The Dragon and the Condor: Chinese Influence in Chile

Valeria Lee

Mentor:
Dr. Annie Dandavati,
Political Science

This research was funded by the Department of Political Science at Hope College.

There have been repetitive studies on the impact of the Chinese influence in the African continent, but the examination of the influence of China in Latin America remains seldom. We wish to examine the PRC's relations with Chile under Salvador Allende's power between 1970 to 1973, then under Agusto Pinochet's rule between 1974 to 1990. We will further investigate how the two nation's relationship developed in the 21st century. In 1963, Allende became a sponsor of the 1964 celebration of China's National Day celebrating the founding of the People's Republic of China proclaimed by the chairman of the Chinese Communist Party, Mao Zedong. In 1970, the inauguration of president Allende lead to Chile's recognition of the PRC. Chile became the first South American country to recognize the PRC formed in 1949. In 1973, Agusto Pinochet led a coup overthrowing Allende's democratic government. The PRC showed its support of the anti-soviet junta by refusing to give asylum to Chilean refugees. In 1975, trade yield between China and Chile dropped from $111.1 million in 1974 to $32.9 million the following year attributed to the domestic political conflict in China. After Mao's death, Deng Xiaoping became the paramount leader of the PRC who supported the relationship with anti-Soviet Chile despite Pinochet's regime. In 1978, copper trade resumed under Deng's authority which led to the increase of trade between the two nations reaching levels above those during Allende's rule. Other leaders including Jiang Zemin and Xi Jinping have sought to increase the bilateral exchange between the two nations. Xi introduced the Belt and Road Initiative which Chile joined in late 2018. I will make educated predictions on how the PRC will react to Gabriel Boric as the new leftist president of Chile.

Geography and Democracy

Shane Mast

Mentor:
Dr. Virginia Beard,
Political Science

The health of democracy globally is currently in question. This study will speak to various factors that influence democratic growth and stability. What characteristics increase the likelihood of a country becoming a democracy? This question has been important since the end of World War II, growing in its focus during the Cold War. Research shows that economic, social, and institutional factors influence democratic outcomes. One under-studied factor in the role that geographical features that make up a country play in influencing its governance as a democracy or not. This project proposes to investigate the gap in democracy research regarding geography. Preliminary research suggests that landforms, natural resources, and agriculture production are a couple of the factors that could predict which form of government rules a nation.

Analysis of United States National Security Policy on Cyberterrorism from China

Megan Mead

Mentor:
Dr. Virginia Beard,
Political Science

to the development of more sophisticated and advanced computer-based technology. Many people question the existence of a substantial threat from the Chinese government in terms of their use of cyber technology on the United States. Intelligence shows China has continuously used their cyber technology capabilities as a way to exploit other countries, businesses, and local populations. Scholarly research, news outlets, and official government documents all conclude that Chinese cyberterrorism is a large security threat to the United States. China has used their technology to infiltrate U.S. networks and infrastructure in the past. They are a continued threat, with government agencies constantly watching and assessing threat levels of Chinese technology along with the political and economic atmospheres. This research examines the implications of how increased cyber attacks from China could be catastrophic to U.S. infrastructure, economy, and intelligence. Along with how the United States has combated previous attacks, developed new technology and implemented regulatory policy to protect infrastructure.

Civil Rights and Civil Liberties: Analyzing the Constitutionality of COVID-19 Public Health Mandates

Allison Mitchell

Mentor:
Dr. Jeffrey Polet,
Political Science

The COVID-19 pandemic has established an imensive platform for heightened political discourse within the United States where divisions have already been growing amongst political parties. The pandemic has created unprecedented amounts of social and cultural elements related to discussions of the pandemic regarding technology, social welfare, and partisan language surrounding public health protocols and mandates. It can be assumed based on the current political climate within the United States that the associated partisan division has turned a public health issue into a political talking point. However, this brings into question the legitimacy of arguments being made regarding the Constitutionality of related public health mandates. This research will examine specific Constitutional language regarding civil rights and civil liberties within the age of a global pandemic to determine where the boundary lies between protection of individual autonomy versus establishing a greater public health collective. A historical analysis of previous pandemics and epidemics will be evaluated to determine how these issues were addressed at the time, in addition to presenting the arguments established within a variety of law journals, legal proceedings, and court cases presently occurring within the state and federal courts.

Does the Type of Electoral System Influence Representation?

Nathan Penoyar

Mentor:
Dr. Virginia Beard,
Political Science

The strength of democracy is founded in its representation of citizens in a democratic state. Evidence exists that suggests that majoritarian, plurality electoral systems, such as the one used in the United States, inhibits the representation of minority factions and marginalized voices. Representation is a key aspect of democracy. Lack of access, voice and participation by significant sectors of society hurts democracy. This paper seeks to examine how institutions, the various electoral systems utilized around the world in particular, impact representation. This paper specifically will examine how a country's electoral system–majoritarian versus proportional representation–along with the way a state uses that electoral system–such as including representation thresholds in proportional representation systems, impact representation.

Analysis of Disability Rights Policy in American Charter Schools

Lily-Kate Pritchard

Mentor:
Dr. Virginia Beard,
Political Science

The Americans with Disabilities Act of 1990 explicitly states that any individual with a disability–physical, emotional, cognitive, or otherwise–is to be protected from discrimination regarding public services, including education. This paper will examine how American charter schools often do not provide such inclusive education. Data indicate that charter schools frequently manipulate requirements in order to avoid serving students with special needs. This paper will look at the problems that exist within charter schools–notably in the Midwest–and explore potential policy solutions to address the discrimination against students meant to be served by special education programs. Many of these schools work around the requirements of the Americans with Disabilities Act (ADA) and the Individuals with Disabilities Education Act (IDEA). For example, preliminary research suggests that charter schools in the state of Wisconsin do not staff properly qualified educators despite having students with various different abilities–cognitively, emotionally and physically, enrolled in their schools. Policies that provide better oversight in staffing could help ensure such failure of service does not occur. This paper will consider this and other gaps in service provision and potential policy solutions.

The Stability of Afghanistan

Jacob Roman

Mentor:
Dr. Virginia Beard,
Political Science

Afghanistan has been invaded time and time again. There has never been a time in the country's history when Afghanistan has been considered stable. Afghani leaders overall have been suspicious of their own people which has made it very difficult to reform and rebuild the country. The leaders of Afghanistan have been more concerned with maintaining their position of power instead of helping the country develop. The United States intervention in Afghanistan, removing the fragile leadership core, created a power vacuum which resulted in a weak and failed state. The Taliban emerged from the environment that the United States created in the country. This outcome resulted in Afghanistan becoming known as a "renter state" because of the shifting of power between the Taliban and radical Islamisc jihadists. This constant shift of power has left the country in shambles. The little to no governmental structure and the poor constitution have only added hurt to the wound. There have been many things that have lead to the instability in Afghanistan but corruption, the suppression of democracy, the rule of law, and terrorist networks have been the most impactful factors.

