



THE 20TH ANNUAL

Celebration of Undergraduate Research and Creative Activity

2021 ABSTRACTS

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WELCOME



April 30, 2021

Dear Friends,

I am excited to welcome you to the 20th annual Celebration of Undergraduate Research and Creative Activity (CURCA) at Hope College. This year will be the second time where CURCA will be offered in a remote fashion. WIth this mode, we are excited to showcase the results of student-faculty collaborations with local, regional, and global audiences.

Engaging students in the scholarship of discovery, creativity, and application is a distinctive mark in Hope's academic program. Moreover, at Hope we are committed to infusing our courses, ensembles, and studios with opportunities to make novel contributions to their fields while making enduring relationships with each other and faculty.

This year's CURCA includes over a hundred presentations by over two hundred students from twenty-four departments and programs. The abstracts from all the presentations are detailed in this annual CURCA Abstract Book, further celebrating and documenting the hard work that occurs year-round at Hope in faculty-student scholarly collaborations.

Thank you for your participation in and support of CURCA 2021. To learn more about student-faculty collaborative scholarship, visit the website: hope.edu/research

Sincerely,

Gerald D. Griffin
Interim Provost

Materiality in Art**Abby Wallar****Mentor:****Lisa Walcott,
Art & Art History**

The materials and research catalogues were supported by the Borgeson Scholar Program through the Department of Art and Art History at Hope College.

Professor Lisa Walcott and I conducted research over the summer focused on the many roles material can play in an artwork through investigations in the studio, exhibition catalogs, and research interviews. Our investigation was rooted in the premise that material understanding enriches an artist's visual vocabulary and understanding of the world. "The Allure of Matter," an exhibition exploring the role of materiality in contemporary Chinese art and served as a focal point for the research through analysis of the exhibition catalog and a research interview with co-curator Orianna Cacchione. Cai Guo-Qiang, an artist included in "The Allure of Matter", works with gunpowder on canvas representing human ingenuity, a complex history, political implications, power, brutality, survival and beauty.

The COVID-19 pandemic altered the planned research patterns, however, collaboration seemed more relevant than ever in such circumstances. The first five weeks of the project were conducted remotely through virtual connections and exchanges of small material sculptures we called the Small Sculpture Ping Pong Series. We took turns adding materials to each small sculptural piece ending the manipulations when we agreed the piece was finished. These small sculptures served as models for seven large sculptures which were made collaboratively in the studio during the second five weeks. The small sculptures had a doodle-like quality which was challenging to achieve in the large pieces. The materials necessarily scaled up and what could previously be twisted between our fingers now needed to be manipulated with the full body.

The work was exhibited in a research exhibition called "Let's Sit on It." Each of the seven large sculptures, along with the small ping pong sculpture series were included. Viewers were able to make formal and material connections among the pieces included. Collaboration, reaction, material, and interaction have emerged as the content of the work produced through this project.

**White Rhodesian Identity
and the Universal
Declaration of
Independence,
1900-1980****Peter Ruiter**

Mentor:

Dr. Lauren Janes,
History

Rhodesia was one of the last reactionary colonial holdouts. A remnant from a bygone age. Aside from the United States, Rhodesia was the only country to make a Universal Declaration of Independence (UDI) from the British Empire in 1965 under the conservative Rhodesian Front Party's leadership. White Rhodesian colonists had ruled the country through an apartheid state since 1923. They cultivated a unique national identity in which Rhodesians believed themselves to be the last true Britons in the world while acting in defiance of the British government. This study analyzes the identity's genesis during the management of the British South Africa Company and how it manifested during the UDI era under Ian Smith, party leader of the Rhodesian Front. Rhodesia was also able to garner considerable international sympathy for its plight, particularly among conservative segregationists and some Vietnam veterans who came as mercenaries to fight in the Bush War, which followed the UDI. The Rhodesian national identity had deep roots in white nationalism and a conservative fantasization of the past. Even today, some continue to identify with the Rhodesian Front party and its ideology, who have no connection with Rhodesia other than sympathy for the "white plight." Rhodesia places itself among the most unorthodox colonial nations in history, a microcosm of imperialism's internal contradictions and a stunning display in its collapse.

Exploration of Black American Music

Houston Patton
Michael Pineda
Dylan Sherman
Carlos Flores
Ka'niya Houston
Joe Wilkins
Eliseo Bustillos

Mentor:

Dr. Jordan VanHemert,
Music

Black American Music is the foundation of all popular music in the United States. This project includes two compositions performed by Hope College Jazz Combo I, learned in the African Oral tradition of the music. “Joe’s Idea”, composed by Joe Wilkins, is a medium tempo composition with several different textural layers. “Keep The Faith” by Donald Harrison is an uptempo gospel composition. By learning the lineage of Black American Music, my colleagues and I refined on the authenticity of our creative approach to improvisation.

Fleeing Oppression: A History of Self-Imposed Exile in Music

Daniel Tague

Mentor:

Dr. Sarah Southard,
Music

Music composition always occurs within a complex tapestry of personal, professional, and political situations. The past two centuries have given scholars many examples of how artists can be restricted, influenced, and even aided by cultural shifts. The Russian Revolution drove many composers to either implicitly support the new regime or exile themselves from the country. Igor Stravinsky and Sergei Rachmaninoff were two composers, who, though vastly different in writing style, experienced similar cycles of growth and career development. Each ended up exiling themselves from their native Russia, through which we can see two contrasting paths taken by immigrant artists to the United States.

**On Natural Evil, Free-will,
and Embodiment****Hannah R. Meade**

Mentor:

Dr. Jack Mulder,
Philosophy

*This research was supported
by the Howard R. And
Margaret E. Sluyter Faculty
Development Fund at
Hope College.*

The problem of evil is the question of how evil can exist in a world with a perfectly good, all-knowing, and all-powerful God. However, what if the existence of human beings as free agents necessitated some form of evil? This idea known as the free-will defense, argues that without the capability to perform evil, human free-will would be cheapened. The problem of natural evil, however, asks why God would permit pain or hurt to be caused by forces, like earthquakes or fires, outside of human control. Can the free-will defense, then, still be used to explain the existence of natural evil? The answer might depend on what counts as a natural evil. Does any slight harm or annoyance from nature count? T.J. Mawson thinks it does. If one took this position, however, one would have to accept several absurd notions of what counts as evil. For instance, the irritation you gain from having to peel a potato which will not peel itself could be considered a natural evil. But this is a problem because this means that the mere fact that humans have bodily limitations is evil. I will argue that this result is a problem for Mawson's argument.