The Impact of Educational Attainment on Political Ideology

Luke Rufenacht

Mentor:
Dr. Jeffery Polet,
Political Science

Colleges around the country are being tagged as institutions that alter the political thoughts and feelings of the students that choose to attend higher education. Post-secondary education has been labeled as four years of politically polarizing propaganda, from professors, staff, and the college itself. Most colleges are known for being bastions of liberal thought, others like Hillsdale College, Liberty University, etc., are known as staunchly conservative. In a world where cooperation and support are needed from both sides, the idea of institutional polarization can be frightening to many. These institutions also require funding from donors, who will often shy away from giving their money to an institution perceived as opposing their ideological stance, or fund one that upholds their views. These institutions have raised the interesting question of whether or not colleges or universities make students more polarized. That in itself is the question being asked in this research proposal. Does educational attainment impact a student's political ideology? Furthermore, if colleges do create polarized students, is there a definitive way in which these students become more polarized, liberal or conservative. College is a time when people are in a state of enormous change. For many students this is the first time living away from their parents (who are the primary determinants of political belief), the first time having individuality, and more. This is also a time when students can self-select much about their path. Students can pick classes that may determine their beliefs, take professors who are more polarized, and choose friend groups that share common principles amongst the body of people. Educational attainment is extremely important and developmental to a growing and maturing human, and it is rational to believe that with the factors listed above, that polarization could come from a college education.

Protectionism and Recovering Markets

Ryan Ruiter

Mentor:
Dr. Jeffery Polet,
Political Science

The market and bank failures of the Great Depression and 2008 Financial Crisis had two vastly different outcomes. On one hand, with the Great Depression, we saw 25% unemployment and the Dow Jones losing 90% of its value. On the other, with the 2008 Financial Crisis, unemployment reached 10%, and the Dow Jones lost 50% of its value. The Great Depression is marked by a protectionist reaction to the economic crisis, highlighted by the Smoot-Hawley tariff act aiming to protect American jobs and farms by raising import taxes by nearly 20%. Raising tariffs, in turn, caused reactionary tariffs by other nation-states shrinking revenue from exports and hindering global free trade. Roosevelt's New Deal which broadened the scope of the government's activity, with major industrial, agricultural, and financial reform aligns more with the 2010 Dodd-Frank and Emergency Economic Stabilization Act. Broadening regulations and placing new standards for the financial sector and allocating 700 billion for relief. While both financial crises resulted in increased government involvement in the financial sector, the 2008 financial crisis did not result in a drastic turn toward protectionism like the Great Depression. With both crises resulting in an economic decline of 4.1%, this research seeks to investigate the relationship between protectionism and U.S. market recovery.

Government Regulation on Zoning and Land Use Associated with Affordable Housing, Housing Supply and City Growth in West Michigan

James Rupp

Mentor:
Dr. Virgina Beard
Political Science

Demand not only for housing but also affordable housing has become a significant problem in West Michigan reflecting a nation-wide problem. In the next five years, Kent and Ottawa counties need to accommodate 30,000 plus additional housing units for projected population growth–not to mention housing needed for current members of their workforces. However, municipal and local laws regarding zoning are significantly affecting the ability of builders to create this demanded housing–especially in ranges affordable to a large portion of individuals and families who work in our communities. Strict regulation is driving up housing costs, creating a barrier in the housing market. In the last decade, there has been little done to help solve this problem. The time has come for federal, state, and local governments to work with private firms to create housing affordable to everyone in their communities. Construction activity is extremely important for a prosperous community and economy. Surrounding areas from construction sites see a significant increase in spending, benefiting the local economy. Limiting construction barriers through zoning and permitting reform will have a long-term positive impact in West Michigan.

Cycling Infrastructure: Does Benefit Education Affect Warmth towards Infrastructure Proposals?

Garett Shrode

Mentor:
Dr. Jeffrey Polet,
Political Science

In modern American cities, urban planning has been necessary to implement infrastructure that is safe and beneficial to a community. Oftentimes, there is tension between urban planning experts and city officials, who propose projects with a myriad of supporting data, and city residents, who often oppose infrastructure changes based on their limited experience. Few scholars have explored the effect that resident knowledge of cycling infrastructure benefits has on warmth towards infrastructure proposals. Focusing on small towns like Holland, Michigan, this research examines the interests of small town residents and how relevant information on cycling infrastructure impacts resident opinions.

The Marginalization of America's Working Class

Hans Siebert

Mentor:
Dr. Virginia Beard,
Political Science

Automation and globalization have pushed aside America's working class. Manufacturing dominated America's economy in the past, but today it is dying out. The loss of manufacturing jobs is nothing more than data to many Americans unaware of the devastation occurring on the ground: Cities once dependent on traditional manufacturing are experiencing an unrivaled decline. When a factory closes its doors, a blight forms on the spot, and it spreads to the surrounding community. Once known for its booming manufacturing sector, America's Rust Belt region is now the epitome of industrial decay. But for many working-class Americans, moving away means stepping away from a beloved community. In addition to exposing the problems facing working-class people in post-industrial America, this project aims to find ways public policy can help these communities without sacrificing the country's overall economic growth.

The Effects of Foreign Aid

Caleb Smith

Mentor:
Dr. Virginia Beard,
Political Science

Foreign aid in all of its forms can ameliorate the most egregious experiences of poverty and its related ills. The effects of foreign aid, however, may have, and has many times had, damaging effects on the country, communities or individuals receiving aid. I will conduct research around the effects specifically of military aid and humanitarian aid and the possible impacts these two forms of aid may have on both active conflict within a state or external conflicts among states. I will examine case study countries including the Ukraine and Taiwan as well as one or two African states. I will situate the impact of foreign aid in the consideration of other factors that cause or correlate with conflict. This project explores the many possible ways that foreign aid can either weaken or strengthen a country.

The Transformation of Media Values and the Impact on U.S. Political Coverage

Taylor Spanbauer

Mentor:
Dr. Jeffrey Polet,
Political Science

America, once heralded for its right to free press and free speech, is now spinning in a web of fake news, loss of media objectivity, citizen journalism, and heightened political polarization. Consequently, the quality and content of policial coverage has undoubtedly taken a hit. America is faced with a media crisis, which has only been exacerbated by President Trump. Who is controlling the media, and why do they want us to think about the things we do? To what degree do media corporations sensationalize stories for the sake of views? Can media outlets be censored without violating Constitutional rights? How do we respond to these changes? This paper explores the relationship between changing media values and their impact on political coverage, and how you, as a rational citizen, need to adapt to these changes in order to form responsible and educated political opinions.