The Intersection of Mental Health and Christianity**Emma Passaglia****Mentor:****Dr. Kate Finley,
Philosophy**

This work supported by the generosity of the Howard R. And Margaret E. Sluyter Faculty Development Fund at Hope College.

In this ongoing research project, we address the relationship between religion, faith (and related experiences, beliefs, and practices) and symptoms of mental disorder. This past summer we analyzed previous research on this topic, created new questionnaire and interview materials, gathered responses to questionnaires and conducted interviews with our target population, and began transcribing and coding data from the questionnaire responses and interviews. We specifically focused on the two components of this relationship between faith and mental disorder: 1) what negative impacts experiences of religion (faith, and spirituality) may have on subjects' experiences of psychiatric disorder, and 2) what positive impacts experiences of psychiatric disorder may have on experiences of religion (faith, and spirituality).

In our work last summer, we focused on gathering questionnaire responses and conducting interviews. We created a detailed questionnaire designed to assess how subjects experienced specific symptoms of mental disorder, their connection to the Christian religion and how these connections were mediated by various external factors (community, professional treatment, surrounding views of mental health, etc.), and gathered responses to this questionnaire from individuals who had experience with symptoms of psychiatric disorder(s) as well as experience with the Christian religion. We then created targeted, specific questions based on questionnaire responses for our interviews with subjects who voluntarily opted-in to participate. This allowed for further exploration of the subjects' experiences with their mental health and their experiences with Christianity.

While we are continuing to analyze our data from the questionnaires and interviews we have also arrived at some interesting preliminary results. On the first component mentioned above, we have found that views of mental disorder in Christianity were the external factor most likely to have a negative effect on subjects' experiences of psychiatric disorder. We also found that experiences of guilt and relational problems were the symptoms most often exacerbated by subjects' experiences of religion. On the second component mentioned above, we have found that the symptoms of depression, hopelessness, and anxiety were most often identified by participants as positively contributing to their experiences of religion. Furthermore, many subjects reported that these symptoms had this positive effect by increasing their sense of God's presence and their reliance on God, increasing their motivation to engage in spiritual practices, and by challenging or undermining false views about God and Christianity that they previously held. I will further address these results in my presentation.

**Drawn into Charity
by Charity****Jacob Kelley**

Mentor:

Dr. Jared Ortiz,
Religion

*Support for this project
came from the Haworth
Fund for the Study of
Markets and Morality.*

I propose that using an Augustinian framework, the Fall can be understood as man's descent from a state of unity and harmony, ultimately with God in his divine simplicity, to a state of disharmony, conflict, and division. Although we will never be fully restored to this primal unity this side of the resurrection, charity is the primary virtue that heals us by bringing us back into union with the God who is Love itself. This disunity, and growing back into unity by growing in love, have implications for all human relationships, including sexual relationships within marriage.

**Spousal Consolation:
Unveiling Conscience in
Augustine's *City of God*****Andrew Levering**

Mentor:

Dr. Jared Ortiz,
Religion

*Support for this project came
from the Norman And Ruth
Peale Fund at Hope College.*

St. Augustine's treatment of rape victims in Book I of *City of God* is often misinterpreted. There, he turns rape victims towards the testimony of their consciences for consolation. This can seem very incomplete to the modern reader, who often assumes the conscience to be cold and isolated; for St. Augustine, however, the conscience is intimate, perhaps even spousal. This paper attempts to unveil St. Augustine's consolation of rape victims, which, by turning a victim towards the testimony of his or her conscience, decisively breaks free from the inner workings of Roman sexual teaching. St. Augustine's turn to the conscience heals broken analogies and prevents isolation, freeing the victim from unnatural guilt that Roman sexual teaching reads into normal protective sensations of shame.

**Stage Management
of *Ordinary Days*****Annika Dekker****Mentors:****Reagan Chesnut,
Theatre****Dr. Daina Robins,
Theatre**

The Stage Manager is the person who is present from the very beginning to the very end of the process of producing a play or musical. As the Stage Manager for Hope College Department of Theatre's production of *Ordinary Days* this spring semester, I am responsible for being the first point of communication between all members of the cast and crew, keeping track of every detail of the production, running meetings and rehearsals, creating and maintaining production records, and being the person who calls every cue during performances. My role started in December before the cast was chosen and the design process began, and will end after a final reflective meeting once performances are finished in late April. As a student, this role is a large responsibility, but the skills and leadership experience I will gain through this opportunity will aid me later in both my creative and professional goals.

**Stage Management
of *Detroit '67*****Lydia Konings****Mentor:****Reagan Chesnut,
Theatre**

The purpose of this is to bring to light the experience of the Student Stage Manager for *Detroit '67* by Dominique Morrisseau, a production from the Hope Theatre Department in Spring '21. Through the lense Stage Management, the production process is one of paperwork, organization, and teamwork. Working heavily with the production team and the director; the stage manager helps implement the vision of the creative team. It all culminates in the week of technical rehearsals, when the stage manager transitions into the point person of the production, and ultimately during the performances where the stage manager calls all the lighting and sound cues to bring the work of the designers to life.

**Virtual Reality STEM,
Real Life Careers****Kate Pikaart
Nick Gersonde****Mentor:****Susan Ipri Brown
Engineering**

*This work funded by
Michigan Space Grant
Consortium, NASA
grant #NNX15AJ20H.*

In order to excite students about science, technology, engineering and math (STEM) careers, undergraduate education majors lead middle and high school students in creating virtual field trips highlighting STEM careers. Direct involvement of middle school students in development of interactive visual career explorations will increase students' confidence in ability to succeed in STEM careers. Working with Holland Public Schools, ExploreHope staff facilitate students creating four virtual field trips which will be made available to area middle schools. Given the limitations on schools for funding field trips and the potential for innovative programming in remote environments, the virtual field trips will function with VR head-sets or as stand-alone videos. Participating middle school students showed 11% simple growth in Likert Scale questions related to their understanding of STEM career paths.



Don Quijote and the Founding of the U.S.**Jamie Breyfogle****Mentor:****Dr. Tatevik Gyulamiryan,
World Languages & Cultures**

Throughout the book *Don Quijote*, Miguel de Cervantes uses his main characters and the situations in which they find themselves to create political commentary. Interestingly, the political views espoused in *Don Quijote* seem to have had some influence on the founders of the United States. Two of the most relevant political thoughts that appear in *Quijote*, and which were quite contrary to popular political thought during the time, and which later appeared in the writings and beliefs of the Founding Fathers, are the idea of natural aristocracy and the idea of equality in the eyes of the law. Through a study of library records and letters of the Founding Fathers, which expose their near universal deep interest in the book, as well as ancient philosophy which may have influenced both Cervantes and the founders, this project delves into the possibility that *Don Quijote* influenced the philosophies of the founders of the United States and thus on the political basis of the country.

Plague and Pandemic in Science and Story**Claire Buck****Mentor:****Dr. Curtis Gruenler,
English**

Narratives of epidemics and the social disruption they bring resonate with particular relevance in our own time. In the midst of the global pandemic that emerged late in 2019 and continues to cause widespread suffering, many have been grasping for a way to make sense of both the scientific and the social consequences. While the tumult and division wrought by COVID-19 might appear unprecedented, historian and philosopher René Girard would argue that the pattern of social disorder accompanying plague has repeated itself throughout history. While science has contributed immensely to our understanding of epidemics, there are some aspects of plague that are best perceived through story. At the same time, both the medieval and modern storytelling surrounding outbreaks of disease have frequently been misleading or even oppressive. Only by approaching from a literary and a scientific perspective can we arrive at an accurate understanding of past and present plagues. This paper analyzes both the medical and fictional narratives around the Black Death through the lens of Girard's mimetic theory in order to explain the public health conflicts that have arisen in the midst of our current pandemic.

**What Predicts Compliance
with COVID-19 Guidelines?
Evaluating the Relative
Roles of Self-Regulation,
Working Memory, and
Heart Rate Variability**

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Abigail Przekop

Avery Slancik

Jason Veldman

Haley Balkema

Ashley Hayden

Ryon Hinga

Linnea Johnson

Lindsey Medenblik

Jimmy Tran

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Mentors:

Dr. Lindsey Root Luna,
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Dr. Alyssa Cheadle,
Psychology

*This work was supported by
the Collaborative Research
in the Sciences.*

Due to the global COVID-19 pandemic, behavioral recommendation compliance (e.g., social distancing, mask wearing) has been highly encouraged. Some individuals willingly adopt these practices whereas others vehemently oppose them. Working memory capacity (WMC) significantly predicted social-distancing compliance during early stages of the pandemic (Xie et al., 2020). WMC is one component of self-regulation, the ability to manage thoughts, emotions, and behaviors aligned with goals (Holzman & Bridgett, 2017). Heart rate variability (HRV), the interbeat variation of R-R intervals, can be utilized as a physiological index of self-regulation broadly, and WMC specifically, due to vagus nerve innervation of the heart and connection to the prefrontal cortex (Laborde et al., 2015; Shaffer et al., 2014). However, physiological factors as predictors of COVID-19 mitigation behaviors have yet to be evaluated. The present study investigates the relative strength of WMC, self-regulation, and HRV as predictors of compliance with COVID-19 mitigation behaviors.

This study utilizes a between-subjects correlational design to evaluate HRV, WMC, and self-regulation as predictors of COVID-19 mitigation behaviors. Participants (psychology undergraduate students anticipated $N = 100$, and Prolific sample anticipated $N = 200$) complete baseline measurements of HRV at rest (1 minute) via photoplethysmography (PPG): a smartphone's flashlight illuminates the skin and reflect into the camera; the resulting data highly correlates with traditional ECG recordings (Plews, et al. 2017). Participants then complete a visual change localization task to assess WMC (Xie et al. 2020) and assessments of demographics, self-regulation, behavioral recommendation compliance, mental health, substance use, and overall health.

We aim to partially replicate Xie and colleagues' (2020) findings regarding WMC and examine the impact of top-down self-regulation and physiology on mitigation behaviors during the COVID-19 pandemic. Discerning the impact of psychophysiological factors and self-regulation on compliance has the potential to optimize public health interventions.

**Evaluating the Relationship
between Religiousness
and Health Outcomes:
Investigating Heart Rate
Variability and Self-
Regulation as Possible
Mediators**

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Lindsey Medenblik
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Ryon Hinga
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Mentors:

Dr. Lindsey Root Luna,
Psychology

Dr. Alyssa Cheadle,
Psychology

In the present study, we sought to evaluate possible mechanisms linking religiousness and health outcomes. Previous literature has connected religiousness to self-regulation and positive health behaviors (McCullough & Willoughby, 2009). Self-regulation—the process of monitoring goal-related behaviors, impulses, and responses—reliably predicts health behaviors and has been posited as a mediator between religiousness and health outcomes (Carver & Scheier, 1998; Cheadle & Dunkel Schetter, 2017). Heart rate variability (HRV), a measure of the beat-to-beat variation in heart rate, is one physiological indicator of self-regulatory capacity and strength (Segerstrom & Nes, 2007). Although previous studies have illustrated the connection between self-regulation and religiousness, and between self-regulation and HRV, the connection between religiousness and HRV has not been evaluated.

This study utilizes a between-subjects correlational design to evaluate religiousness as a predictor of health through self-regulation and HRV. Participants (undergraduate psychology students anticipated $N = 100$, and Prolific sample anticipated $N = 200$) utilized a smartphone application employing photoplethysmography, a validated method to collect HRV data remotely (Perrotta et al., 2017). Participants also completed measures of religiousness (religious identity, self-reported service attendance, and relative importance of religion), self-regulation, and demographics, along with substance use and health measures. Additionally, participants completed a working memory capacity task for another study.

This study will empirically evaluate self-reported self-regulation and a physiological indicator of self-regulation (HRV) to examine the influence of religiousness on mental and physical health through self-regulation. Understanding this mechanism will aid in collaborative efforts between disciplines and could contribute to future wellness interventions.

**Identification of Genes
that are Differentially
Expressed in the HCA
Animal Model of Bipolar
Disorder through qPCR
Analysis**

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Mikala MacGeorge
Anna Lunderberg

Mentor:

Dr. Leah Chase,
Biology and Chemistry

*This work was supported
by the Schaap Endowed
Fund for Undergraduate
Research and the Hope
College Neuroscience
Program.*

The discovery of an association between elevated levels of homocysteine (HCY), oxidative stress and mood disorders led us to test the hypothesis that homocysteic acid (HCA) may act as a potential trigger for the development of bipolar disorder. We performed daily intraperitoneal injections of HCA in rat pups from postnatal day 3 to 17 and observed that these animals developed manic and depressive behaviors following puberty. Subsequent analysis showed that these behaviors exhibited in the HCA rats could be reversed by treatment with lithium, a common drug used to manage manic and depressive episodes in humans with bipolar disorder. Collectively, these studies suggested that we created a novel animal model of bipolar disorder. Therefore, in this study we sought to better understand the specific effects of HCA at the molecular level. We performed a comparative RNA microarray analysis of tissue collected from the prefrontal cortex of control ($n=4$) and HCA-treated female rats ($n=4$) and identified 132 differentially expressed genes at postnatal day 21, and 316 differentially expressed genes at 32 weeks of age. We are currently using qPCR to perform gene expression analysis of a subset of those genes identified in our original screen from tissue obtained from more animals in order to verify the results obtained in the microarray analysis. We are focusing on genes associated with myelin production and oligodendrocyte development in the tissue obtained from younger animals as these were the most commonly identified genes immediately following HCA treatment. However, we are examining genes which are known to regulate neuronal excitability and interneuron abundance in tissue from the older animals as these genes were the predominant class of genes identified in the 32 week old animals. Ultimately, this analysis will allow us to determine if the changes we observe in gene expression in our animal model match those observed in individuals with bipolar disorder and provide us with a better understanding of the molecular events that are involved in the development of the disease.