China's Mistreatment Of The Uyghur Population

Olivia Van Ark

Mentor:
Dr. Jeffrey Polet,
Political Science

The Uyghurs are a Turkic ethnic group that stems from Central and East Asia and are mainly found in the North-Western province of China, Xinjiang. In recent years, there have been mounting, international, concerns of a massive human rights violation in the way that the Chinese government has handled the Uyghur people. Uyghurs have been put into re-education camps in China to combat Islamic-militancy and separatism within the region of Xinjiang. These camps have accusations that they are using the Uyghur people as forced labor and that there are abuses of all types happening within them. This paper will discuss who the Uyghur people are, what is happening in the Xinjiang region, what led it to happen, what safeguards should have been in place, and why no one is doing anything about it.

The Effects of Police Funding on Crime Rates and Community Relations

Elijah Vander Lee

Mentor:
Dr. Virginia Beard,
Political Science

As mass protests have swept across the United States over the past two years under the umbrella of Black Lives Matter, one of the main goals is to defund the police. Many protestors and politicians argue that there is too much money given to police departments for efforts that are not central to the security work of police forces. Such funds have made police departments increasingly militarized, hurting police relationships with their communities. Protestors and politicians would rather that money be transferred to such places as more social workers who can de-escalate situations such as domestic violence better than a police officer. The tension between citizens who oppose the high funding, citizens who support it, and the police officers themselves create an interesting and diverse situation in communities. This project will explore police funding and evidence on current police militarization, crime rates and community relations.

Mental Health and Homelessness

Makayla Wilson

Mentor:
Dr. Virginia Beard,
Political Science

Since the onset of the COVID-19 pandemic, one area tragically impacted has been access to secure housing. The huge economic impacts of the shutdowns and job losses of the pandemic prompted the federal as well as state governments to provide emergency resources for help keep people housed as well as to help those without housing to secure a place to live. These interventions have had many important impacts. They have not, however, reduced or ended the rising levels of homelessness nationally since 2016. The result is an increasingly visible epidemic of unsheltered homelessness, affecting both individuals and families. When analyzing factors influencing those who are experiencing housing insecurities, individual factors, as well as systemic factors, are contributing to the ongoing issue. In regards to individual factors, mental health continues to influence homelessness, becoming a crucial factor with the deinstitutionalization in the 1960s and 1970s. This study proposes to examine the impact of mental health as a crucial factor among many that predicts and results from experiences of homelessness, exploring potential solutions to prevent mental health, in the context of other factors, from leading to homelessness in the ways currently occurring.

Juvenile and Youth Offenders: Delinquency and Recidivism

Corri Zimmerman

Mentor:
Dr. Jeffrey Polet,
Political Science

Juvenile and youth offenders have a higher recidivism rate than adults. These numbers prove true despite the many programs created and offered that may not be available to their adult counterparts. This research hopes to explore factors that influence recidivism rates that can affect both adults and youth offenders but seeks to go more in-depth on factors that specifically impact youth and juvenile offenders. There are many factors that influence the recidivism rates of offenders including the presence of a positive role model in the home, access to education and employment, proximity to other offenders, and the condition of the environment in which the juvenile resides. This research is important because the number of juvenile offenders is fairly large, and research has shown that juvenile offenders are more likely to be reconvicted of committing crimes after being released than adult offenders. If there is a failure in the system and certain factors that lead to recidivism can be addressed, then it is important to remedy this failure to give children who would otherwise offend a chance at life without confinement.

The Influence of Parent Characteristics on Implicit and Explicit Partner Preferences

Taylor Clarke
Jennifer Almquist

Mentor:
Dr. Carrie Bredow,
Psychology

Previous research on sexual imprinting has focused primarily on animals, producing evidence that offspring use their parents' physical characteristics as a template for mate choice. Extensions of this work to human partnering have found that individuals tend to be attracted to and choose partners who have similar physical characteristics to their parents. However, only a handful of studies have examined whether people prefer and choose partners who resemble their parents on non-physical traits, such as kindness or intelligence. Existing research in this area also suffers from additional limitations, including failing to account for assortative mating. Our study addresses these limitations by examining whether people's opposite- and same-sex parents' traits predict their explicit and implicit mate preferences, controlling for their own characteristics. We also examine whether the strength of these associations is moderated by the quality of the parent-child relationship. Data were collected from 682 unmarried participants (203 men, 477 women) recruited from an undergraduate institution or online. Participants completed three single-category implicit association tests to determine their unconscious associations regarding the desirability of three dimensions of traits in a long-term partner (attractiveness/vitality, status/resources, warmth/trustworthiness). Participants then completed a survey rating their explicit mate preferences, their parents' characteristics, their own traits, and parent-child relationship quality. Participants' parents were then contacted via email and asked to report on their own characteristics and relationship with their child. We hypothesize that parental characteristics on the three trait dimensions will be positively correlated with participants' implicit and explicit preferences for those traits; we will use linear regression to test if these associations remain when controlling for participants' own characteristics. We will then use moderated regression analyses to test our second hypothesis that the links between parental characteristics and mate preferences will be more pronounced when parent-child relationship quality is higher.

There's No Place Like Dorm: Actual-ideal Dorm Ambiance Discrepancy as a Unique Predictor of Psychological Well-being in Undergraduate Students

Brynn Anderson
Kayla Brady
Elliana Hamilton

Mentor:
Dr. Benjamin Meagher, Psychology

College is a highly stressful period in the lives of many students. One potential means of coping with this stress that has received little attention is through the use of one's on-campus housing. Dorm rooms are one of the only spaces on campus where students are able to alter, personalize, and exert control over their environment. In so doing, they can potentially create an ambiance that elicits desirable emotions and psychological benefits (e.g. restoration, less stress, positive feelings; Graham et al., 2015). There are, however, possible factors that keep students from being able to adapt these spaces into one's own, such as roommate conflict, spatial limitations, or lack of self-regulation. In this study, we are investigating the extent to which the discrepancy between a student's ideal dorm room ambiance and its actual ambiance is uniquely predictive of psychological well-being.

Satisfaction with room ambiance is being measured by the correlation between a pair of Q-sorts: first for participants' desired emotions in their ideal room, and then for the emotions elicited by their actual room. We will be evaluating the extent to which this measure predicts positive and negative affect (Watson et al., 1988), anxiety (Spitzer et al., 2006), and depressive symptoms (Eaton et al., 2004) while controlling for a number of constructs related to student well-being: academic satisfaction and self-efficacy, school connectedness, physical health, big five traits, and roommate satisfaction.

We predict congruence between students' ideal and actual dorm room to be predictive of positive well-being. Because of the everyday stressors placed on college students, having a space they are in control of should give students an outlet for better coping and thus increase well-being. Furthermore, looking at the association between anxiety and/or depressive symptoms with students' feelings about their living space can help reveal whether one's mental health is reflected in their sense of connection to where they live.

Colleges and universities typically prioritize students' mental health and well-being, but may not readily consider students' connection to their housing when thinking of ways to improve these aspects of students' lives. Our results could provide valuable information for colleges and universities to consider when evaluating student living spaces, as well as the processes that determine where students' will be living and who their roommates will be.

Visual Mechanisms as a Means to Word Learning

Emma Benoit
Erin Vokal
Rebekah Miller

Mentor:
Dr. Lauren Slone,
Psychology

The ability to communicate via language is one of the most important social functions of everyday life. Language is dependent on the neural networks and sensory information first gathered by infants from their environment during the first several months and years of life. What mechanisms enable infants to learn the correct words for objects despite highly ambiguous environments with many distracting places to look? We investigate patterns of visual attention and eye gaze as a means of forming new associations between words and objects. Are participants able to learn word-object pairings in settings of referential ambiguity and distractions, and what visual mechanisms do they employ to learn new words? Undergraduates and infants were shown combinations of three novel objects on a screen, one target object and two distractor objects. The novel name of the target object in each image was simultaneously spoken. An eye-tracking device was used to measure gaze patterns and looking behaviors. Test trials on word learning were conducted to assess whether participants successfully learned the correct word-object pairs. By utilizing eye tracking data, we will investigate if eye movement patterns during the learning trials are predictors of language acquisition determined during the test trials. We hypothesize that after multiple exposures to word-object pairings, participants will look longer at the correct target object, demonstrating word learning. We further hypothesize that stronger word learners will have different mechanisms of learning compared to weaker learners. For learned words, we expect that participants will shift their gaze more during the first presentations of word-object pairings, but their gaze will become more fixated and focused during later blocks of trials. Results of this study will enable a deeper understanding of word learning and its underlying mechanisms. By gaining insights on how language acquisition occurs, we can create environments better for word learning.

Forgive and Fall Asleep: Compassionate Reappraisal Leads to Earlier Sleep Onset and Fewer Sleep Disturbances than Rumination

Sabrina Blank

Mentors:
Dr. Andrew Gall, Psychology

Dr. Charlotte VanOyen Witvliet, Psychology

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Forgiving real life offenders is associated with psychological and physiological well being (Witvliet et al., 2020). Research has suggested indirect associations between high trait f orgiveness and sleep quality (Toussaint et al., 2019, Stoia-Caraballo et al., 2008). However, the field of forgiveness has no experimental investigations of sleep, a concern raised by Toussaint et al. (2019).

Accordingly, the present study examined sleep associations with forgiveness as a trait and when influenced by experimentally induced states of rumination and compassionate reappraisal (Witvliet et al., 2020). We predicted that compared to rumination, compassion would promote forgiveness, better sleep, prosociality, and flourishing.

We tested 180 college students on two consecutive nights through self-report surveys. On night one, we collected trait data and experimentally prompted rumination and writing about a previous, non-traumatic interpersonal offense. The next night, participants considered and wrote about the same offense, but instead, focused on the humanity of the offender and desired their positive transformation through compassionate reappraisal. Each night, participants made ratings of forgiveness and emotion. The following mornings upon awakening, participants completed assessments of their night's sleep, their prosociality through accountability in relationships, and flourishing.

At the trait level, higher levels of forgiveness were indirectly associated with better sleep quality through reduced rumination and negative affect. The experiment demonstrated that compassionate reappraisal elicited increased levels of empathy, forgiveness, and prosocial accountability compared to rumination–which activated negative emotion. Furthermore, compassion resulted in less time to fall asleep and decreased sleep disturbances. Interpersonal hurts are common, and sleep is important for overall health (Grandner, 2019). This study replicated the indirect effect of trait forgiveness on sleep quality through low rumination and negative affect. Our novel experiment demonstrated that compared to offense rumination, compassionate reappraisal promoted forgiveness, better sleep, prosociality, and flourishing.

Does Knowing Someone Who Has Had Covid Change Your Health Behaviors?

Nina Cuthrell
Samrawit Kelkay

Mentor:
Dr. Alyssa Cheadle, Psychology

With how quickly COVID-19 spreads, it is likely that most people know at least one person who has fallen ill. Literature has shown that perceived risk and self-reported exposure potential play a role in how well one participates in healthy behaviors to minimize the spread of COVID-19. Self-perceived risk can be defined as how at-risk someone believes themself to be. A factor that can influence self-perceived risk of COVID-19 is whether or not the subject knows someone who has fallen ill with COVID-19. This research aims to see whether this self-perceived risk motivates people to follow COVID-19 guidelines. Data from 280 students at Hope College were collected using a survey at four timepoints over a single semester. The survey contained measures of adherence to COVID-19 related health behaviors as well as measures of risk perception including the number of people the student knew who had contracted COVID-19. Initial data suggest that knowing someone who has COVID-19 is associated with greater risk perception and better adherence to guidelines regarding COVID-19 related health behaviors.

Attitudes towards the Outdoors: College Students' Trends before and during the Pandemic Shutdowns

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Corine LaFrenier
Elijah H Maxwell
Natalie A Ramsay
Mikenna K Davidson

Mentor:
Dr. Sonja Trent-Brown, Psychology

This project was supported by in-kind contributions from Hope College and the Hope College Department of Psychology.

COVID-19 changed many people's lives in the realm of being outdoors. Spending time outdoors was a safer option for activities with COVID-19 Guidelines. Several common indoor ways to exercise and socialize were shut down, making the outdoors the most viable option. Many worked remotely or transitioned to online school, cooped up indoors all day, making the outdoors an escape from a place that was both home and work. Outdoor activities were deemed more accessible because they simply involved opening the door and taking a few steps. We were interested in whether peoples' attitudes towards the outdoors had changed during the pandemic. The Outdoor Foundation (2019) study reported that almost half the U.S. population didn't participate in any outdoor recreational activity in 2018 (p.3). Before the pandemic, in 2018, people were involved in fewer outdoor activities than prior years. For our study, an online survey with undergraduate students consisted of questions regarding time outdoors, desire to be outdoors, and attitudes toward spending time outdoors. We hypothesized 1) that people would spend more time outdoors during the COVID-19 shutdown and 2) that people would have a more positive outlook on the outdoors during COVID. T-tests showed no significant difference between people's time spent outdoors before and during COVID-19, ($t(193) = -.231$, $p = .160$), a significant difference for people who looked forward to outdoor activities prior to and during COVID-19,($t(191) = -.135$, $p = .001$), a significant difference for people who used outdoor activities as a mood booster from before to during COVID-19, ($t(193) = -5.464$, $p < .000$). Our first hypothesis wasn't supported, perhaps because people had the same amount of free time or even less during the pandemic. Our second hypothesis was supported, people had a more positive outlook on the outdoors from before to during the COVID-19 shutdown.

Do People Learn Object Names Better When the Object Appears Bigger?