Does Phosphorylation of System x_c^- Lead to Changes in Cell Surface Localization?

Jane Ellen Altevogt
Claire Buck

Mentor:

Dr. Leah Chase,
Biology and Chemistry

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

System x_c^- is a membrane transporter that is highly expressed in astrocytes and GABAergic interneurons in the brain. The transporter exchanges intracellular glutamate for extracellular cystine, the rate limiting reagent for the production of the antioxidant glutathione. Therefore, this transporter plays a key role in the cellular response to oxidative stress and the regulation of extracellular glutamate levels in the brain. Previous studies in our lab demonstrated that System x_c^- is regulated by the oxidative state of the cell. Specifically, the transporter exhibits increased cell surface expression within ten minutes of exposure to H_2O_2 in confluent U138MG human glioma cells. More recently, we demonstrated that activation of the cellular kinase, Akt is necessary for transporter translocation to the plasma membrane in response to H_2O_2 . Since phosphorylation of neurotransmitter transporters, e.g. the dopamine transporter, is known to regulate trafficking to and from the membrane, we hypothesized that Akt activation following H_2O_2 exposure alters the phosphorylation status of System x_c^- (either directly or indirectly) thereby regulating its trafficking to and from the plasma membrane. To test this hypothesis, we identified 20 putative phosphorylation sites on xCT using a combination of the P-site phosphorylation predictor algorithm (Kinexus) and a literature-based screen. All of these sites are highly conserved across species and 16 of these sites are localized on the cytoplasmic domains within the protein. We are creating phosphorylation-null ($S/T \rightarrow A$) and phospho-mimetic ($S/T \rightarrow E$) mutations of the 16 cytoplasmic sites so that we can screen each mutant for transport activity in the presence and absence of hydrogen peroxide. Those mutants which exhibit altered transport activity relative to wild-type will be further assessed for cell surface expression. Thus far, we have created phosphorylation-null and phospho-mimetic mutants at six of these sites and we are currently assessing the activity of these 12 mutants. Ultimately, this analysis will allow us to determine whether phosphorylation of xCT regulates cell surface expression.

Knockout of VACM-1/cul5 Gene in Endothelial Cells Using CRISPR/Cas9 Regulates Cellular Response to Antiproliferative Compounds

**Megan Flynn
Emily Smith
Gatwiri Mwenda**

Mentor:

**Dr. Maria Burnatowska-Hledin,
Chemistry**

*This work was supported by
the Thomas L. Riechel
Endowed Fund for Summer
Research in Chemistry*

The VACM-1/cul5 protein found in human endothelial cells is a component of the CRL5 E3 ligase complex. This protein complex working in the Ubiquitin Proteasome System (UPS) is responsible for tagging proteins with ubiquitin for degradation by the proteasome. Previous work has demonstrated that VACM-1/cul5 dependent E3 ligase decreases cellular proliferation. This reduction in regulation of the ubiquitin proteasome pathway can result in uncontrolled cell growth and tumor formation. Utilizing the CRISPR/Cas9 system, a bacterial immune system used for editing genomic DNA, the VACM-1/cul5 gene was targeted and knocked out in human umbilical vein endothelial cells (HUVEC). AlmarBlue® growth assays and LDH cytotoxicity assays were used to demonstrate the effects of antiproliferative compounds in HUVEC cells. Our work showed that absence of VACM-1/cul5 in HUVEC leads to a significant increase in cellular proliferation and compromises cell response to growth inhibiting compounds. These findings indicate VACM-1/cul5 as a potential cancer treatment target for drug design and development.

The Role of Circulating Mitochondrial DNA in the Inflammatory Response in Neurological Disorders

Gonzalo E. Moya

Mentors:

**Dr. Kristin Dittenhafer-Reed,
Chemistry**

**Dr. Phillip Rivera,
Biology**

*This work was supported by
the Sheldon & Marilyn
Wettack Summer Research
Fund and the Hope College
Schaap Endowment.*

Mitochondria are regarded as the center of cellular metabolism. In addition to their important role in energy production, these organelles are integral in many other cellular processes, including the immune response. One way mitochondria can trigger an immune and inflammatory response is through the release of mitochondrial DNA (mtDNA). mtDNA shares common features with bacterial DNA, eliciting a cellular immune response. mtDNA release into the cytosol and bloodstream can occur as a response to many different types of tissue damage and stress, including hypoxia, sepsis, traumatic injury, excitatory cytotoxicity, and drastic mitochondrial membrane potential changes, to name a few. In this work, we explored the signaling role of mtDNA in neuroinflammatory processes. First, a brief overview of the different mechanisms by which mitochondria release mtDNA and the stimuli that trigger these responses will be discussed. Then, we will briefly highlight some of the better characterized neurological disorders in which mtDNA acts as a key damage associated molecular pattern and leads to a neuroinflammatory phenotype. We also highlight preliminary findings of our studies on mtDNA levels in addicted mice.