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Lars Overos
Nycole Kragt
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Mentor:
Dr. Lauren Slone,
Psychology

Language is a vital component of everyday life, and serves as a foundation for academics, relationships, and professions. A rich visual and sensory environment, which could include bright colors and objects of different shapes, textures, and sizes, is necessary for the success of language development in children (Yu and Smith 2012). Having certain objects dominant in view creates a more complex visual environment; which, as suggested by Yu and Smith (2012), aids in language learning. This emphasizes that having one object dominant in view when being named can help decrease the uncertainty of that object's name. What role do these environmental characteristics play in the word learning process? We wonder if increasing the size of an object optimizes learning of that object's name. To investigate whether visual dominance facilitates successful learning, we will conduct a study in which infant and undergraduate participants experience a novel name learning task. Participants will view images of three objects at a time. One object will be the target. In one condition, this will be the object verbally named. The other two objects will be distractors. Some participants will experience three objects that are equal in size, whereas some will experience a target that is larger than the distractors. This addition of making the target larger and thus visually dominant, allows us to investigate the effects it has on the number of objects that participants learn. We predict that when participants experience a visually dominant target, they will learn more words compared to participants who do not experience a larger target. Visual dominance could create less confusion and thus stronger connections between that object and its name. Finding a result that supports our hypothesis would show that visual dominance provides learners with an optimized environment for successful learning of objects and their names.

Impact of Spirituality on Mental Wellbeing during COVID-19

Samrawit Kelkay
Nina Cuthrell

Mentor:
Dr.Alyssa Cheadle,
Psychology

Mental health issues have become more prevalent during the COVID-19 pandemic. The mental health of university and college students has been affected by the pandemic. Research has shown that people have been able to cope with adversity through their faith and spirituality. In this study, the impact spirituality has on mental health during COVID-19 was investigated. Data come from a study Hope College conducted to understand people's experiences of the coronavirus pandemic. For this study, a survey was conducted at four time points with a sample of 280 Hope college students during the Fall of 2020. The survey included questions about religious identity and behaviors, mental health and emotional wellbeing, and COVID-19 and the preventative steps they participated in.The goal of this study is to understand how faith has played a role in coping with COVID-19 with college students. The analysis of the research is ongoing and conclusions are still being drawn. Based on results from past research, I expect spirituality to help people with coping with the different challenges the pandemic presented. However, I also expect to see how spirituality was not a source of strength for everyone and that there was use of other methods to cope with the pandemic.

Exploring Religious Deidentification

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Mentor:
Dr. Daryl Van Tongeren, Psychology

This research was supported by the Frost Center Fellowship.

Religion can be a central part of one's social and personal life. However, there are many people who are leaving their religion at increasing rates, and there is not a good understanding as to what exactly may prompt someone to start to deidentifiy from their religious identity. National polling data reveals that nonreligious individuals comprise the third largest "affiliative" group (at over 1 billion individuals) and are growing quickly (Pew-Templeton, 2015). Recent theoretical work (Van Tongeren & DeWall, in press), suggests that people may deidentify from religion because of four different dimensions: disbelief (i.e., no longer believing in supernatural agents), disengagement (i.e., no longer connecting with the sacred), discontinuance (i.e., no longer following the moral standards of religion), or disaffiliation (i.e., no longer associating with religious communities). However, little is known regarding what predicts these features of deidentification or what the downstream consequences of these dimensions are.

Toward that end, we conducted a large-scale data collection effort of community members undergoing religious change over a one-year period. These individuals were recruited from a conference, and through social media advertisements (e.g., Facebook messages, Instagram posts), associated with Evolving Faith, which is a community of individuals who are experiencing their Christian faith in new ways. A signature feature of this group is that most have undergone, or are currently undergoing, significant religious change. We collected data from more than 200+ individuals across two timepoints one year apart, who completed an hour-long survey of qualitative and quantitative responses. We examined these data to determine various features of religious deidentification, focusing on the dimensions of disbelief, disengagement, discontinuance, and disaffiliation.

Health Implications of Deidentifying from Religion for Young Adults

Amy Osterbaan

Mentor:
Dr. Alyssa Cheadle, Psychology

This research was supported by the Jerold Paul '55 & Lois Tornga '56 Veldman Faculty Development Fund and the Psi Chi Undergraduate Research Grant.

The purpose of this study was to investigate the health of people who stop identifying as religious as young adults. Generally, religious people have better health than nonreligious people (Cheadle & Dunkel Schetter, 2017). However, little is known about the health of those who deidentify. They may experience worse health than others (Fenelon & Danielsen, 2016). Alternatively, the religious residue hypothesis contends that formerly religious people resemble always religious people in terms of prosocial behaviors and moral reasoning (Van Tongeren et al., 2021). The current study utilized data from the National Longitudinal Study of Adolescent to Adult Health, Waves III through V, including 18,379 Americans surveyed in 2001-02, 2008, and 2016-18. Surveys included information that allowed formation of religious identification categories and assessments of physical and mental health and health behaviors. In cross-sectional analyses, formerly religious people reported poorer health and engaged in more risky health behaviors than always and never religious people for over 30 markers of health at each Wave (all $p \leq 0.037$). In prospective analyses, formerly religious people reported poorer health and engaged in more risky health behaviors at Waves IV and V for over 30 markers of health (all $p \leq 0.047$). Wave IV identification followed this pattern when predicting Wave V for 31 markers of health (all $p \leq 0.049$). Cross-lagged panel, mediation, and moderation analyses are planned. Overall, results suggest boundary conditions for the religious residue hypothesis and the health benefits of religiousness. People who deidentify appear to experience worse health even than those who were never religious. Further, poor health and risky health behaviors preceded religious disaffiliation in retrospective analyses. Additionally, longer duration of disaffiliation was associated with worse health and greater engagement in risky health behaviors. These findings have implications for research and practice.

Is It Meant to Be?: Dyadic Effects of Room Ambiance

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Brynn Anderson
Elliana Hamilton
Kayla Brady

Mentor:
Dr. Benjamin Meagher, Psychology

Discovering what predicts successful roommate pairings can be beneficial for roommate relationships but also the well-being of each roommate. A potential factor for this success is the shared dorm room ideal and actual ambiences that they wish to elicit. When two individuals are living and studying in the same space, sharing the same ideal and actual ambience of the room could benefit both individuals. In our previous study, the ideal-actual discrepancy of a student's dorm room ambience was correlated with reduced depression and negative affect. This shows that there is a relationship between a student's well-being and the space they inhabit. This study sought to again evaluate whether the ideal-actual discrepancy of students' dorm room ambience is associated with their well-being, while also testing its effect on students' relationship satisfaction with their roommate. Using a sample of roommate pairs at Hope College, we measured ideal and actual room ambiences for each roommate simultaneously, but done separately. They were told not to talk or ask for their roommates help on any part of the survey or ambience matching. They were instructed to place ambience cards (e.g. inviting, friendship, community, etc.) on a cardboard scale from "not at all important" to "extremely important" for ideal ambience and from "strongly disagree" to "strongly agree" for actual ambience. They were also instructed to complete an online survey that included measures of the Big Five Personality Traits (Gosling et al., 2003), Anxiety (Spitzer et al., 2006), the PANAS scale (Watson et al., 1988) for positive and negative affect, the Center for Epidemiologic Studies Depression Scale Revised (Eaton et al., 2004), and a measure of Roommate Satisfaction. We test how attitudes towards one's dorm room predict a person's satisfaction with their roommate in terms of several measures of congruency, these being (a) actual-ideal for oneself, (b) actual-ideal for one's roommate, (a) ideal-ideal between self and roommate, and (d) actual-actual between self and roommate. This analysis will allow us to evaluate our hypotheses and provide a greater sense of what best predicts having a positive experience living on campus.