**Post-Translational
Modifications of
Mitochondrial RNA
Polymerase Provide a
Potential Regulatory
Mechanism for mtDNA
Transcription**

**Katelynn Paluch
Matthew Gross
Helen Dodge
Karlie Platz**

Mentors:

**Dr. Kristin Dittenhafer-Reed,
Chemistry**

*This material is based upon
work supported by the
National Science Foundation
under Grant No.1814845.*

Mammalian cells contain genetic information in two compartments, the nucleus and the mitochondria. Mitochondrial DNA (mtDNA) encodes thirteen protein subunits required for oxidative phosphorylation (OXPHOS). The remaining mitochondrial proteome is encoded by the nuclear genome, which includes additional OXPHOS subunits in addition to the proteins necessary for mtDNA replication and expression. Therefore, to respond to metabolic changes, mitochondrial gene expression must be coordinated with nuclear gene expression; however, the mechanisms of this communication and regulation of mtDNA transcription remain unclear. We hypothesize that protein post-translational modifications (PTMs) may play a regulatory role in mtDNA transcription. These modifications include threonine/serine phosphorylation and lysine acetylation, which can alter the physical and chemical structure, as well as the function of the protein. Previous research in the Dittenhafer-Reed lab on mitochondrial transcription factor B2 (TFB2M) has shown that PTMs, phosphorylation in particular, can inhibit mtDNA binding and transcription, providing a potential regulatory mechanism. This research is focused on mitochondrial RNA polymerase (POLRMT), the only enzyme involved in transcription initiation. POLRMT initiates transcription after TFB2M melts mtDNA at the promoter region. Multiple PTM sites have been identified via mass spectroscopy in previous studies, including the acetylation of lysine 402. To mimic acetylation, this amino acid was mutated to a glutamine, which mimics the size and shape of an acetyl group, or an arginine. WT and mutant POLRMT were purified and mtDNA binding was analyzed using fluorescence polarization. In order to analyze PTMs of POLRMT in human cell lines, multiple experiments were performed using wild type POLRMT to determine the optimal cell culture conditions for POLRMT overexpression as well as to establish baselines for cellular studies involving mutated POLRMT.

**Genomic Analysis of Novel
B9 Mycobacteriophage
PenguinLover67**

Quinn Baar
Natnael Belay
Kayla Carpenter
Alexis Erickson
Therese Joffre
Sophie Klanseck
Lydia Konings
Ellie Marion
Rachel Mast
Jenna Mustapha
Madeleine O'Donnell
Tasia Parsons
Allison Ziemba

Mentor:

Dr. Joseph Stukey,
Biology

*This work was supported
by the Hope College
Department of Biology.*

Fourteen 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 or direct plating at 37°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 PenguinLover67 was chosen as one of two phages for complete genome sequencing and comparative genomic analyses. The predominant plaque produced by PenguinLover67 after 24-48 hours at 37°C was clear with well-rounded edges and approximately 1 mm in diameter. The complete genome sequence for PenguinLover67 showed it was similar to mycobacteriophages of cluster B, subcluster B9, which now contains 4 sequenced members. PenguinLover67 is most similar to the B9 phage CRB2. The genome size of PenguinLover67 is 70,299 bp, making it the smallest of the B9 mycobacteriophage genomes. The PenguinLover67 genome contains 97 protein-encoding genes and no tRNA or tmRNA genes. PenguinLover67 contains several interesting genomic features including multiple copies of a conserved 17-bp sequence (GCGGGAHYGSCCCCGCG) found adjacent to 8 genes in the right arm of the genome. Five of those repeats also have an additional 26-bp conserved sequence (GTGCAWWWDCCCKCCCWTGTCGGTAT) element nearby. The genomic positions and specific orientations of the sequences relative to the translation initiation sites of adjacent genes suggests these elements may have a role in influencing translation as proposed for the Start Associated Sequences found in Cluster K mycobacteriophages. PenguinLover67 also contains 4 ORPHam genes. Comparative analysis suggests their presence may impact expression of adjacent genes. In all 4 cases, the quality of the Ribosome Binding Site (RBS) for the adjacent gene is much stronger in comparison to the RBS scores for the corresponding genes in the highly similar B9 phage, Quesadilla, which lacks all 4 ORPHam genes. PenguinLover67, like many other Cluster B mycobacteriophages – but not those in the well-represented B1 and B2 subclusters – also carries a gene (81) encoding a component of the HicAB Type II toxin-antitoxin system found in many bacteria.

**Genomic Analysis
of Novel L2
Mycobacteriophage
Vetrix**

**Natnael Belay
Quinn Baar
Kayla Carpenter
Alexis Erickson
Therese Joffre
Sophie Klanseck
Lydia Konings
Ellie Marion
Rachel Mast
Ellie Megel
Jenna Mustapha
Madeleine O'Donnell
Tasia Parsons
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Mentor:

**Dr. Joseph Stukey,
Biology**

*This work was supported
by the Hope College
Department of Biology.*

Fourteen 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 or direct plating at 37°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 Vetrix, isolated by direct plating, was chosen as one of two phages for complete genome sequencing and comparative genomic analyses. The predominant plaque produced by Vetrix after 24-48 hours at 37°C was 1-2 mm in diameter and a little turbid. The complete genome sequence for Vetrix indicated a relationship to mycobacteriophages of cluster L, subcluster L2, and greatest similarity to the L2 phage, LilDestine. Further, the genome of Vetrix, at 76,520 bp in length, is larger than many other L2 mycobacteriophage genomes. The Vetrix genome contains about 130 protein-encoding genes and 11 tRNA genes. Despite its strong similarity to other L2 mycobacteriophages, Vetrix does have uniquely interesting genomic features including several novel genes not represented in current databases, and a small region with several genes that are less commonly found in other mycobacteriophages, including those of Cluster L. One gene in this region may encode a restriction endonuclease with a role in the hijacking of the host cell during phage infection. The predicted protein of a second small gene in this region appears to contain a LIM domain, which are conserved protein domains known for mediating protein-protein interactions in a variety of metabolic processes in both prokaryotic and eukaryotic cells.



**Genetic Changes of
Lignification Genes
between Trees and Shrubs****Lukas Bruxvoort**
Victoria King**Mentors:****Dr. Jianhua Li,**
Biology**Dr. Leah Chase,**
Biology and Chemistry*This work funded by
Michigan Space Grant
Consortium, NASA
grant #NNX15AJ20H.*

Lignins are a vital component of vascular plant cell walls that aids in plant growth, protection against pathogens, and environmental adaptability. They are also an important carbon sink due to the difficulty of decomposition by bacteria and fungi. Previous studies have shown that lignin production is negatively correlated with wood volume or biomass. Trees produce a much greater biomass than shrubs, suggesting that lignin production may be less in trees than in shrubs. There are over 20 lignification genes each with one to multiple copies, and their gene expressions affect the production of lignins. Little study has been done to examine genetic changes between trees and shrubs that are closely related. In this study, two lignification genes phenylalanine ammonia-lyase 1 (PAL1) and laccase 17 (LAC17) were obtained using the targeted genomic sequencing technology from trees and shrubs in *Corylus* (hazelnut), *Cornus* (dogwood), and *Populus* and *Salix* (poplars and willows). These two genes are involved in the production of lignin units and polymerization of individual units, respectively, providing a model to explore the genetic changes between trees and shrubs. Our results showed a variable number of changes from trees to shrubs in the three woody plant groups in both PAL1 and LAC17 genes. However, for the PAL1 gene, there were twice as many transitional changes as transversional changes, while for the LAC17 gene, the two changes were similar. Our next steps are to examine the other copies of both genes to see whether the pattern holds and to focus on whether any of the genetic changes are in the active sites that directly affect the function of the gene in the production of lignins.