Screen Time and College Students' Mental Health before and during the COVID-19 Shutdowns

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Elijah Maxwell
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Mentor:
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This project was supported by in-kind contributions from Hope College and the Hope College Department of Psychology.

Before the Pandemic, technology use was discouraged in most households and education systems. Pre-COVID, college students spent 8-10 hours daily on smartphones (Roberts et al., 2014). In March 2020, the country experienced a stay-at-home order and students were forced into online schooling. Institutions purchased video chatting software and updated classrooms to accommodate virtual learning. Due to the increase in virtual classrooms and educational activities, our interest aligned in analyzing the magnitude of COVID's impact on the amount of screen time students spend weekly for leisure, work and educational uses through an undergraduate online survey. College students spent more time before the pandemic using technology for work ($t(99) = 2.495$, $p=.014$) than during the pandemic. Contrarily, college students spent more time using technology for educational purposes during the pandemic than they did before the pandemic ($t(193) = -4.38$, $p<.01$). Significant correlations were found between hours spent on technology and mental health indicators before and during the pandemic, and no significant correlations for mental health indicators and work and educational tech use before the pandemic. During the pandemic, as participants spent more time using technology for work, they scored higher on anxiety and negative feelings. Hours using technology for leisure and work purposes before and during the pandemic were significantly negatively correlated with the PANAS 2 Positive Affect scores implicating as hours in screen time increased, positive feelings looking back at the stay-at-home order decreased. As participants spent more time using technology for education during the pandemic, they scored higher for anxiety and negative feelings as well as when reflecting back at the stay-at-home order. These results imply that students' overall screen time during the pandemic has had a significant impact on the daily lives of students and their mental health indicators before and during the COVID-19 Pandemic.

A Retrospective and Prospective Study of Physical Activity and Health Indicators during the COVID-19 Shutdowns: a Holistic Approach

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This project was supported by in-kind contributions from Hope College and the Hope College Department of Psychology.

Previous research suggests that physical activity is associated with both positive physical and mental health outcomes. Approximately half of U.S. adults have chronic conditions for which physical activity would be beneficial. A large cross-sectional study found adults engaged in physical activity reported fewer poor mental health days than those who didn't (Chekroud et al., 2018). Despite this evidence, 80% of adults don't meet recommended muscular strength and aerobic conditioning guidelines (*U.S. HHS,* 2018). The present study investigates how the relationship between physical activity and attitudes relates to a holistic assessment of health from both a retrospective and prospective standpoint, examining how past, current, and future behavior patterns impact physical activity and overall health, both physiologically and psychologically. College students were surveyed regarding attitudes toward physical activity from childhood, emerging adulthood, and during the COVID-19 shutdown. The survey assessed health indicators using PHQ-9, GAD-7, PANAS, and self-reported measures of BMI. A correlational analysis found significant positive relationships between activity level and current amount of time spent outside, indoor and outdoor preferences, and scores on the COVID-19 PANAS. There were also positive relationships between likelihood to continue current exercise levels and amount of time currently spent outside as well as positive affect scores on the current PANAS and a significant negative relationship between the PHQ-9 score and current time spent outside. This implies that better overall physical and mental health were associated with greater levels of physical activity and time spent outdoors, and attitudes about physical and outdoor activity were related to behavioral trends. During the COVID-19 shutdown, physical activity and time outdoors were associated with better mental health outcomes. Establishing positive attitudes regarding physical and outdoor activity early on in life is crucial for ensuring desired behavioral trends. Consequently, these attitudes will yield protective measures for health.

Hope for the Future: Lived Hopes Fulfilled Predict Greater State Hope, Self-Regulation, & Flourishing

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MacKenna Shampine
Isabel Santos
Onnah Dereski
Caitlyn Phillips

Mentor:
Dr. Lindsey Root Luna, Psychology

Human cognition involves imagining and hoping for future outcomes. Hopelessness has been correlated with depression in adolescents (Waszczuk et al., 2016), whereas hope has been associated with positive emotions (Snyder et al., 1991). In this study, we systematically examined hope imagery and lived hope fulfillment. We asked participants to imagine a hoped-for outcome and later report on their lived experience. We predicted that hope-fulfilled imagery would increase positive emotion and positive state measures (state hope, self-regulation, & flourishing), while decreasing negative emotion; we expected a similar pattern for the lived reality.

This study utilized two waves of data collection. In wave one, psychology undergraduates (N=94) were randomly assigned to a control, hope-fulfilled, or hope-unfulfilled imagery condition and self-reported trait measures and emotional processes before and after taking part in their respective imagery condition. Three weeks later, wave two (n=74) assessed the impact of participants' lived outcomes on the same measures. Participants rated the degree that their hope was fulfilled: mostly or completely (hope-fulfilled), compared to partially or not-at-all (hope-unfulfilled).

One-way ANOVAs with .95 confidence interval comparisons were conducted. In wave one, contrary to our hypothesis, hope imagery conditions did not reliably impact state-hope, hopelessness, self-regulation, or flourishing, while participants in the hope-fulfilled and control conditions endorsed more positive emotions and less anger compared to hope-unfulfilled. Happiness and joy were reliably higher following hope-fulfilled imagery compared to hope-unfulfilled, though neither condition differed reliably from the control. In wave two, negative emotions and hopelessness were reliably higher when hopes were unfulfilled. Fulfilled hopes were associated with reliably greater positive emotions and state measures.

This study explored the impact of hope-fulfilled and hope-unfulfilled imagery, along with lived experience, on self-regulatory resources and emotional processes. Lived fulfillment of hopes provided more value than hope imagery, particularly regarding self-regulation and flourishing.

The Psychological Costs of Holding Views with Humility

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Mentor:
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When faced with existential questions, are people able to respect the perspectives of others? Remaining humble in the face of difficult life questions is known as *existential humility*—marked by knowing one's own limitations, regulating arrogance, and receiving contrary ideas without taking offense (Church & Barrett, 2017; Leary et al., 2017; Roberts & Wood, 2003; Whitcomb et al., 2017). However, most people are defensive about their cherished beliefs and unwilling to listen to others. The purpose of this study is to explore the psychological consequences of being existentially humble.

We hypothesized that existential humility is positively associated with religious wellbeing over time. Participants were 77 first-year college students enrolled in an introductory to psychology course. They were sampled at three time-points separated by three weeks each. At each time point, participants completed surveys assessing their existential humility, religious/spiritual struggles, religious well-being, and other aspects of hedonic and eudaimonic flourishing.

We examined an indirect effects model using PROCESS over 5,000 iterations. We found that existential humility at baseline predicted greater religious struggle in face of a stressor (COVID-19) at Time 2, which predicted poorer religious well-being and greater religious/spiritual struggles at Time 3. In short, existentially humble individuals report poorer religiously-related outcomes in the future because stressors are more disruptive to their religious/spiritual beliefs.

The results of our study reveal that there are psychological costs to being existentially humble. Those participants high in existential humility had more religious doubts and lower levels of religious well-being. This provides an initial clue as to why many people so ardently defend their beliefs: rigid beliefs provide existential comfort. However, other works suggest there are some benefits of humility; future work should explore these tradeoffs. Specifically, additional work should explore the dynamics of tolerance and interpersonal defensiveness to identify a pattern of tradeoffs—and may explain why certain religious belief systems, such as those that offer certainty, have thrived.

Getting by with a Little Help from My Friends: Examining Links among Body Talk and Affirmation in Secular and Religious Settings on Women's Body Satisfaction

Dylan Sherman
Demetria Johansen

Mentor:
Dr. Mary Inman,
Psychology

Given women's body dissatisfaction, it is important to identify how much friends, church, and nonreligious friends aid (or hurt) body satisfaction. Church can be a source of affirmation when one feels judged by secular friends. Our earlier work proposed and found feeling affirmed-from-church weakened the effect of weight anxiety on body dissatisfaction. Affirmation-from-church was related to hearing less fat-talk and more body-acceptance talk at church. The present longitudinal study attempts to identify causal relations among women's body talk, feelings (of judgment, support) in various groups (friends, religious, nonreligious) and their body satisfaction. Our main questions were (a) does affirmation-from-church weaken the weight-sensitivity-body dissatisfaction relationship and (b) to what extent do body-talk and feelings-in-these-groups predict body satisfaction? We expected fat talk and feeling judged at Time 1 would predict body dissatisfaction at Time 2; however, affirmation-from-church may weaken this relationship. Over 80 undergraduate women completed the weight-rejection anxiety, body dissatisfaction (actual-ideal body) and weight esteem (self-talk) scales, affirmation-from-church scale, feelings (of acceptance and judgment) and frequency of body-talk in their friend-, religious-, and nonreligious-circles (alphas >.90-.97) in a online anonymous survey for course extra credit as Wave 1. Waves 2 and 3 occur 4 and 8 weeks later and contain only these items. Preliminary analyses with Wave 1 showed that high affirmation-from-church significantly weakened (but did not negate) the relation between weight-sensitivity and body dissatisfaction, though the weight-satisfaction relationship was stronger with low church affirmation. Wave 1 correlations showed that women's body satisfaction was more closely linked to the body-acceptance talk in the three circles (rs =.22-38, ps<.05) than to feelings in those places. Women's weight esteem was related to feelings of nonjudgement by friends and religion and not hearing fat-talk among friends. Affirmation-from-church is an important potential buffer for body satisfaction. Both body talk and feelings in the three circles are important for women's body evaluations.

Does Affirming Privileged Groups Make Them More Sympathetic to Outgroups' Explanations about Racism?

Zach Wiggins
Ellie Margason

Mentor:
Dr. Mary Inman,
Psychology

Hearing that your group is privileged at the expense of others threatens the self. Caucasians can become defensive about their unearned cultural privilege (Knowles et al., 2014; Reid & Birchard, 2010). We propose defensiveness increases when learning about offenses committed by one's in-group and when hearing explanations from those who were offended. When Caucasians learned of a college ghetto party that occurred at their school (versus at one far away) and when they heard (versus not) why ethnic minority students were offended, Caucasians were defensive and minimized seeing the event as racism (Kahn et al., 2011). The present study kept these two manipulations and added a self-affirmation to test whether self-affirmation would weaken this defensiveness (raise support for the offended group). We tested whether self-affirmation increased supportive thoughts about the outgroup's claim, increased anger and guilt towards American racism, and increased positive attitudes towards repairing racism in the US. We manipulated self-affirmation, location of a contentious college ghetto party, and the presence of why students of color were offended. Caucasian ($N = 238$) and students of color ($N = 67$) read about a college ghetto party, completed a thought-listing task, indicated their immediate reactions to the party, and to their feelings about US racism in general. We focused on the thoughts, emotions, and attitudes of the 238 Caucasian subjects to see if more positive change occurred in the high-threat condition (near college, explanation given) when self-affirmed versus not affirmed. Caucasians in the high-threat condition self-affirmation group showed more supportive thoughts, more anger and guilt about US racism in general, and more positive attitudes about anti-racist policies and behaviors than unaffirmed Caucasians in the same condition. The responses of affirmed Caucasians more closely resembled students' of color responses than did the responses from unaffirmed Caucasians. Results suggest that affirmation may be helpful when hearing group- threatening news.

Visual Attention across Language Development

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Mentor:
Dr. Lauren Slone,
Psychology

This work supported by the Hope College Department of Psychology.

Would you consider yourself a visual learner? Many of us have a sense that what we learn depends on what we see. But how exactly does visual learning happen? How does that change as we grow older? We examined how visual attention changes across development and how that relates to word learning. Previous research on word learning has proposed various ways that people may learn words. However, there is a gap in understanding how visual attention might be crucial for this task, despite the fact that many words are labels for things we see. Previous literature highlights connections between higher recalling ability and gaze direction towards larger, or visually dominant, objects along with the ability to correctly match new objects with unknown words (McMurray et al., 2012). We will begin to answer these questions by examining how infants and adults attend to new objects, and how this relates to their ability to learn those objects' names. In this experiment, participants will be placed in front of a screen where they will be shown a series of unknown objects and hear names for some of those objects. Eye tracking technology will keep track of where on the screen they gaze during this process. We will examine how infants and adults allocate their attention by comparing the percentage of overall looking time spent on the named objects versus distraction objects. We will also test word learning so that we can compare the types of visual attention that led to the best word learning, and whether this may change across development. We hypothesize that when participants spend a greater percentage of their looking time on the target object, then, they will show greater accuracy in word-referent pairing during test trials. This study is ongoing; results and conclusions will be shared at the celebration.

Hope4Athletes: Examining Sport Commitment, Motivation and Neuroticism in Collegiate Soccer Players

This project was an interdisciplinary endeavor between the Departments of Kinesiology and Psychology. See page 79 in the Kinesiology section of this book for full abstract.