The Effect of Serotonin on Male Responses to Female Ultrasonic Vocalizations and Urine in the House Mouse (*Mus musculus*)

Madisyn Kovacs

Lindsay Jankowski

Brooke Van Wyk

Sarah Yonker

Lindsay Martin

Mentors:

Dr. Kelly Ronald,
Biology

Dr. Laura Hurley,
Indiana University

This work was supported by the Michigan Space Grant Consortium, NASA grant #NNX15AJ20H; a Beckman Scholars Program award from the Arnold and Mabel Beckman Foundation; the Indiana University's Center for the Integrated Studies in Animal Behavior (CISAB); and the of the National Institutes of Health under Ruth L. Kirschstein National Research Service Award T32HD049336.

Animals communicate with multimodal signals (i.e., a mix of auditory, visual, or olfactory information). Signals that span several modalities may provide animals with more complete information to allow for greater accuracy in behavioral decisions. In addition, 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. In our experiment we asked the question: Does an increase in the precursor for serotonin (i.e., 5-HTP) affect the behavior of mice (*Mus musculus*) when exposed to multimodal stimuli? Mice are known to use multimodal signals (e.g., ultrasonic vocalizations, i.e., USVs, and olfactory cues) during communication and therefore are appropriate models for this experiment. USVs are often the first indication of a valence change in a mouse. USV playback for conspecifics has been shown to alter mouse behavior. To test our hypothesis, we presented olfactory (e.g., female urine) and auditory (e.g. female USVs) stimuli to male mice. Prior to the behavioral experiment, mice were either given an injection of 5-HTP or saline. 5-HTP has been shown to increase serotonin in the inferior colliculus, a region of the auditory midbrain, which plays a role in the processing of vocalizations. 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. We predicted that sexual activity and interest behavior would increase in 5-HTP animals. These results will shed light on the role of serotonin in multimodal communication during an intersexual interaction.

Needs to be filled
in with the relevant
NIH Center/Institute

Sex-differences in Ethanol Addiction Observed in Mice with a Novel Self-administered Behavioral Paradigm

Paulina Kozan
Erick Alvarado
Mikayla Zobeck
Vanessa Sauer

Mentor:

Dr. Phillip Rivera,
Biology

According to the World Health Organization, addiction is a compulsive behavior that affects ~275 million people worldwide. In 2017, the National Survey on Drug Use and Health reported that 19.7 million Americans (ages 12 and older) battled a substance use disorder. Previous studies show the importance of sex-differences in describing pathologies of mental health disorders, such as addiction, between males and females. Moreover, differences in immunity and inflammatory responses are observed between males and females in humans and mice. One way to determine these differences in innate immune involvement is to focus on microglia, resident immune cells found in the brain, and their function during the onset of addiction. Studies have shown that the intrinsic features of microglia, such as morphology and molecular traits, are affected in a sex-dependent manner. First, a group of mice were trained to establish a preference for ethanol (EtOH) via drinking in the dark (DID), a 4-day binge paradigm. Two days later, they were introduced to ethanol conditioned place preference (eCPP), an 8-day behavioral paradigm that can be used to study the rewarding and aversive effects of EtOH. On the last day of eCPP, 90 minutes post-test, mice were sacrificed and their brains extracted for molecular analyses of inflammatory cytokines. This process was repeated with a second group of mice and data from both groups were combined. Thus, if we can understand the contribution of resident microglia to the onset of addiction in a sex-dependent manner, we may be able to develop sex-specific treatments of addiction.

Understanding the Impact of Chronic, Low-dose Proton Radiation on Behavior and Systemic Inflammation in Mice

Corine LaFrenier
Benjamin Gleeson

Mentors:

Dr. Phillip Rivera,
Biology

Dr. Paul DeYoung,
Physics

Andrew Bunnell,
Physics

NASA's 2018 strategic plan outlines four main objectives for safely sending astronauts to and beyond lunar orbit within the next few decades. Among the many goals of these objectives, understanding the responses of physical and biological systems to radiation is a crucial step in sending astronauts deeper into outer space. To date, research has focused almost exclusively on the effects of mimicked space radiation using high-dose rates of ions with a high atomic number. However, the present study examined the effects of chronic, low-dose proton radiation on behavior and systemic inflammation in mice as this is the most abundant particle found in space radiation. We hypothesized that exposure to chronic, low-dose proton radiation would negatively impact behavior by causing lasting systemic inflammation in the body. To do this, mice were irradiated with a low dose of 0.17 mGy of protons per day on 13 non consecutive days resulting in a cumulative dose of ~2.5 mGy. After 10 weeks post-irradiation, mice underwent behavioral testing to examine stress-related behaviors. The present study found that irradiated mice exhibited increased activity levels and compulsion-like behavior as determined by the open field test and the marble burying assay, respectively. These behaviors have a presentation similar to attention-deficit hyperactivity disorder (ADHD) and/or obsessive compulsive disorder (OCD). However, further research is warranted in order to fully understand the magnitude and physiological mechanisms responsible for the observed behavior.

*This work funded by
Michigan Space Grant
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Optimizing Protein Precipitation Methods and Quantifying Immune Proteins in Human Nail Samples

**Eliese Moelker
Mikaela Stephan
Nathan Koorndyk
Elizabeth Ngun Cer Sung
Alexander Mathew**

Mentor:

**Dr. Phillip Rivera,
Biology**

The objective of this project was twofold: continued optimization of protein precipitation in human nail samples, and identification and quantification of immune proteins present in human nails. Over the past semester, we collected survey data and fingernails from Hope College participants. Protein was precipitated from the nail samples using a variety of methods and solutions (TRIzol, Shindai, and F3) in an ongoing effort to develop an efficient protocol that can be easily replicated. An aggregate sample was used to identify and quantify immune cytokines present in healthy individuals. These results will be used in future studies to establish baseline immune cytokine levels in young adults. Advantages of using nail tissue range from a low cost screening tool, increased availability of diagnostic testing, and eventually better patient outcomes, especially if early detection of mental disorders can be determined. Therefore, this minimally invasive technique, which is also much less expensive than current blood and serum analysis, has the potential to provide early detection and treatment of mental disorders, which may result in a better prognosis and functional outcome in adult life.

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

**Morgan Sherrard
Lindsay Martin
Timothy Boycott
College of William and Mary**

Mentors:

**Dr. Kelly Ronald,
Biology

Dr. Megan Gall,
Vassar College**

This material is based upon work supported by the Hope College and Vassar College Departments of Biology.