Privileged Latinx Project Part 1: What We Know So Far

Vicente Bickel

Mentor:
Dr. Rodrigo Serrao, Sociology

Research Supported by the Matthew J. and Anne C. Wilson Foundation Faculty Development Fund.

According to the Pew Research Center, "The U.S. Hispanic population reached a record 60.6 million in 2019, up 930,000 over the previous year and up from 50.7 million in 2010" (Noe-Bustamante, Lopez, and Krogstad 2020). According to Pew, Latinx alone were responsible for 52% of the entire U.S. population growth for the past ten years. However, when it comes to understanding the Latinx population, the literature has primarily focused on their ethnic identity and omitted most or if not all aspects of their racial identity. Hence our project seeks to understand the role that race plays for Latinx, focusing on those who are White identifying or White-passing. For part 1 of this project, professor Serrao and students Vicente Bickel and Hannah Santiago, conducted a literature review with the goal of assessing the research on the intersection of race and Latinx identity. The literature, though vast and highly nuanced, has focused primarily on three major topics: racialization, immigration, and colorism. Each of these topics serves as umbrella terms for discussing other issues, such as U.S. westward expansion, the role of the U.S. Census for our understanding of race making and national identity, White supremacy, assimilation issues, racism, skin-color prejudice, immigration legislation, among others. We found a gap in the literature related to the idea of privileged Latinx. "Privileged Latinx" has not been fully explored in the literature. Privilege in this context does not translate squarely with non-Hispanic White privilege but is a combination of intersecting identities involving skin-color, nationality, social class, language, among others.

Social Support and Change in Empathy in Undergraduate Pre-Health Students

Merrik Campagna

Mentor:
Dr. Aaron Franzen , Sociology

Many medical education studies show that medical students often lose empathy throughout their time in medical school, but thus far we do not know whether these trends have their roots in earlier educational experiences. This research begins to fill this gap, exploring whether indications of these changes in empathy start in undergraduate programs. This is important because patients who feel more empathy from their doctors tend to listen to and trust their doctors more. If we can better understand what factors lead to a loss of empathy we can adjust programs to help negate this effect. Our data comes from a longitudinal cohort study of all incoming Hope students indicating a pre-health interest and nursing students. This data includes a total of 530 students with freshman year response rates ranging from 71% - 84% for the three cohorts. The survey included measures for empathy scale, social support, burnout, humility, boredom proneness, and other factors. We used SPSS to analyze the data. We found social support to be one of the biggest variables impacting change in empathy, reinforcing how important having support is to students in their early college experience.

Child Labor in Ghana and the Ivory Coast's Cocoa Production: Causes and Efforts to Reduce

Caroline Daniels

Mentor:
Dr. Shanna Corner,
Sociology

Child labor is a recognized problem in the production of cocoa in Ghana and the Ivory Coast for the international chocolate industry. This project sought to expand knowledge of root causes of this problem and factors that have hindered its elimination. To do this, relevant documents produced by several chocolate industry actors and regulating agencies were systematically collected, as was a body of past research studies focused on this topic. These documents and studies were reviewed to uncover central themes. In addition, word searches were conducted to identify patterns in the frequency of discussion of notable concepts in relevant literature and databases. Preliminary findings from this literature review and document analysis illustrate the complex and insidious nature of this cross-national issue by uncovering several demand and supply side challenges that have helped to create and sustain it. This project finds some notable actions that have been taken by different actors to address this problem, but also identifies room for greater work to address and reduce this issue and aspects of its underlying causes.

Exploration of Language around Ability

Julia Hopkins

Mentors:
Dr. Dennis Feaster,
Social Work

Elizabeth Schultz,
Community Interlocutor

This research was supported by the Howard R. and Margaret F. Sluyter Faculty Development Fund.

While the use of person-first language to refer to persons with disabilities has become standard in academia, professional practice, and in popular culture, many communities have expressed a preference for identity-first language. These preferences vary according to the nature of the disability, the age of the person, and many other factors. The implications of language choices are dynamic, changing not only with who it refers to but also context and situation. We seek to contribute to the work of investigating preferences for and responses to these two kinds of language across different disabled populations and what has shaped them. This project uses a variety of tools to probe this area: review of relevant literature; interviews with people with disabilities; digital analysis of text databases. Implications of the project are relevant not only to further academic understanding, but also to facilitate the development of therapeutic alliances between members of this highly marginalized population and the professionals who serve them. While the broader questions apply to all disabilities, for the purposes of this investigation, we focus specifically on physical, medical, and developmental disabilities that do not include intellectual disabilities.

Stress and Social Support of Foster Parents during COVID-19

Carlie McNiff

Mentor:
Dr. Elizabeth Sharda,
Social Work

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Foster parents provide crucial care to hundreds of thousands of children in the U.S., and with their role comes a variety of challenges. They face a great amount of stress which is why the turnover rate is high, and there is a critical need for more foster parents. Uncertainty is a large component of the foster care system, and the COVID-19 pandemic heightened this. It is unknown how stress that foster parents have experienced during this time was affected, and this study seeks to explore that. Additionally, this study focuses on types and sources of social support of foster parents within the pandemic. This qualitative study utilized semi-structured interviews in order to collect firsthand experiences of stress and support during the COVID-19 pandemic from licensed foster parents in the state of Michigan (N=16). Preliminary results show that due to COVID-19, foster families' stressors increased, and their supports were strained. A common theme was difficulty with aspects of life turning virtual or completely stopping, such as biological parent visits, school, and child-related services. Another common theme was the benefits of foster families experiencing a smaller world and the bonding time it provides. This study contributes to existing literature by filling gaps regarding COVID-19 in general since knowledge of life in the pandemic is new. More specifically, the use of interviews allows for the voices of foster parents to be heard. Findings from the study have multiple implications for those who interact with the foster care system, such as more support resources for returning to or finding services in a pandemic and the need for therapy after such a traumatic time.

American Evangelicals, Islam & the Competition for Religious Authority

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American evangelical relations with Islam have undergone significant changes throughout our nation's history. Over time, the focus of this relationship has shifted between evangelical and religious saviorism to nationalist and orientalist thinking, leading up to the attacks of September 11, 2001, when Evangelical Christians began more strictly dictating the discourse regarding Islam with consistent themes of eschatological significance and radical othering. This growing tendency to understand and define Islam from an American evangelical perspective is most clearly observable in literature of the last half-century, which is dominated by apocalyptic, apologetic, and missiological genres. This project analyzes the discourse presented in evangelical books on Islam and how this discourse affects Christian-Muslim relations in both global and interpersonal spheres. Within this analysis, this project considers whose voices are most prominent and how evangelical rhetoric vis-a-vis Islam and Muslims is shaped by the social, political, and religious contexts of these authors.

Student Presenters

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> "Through film and in life, we must strive to turn our negatives into positives. Remember that beauty can be found in the least likely of places, even through the shadow appearing on a dusty kitchen floor."
>
> —*K. Winter*

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