Birds use multimodal signals (e.g., combined auditory and visual signals) to communicate. Multimodal signal propagation through the environment can be influenced by abiotic factors like habitat structure. Deer can alter habitat structures by consuming the forest understory; indeed, past research showed that pure-tone propagation is affected by deer density. These changes could ultimately have fitness consequences for the bird species acoustically communicating. Nevertheless, it is still unknown whether other sensory modalities, like vision, are impacted by deer browsing. Preliminary work from the Ronald lab found a statistical interaction between deer presence and forest type on the chromatic contrast (i.e., how much an object stands out from the visual background) of brown-headed cowbird plumage. The current study investigated achromatic contrast, the contrast of an object from the background based on luminance difference. Both chromatic and achromatic contrast are modeled using four parameters: the reflectances of the background, ambient light, reflectance of the object, and the receiver's visual system. The background reflectance (i.e., forest understory) and irradiance measurements were taken in both deciduous and mixed forest types and at 2 different heights from the forest floor (i.e., low and high). We predicted that deer browsing would impact achromatic contrast of feather plumage against the forest background. Specifically, we predicted that areas that allow deer to move freely will allow birds to stand out more from their background. Additionally, we expected the effects of deer browsing would be greater at lower heights because deer consume more of the landscape and forage at lower heights. In the future, different species of birds will be studied to determine if chromatic and achromatic contrast will be affected similarly due to deer browsing. Taken together, this work will shed light on how different environments can drastically affect the way birds communicate with each other.

**Testing Changes in
Bacteriophage Genome
Structure for Effects
on Viral Fitness**

**Matthew Switalski
Stephen Bojanowski**

Mentor:

**Dr. Joseph Stukey,
Biology**

*This work was supported
by the Hope College
Department of Biology.*

How genes and genomes evolve in organisms is a pertinent question in the research of life's evolution. That applies to all organisms, even bacteriophages (phages), which are viruses that infect bacteria. Phages are one of the simplest and the most numerous "organisms" on Earth, and are believed to be very old, perhaps as old as their bacterial hosts. The genomes of just a small sampling of all phages show them to have an enormous amount of genetic diversity, suggesting their genomes are constantly under change. What drives and shapes that change is the underlying focus of this project. One expected force of change is biological fitness – those organisms with greater comparative biological fitness (i.e., those that have a selective, reproductive advantage) will pass relatively more of their genetic material to subsequent generations over time. We hypothesize that a driving mechanism could be a "gene-packed" genome state: phage genomes with many, tightly-spaced genes. Our prediction is that phages with genomes tightly-packed with genes have a reproductive advantage over phages with comparatively less gene-packed genomes. We used a collection of 5 different pairs of genome-modified variants of mycobacteriophage Giles, in which for each pair, the sequence of a particular non-essential gene was scrambled to encode a biologically irrelevant protein (representing the gene-packed state) or non-coding, intergenic space (representing the comparatively less gene-packed state). The non-essential genes targeted for modification are found in various positions in the phage Giles genome and on both strands of DNA. As we anticipate the effect of the difference between paired genome modifications on phage growth may be small, we are working through multiple methods, ranging in sensitivity, to comparatively test the growth of each modified phage pair. Two related experimental approaches measuring fecundity (measuring how many new phages are produced in a defined period of time) in solid and liquid media growth conditions did not support our predicted relationship between fecundity and genome density. However, testing is still ongoing with different procedures that are hopefully more sensitive and precise in measuring fitness.

Understanding Water Quality in the Lake Macatawa Watershed using Machine Learning

Alexander Bauer
Madeleine Rabitoy

Mentors:

Dr. Brent Krueger,
Chemistry

Dr. Aaron Best,
Biology

This material is based upon work supported by the National Science Foundation under Grant Nos. 1039925, 1616737, and 1919571. This research was also supported by the Herbert H. and Grace A. Dow Foundation, the Schaap Research Fellows Program, the Schaap Endowed Fund for Undergraduate Research, and the Department of Chemistry.

Water samples were taken from twelve sites in the Lake Macatawa watershed at weekly intervals from 2016 to 2018 and analyzed for a variety of characteristics, such as temperature, nutrient concentrations and bacterial community composition. We have applied machine learning algorithms to predict some of these characteristics based on the bacterial community data. Programs were built using 21 different classification algorithms in Python using TensorFlow and Scikit-learn. All classifiers have demonstrated reasonably good accuracy predicting geographical and seasonal features of the data. The same classifiers have been applied to fecal contamination data from Roguet et al. and are compared here.

Roguet et al. *Microbiome*. 2018. Fecal source identification using random forest.



**Computing UV-Vis-NIR
Absorbance Spectra
of a Library of Novel
Long-Wavelength
Azo Dyes**

Colin Bradley

Mentor:

**Dr. Jason Gillmore,
Chemistry**

Acknowledgment is made to the Donors of the American Chemical Society Petroleum Research fund, for partial support of this research. This project was also supported by the Hope College Chemistry Department's Schaap Research Endowment and Schaap Fellows Program. This material is also supported by the National Science Foundation under Grant Nos. 1919571, 1039925, and 0520704.

Nearly a decade ago Aprahamian and coworkers first reported their accidental discovery (Yang, *et al.*, *J. Am. Chem. Soc.* 2012) of a series of BF_3 -coordinated azo dyes which photoisomerize at much longer (lower energy) wavelengths than conventional azo dyes. They published a second paper using electron donors on only the phenyl moiety to tune spectroscopic and photophysical 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.

The Gillmore group has recently launched a newly funded project to capitalize on our ability to functionalize the quinoline ring of the dyes. This has the potential to allow significantly expanded spectroscopic tuning of these dyes. We have proposed several hundred possible targets, far more than we could ever synthesize in the next 3-5 years. 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 we have now realized that the single computational prediction of the parent dye made by Aprahamian & Hughes was a fluke. Computational predictions of the spectra of known substituted compounds have been found to differ in a random and inconsistent manner compared to experiment. We spent a fruitless year attempting to vary functionals, basis sets, solvent models, and other parameters, guided in part by conversations with computational chemists including Hughes himself. We have now recently decided to focus our efforts on attempting to achieve qualitative rank ordering of the dyes' long-wavelength absorbance maxima rather than quantitatively match spectra or wavelengths. In this presentation, I detail the struggles we experienced and the knowledge we have gained over the past year.

**Parameterizing
Fluorescent Protein
Chromophores for
Molecular Dynamics
Simulations**

**Kimberly L. Breyfogle
Dalton L. Bood
Andreana M. Rosnik**

Mentor:

**Dr. Brent Krueger,
Chemistry**

Fluorescent proteins (FPs) are important to many studies of protein function, and we plan to examine them in the future using molecular dynamics (MD) simulations. Before running MD, fluorescent protein chromophore parameters must be determined that are consistent with the latest version of the Cornell et al. force field (1995, J. Am. Chem. Soc.), ff14SB (Maier et al., 2015, J. Comp. Theo. Chem.) along with the generalized AMBER force field (Wang et al., 2004, J. Comput Chem.). Parameterization was carried out using quantum mechanical calculations to determine the optimized geometry and electrostatic potential of each chromophore. The restrained electrostatic potential (RESP) charge fitting procedure was used to derive atomic charges. All other parameters (Lennard-Jones, Bond length, Bond Angle, Dihedral Angles) were assigned by analogy to pre-existing force field parameters. Complete MD parameters are presented for the chromophores of six common FPs: EGFP, mCherry, DsRed, EBFP, EYFP, and ECFP.

This material is based upon work supported by the National Science Foundation under Grant Nos. 1058981, 1039925 and 1919571, MU3C, Schaap Research Fellows Program, Schaap Endowed Fund for Undergraduate Research, and the Hope College Department of Chemistry.

**Methoxy-Substituted
Quinaldines for
Electron-Rich
Long-Wavelength
Azo Dye**

**Thomas Cygan
Claudia Bouma
Colin Bradley**

Mentor:

**Dr. Jason Gillmore,
Chemistry**

Acknowledgement is made to the Donors of the American Chemical Society Petroleum Research Fund, for partial support of this research. Additional support is provided by the Hope College Chemistry Department's Schaap Research Endowment and Schaap Fellows program.

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.

The Gillmore group has recently launched a newly funded project to capitalize on our ability to functionalize the quinoline ring of the dyes. This has the potential to allow significantly expanded spectroscopic tuning of these dyes. In this presentation we showcase specific efforts toward methoxy-substituted analogs of these dyes.



**Synthesis of Titanium
Dioxide Nanoparticles for
Solar Disinfection from
Aqueous Solutions**

S. Charles Davenport
Lindsey Boltz
Liam Diephuis
Luke George
Tristan Porter
Anna Molloy

Mentor:

Dr. Natalia Gonzalez-Pech,
Chemistry

This work funded (partially funded) by Michigan Space Grant Consortium, NASA grant #NNX15AJ20H.

Solar Disinfection (SODIS) is a preexisting method of water disinfection developed around the 1980s to inexpensively disinfect drinking water by utilizing UV rays to kill microbes and render pathogens ineffective in drinking water. Users would fill a plastic bottle with water, shake to oxygenate, and lay out in the sun for a certain amount of time ranging from 6 hours to 2 days. Although this water disinfection method has been proven to reduce viruses, bacteria, and protozoa in water, the current length of time required as well as the inability to pretreat water of higher turbidity are a few of the drawbacks of SODIS. Titanium dioxide anatase nanoparticles could improve SODIS by acting as a catalyst. Past studies have shown TiO_2 to disinfect water within 15 minutes. By synthesizing titanium dioxide nanoparticles from aqueous solutions, we can get a better understanding on which sizes of particles are most effective in UV disinfection of drinking water.

**Design of New
Nanomaterials for
Arsenic Remediation**

Liam Diephuis
Luke George
Lindsey Boltz
Anna Molloy

Mentor:

Dr. Natalia Gonzalez-Pech,
Chemistry

Heavy metal pollution is a serious problem for communities around the world. In regions with high concentrations of arsenic or other heavy metals in soil, drinking water reserves in waterways and aquifers absorb them, frequently at levels that are harmful to human health. To develop a novel technology to remove heavy metals from drinking water, Dr. Natalia Gonzalez-Pech has developed multifunctional nanoparticle collectors (MNCs) made of magnetite or anatase. These MNCs hold smaller nanoparticles, and resist agglomeration when placed in a filter setup. Heavy metals in solution bind to the nanoparticles, and are removed from the water. These MNCs were analyzed using SEM and DLS, and were shown to have spherical shapes with diameters of 200-300nm. BET analysis was used to measure the surface area of the nanomaterials and approximate their effectiveness. The MNCs were placed in a column to simulate conditions in the field, and a solution of arsenic was pumped through the column. By measuring the arsenic concentration after being pumped through the column, the MNCs were shown to have promising activity towards absorption of arsenic from water. Should the MNCs be reliably effective at removing heavy metals from water, in a real filter pack over long periods of time, this technology can improve drinking water and quality of life for communities around the world.

Morphology of EDOT Films Depends on Monomer Identity**Macy Elarton
Isabelle Dial****Mentors:****Dr. Elizabeth Sanford,
Chemistry
Dr. Kenneth Brown,
Chemistry;****Dr. Mary Elizabeth Anderson,
Furman University**

Poly(ethylenedioxythiophene) (PEDOT) is formed from the electropolymerization of ethylene dioxythiophene (EDOT) to give polymer films with good mechanical stability, and excellent electronic and optical properties for a variety of applications, including the development of electrochemical sensors. This study was designed to examine the differences in the surface morphology of the electropolymerized films as the functionalized EDOT monomer was varied. EDOT monomers were prepared for this study and then were electrochemically polymerized using cyclic voltammetry (CV) on indium tin oxide (ITO) glass. The surface morphology of the resulting films was analyzed using scanning electron microscopy (SEM). The wettabilities of the films were also investigated using contact angle goniometry. The surface morphology and wettability data from each of the films were then compared to unsubstituted PEDOT films. Significant differences in surface morphology and wettability were observed among the monomers and when compared to PEDOT.

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

Synthesis and Implementation of Copper Nanomaterials into Iron Oxide Nanoclusters for CO₂ Remediation**Luke George
Anna Molloy
Lindsey Boltz
Liam Diephuis****Mentor:****Dr. Natalia Gonzalez-Pech,
Chemistry**

CO₂ has recently been painted in a very negative light, mostly in regard to climate change and CO₂ emissions. Countless corporations are now attempting to reduce CO₂ emissions by any means necessary. However, the ability to utilize CO₂ would be a revolutionary concept with many very useful applications. One potential use of CO₂ could be the creation of hydrocarbon fuels. In order to begin the process of utilizing CO₂, we have synthesized a library of multifunctional nanoparticle collectors (MNCs) made of iron oxide nanomaterials. To create a variety of MNCs, we have used different combinations of surface coatings and polymers consisting of polyethylene glycol, polyethylenimine, or polyacrylic acid. We have also synthesized these nanomaterials at 150, 175, or 200°C. The first step to reach the ultimate goal of this project was to analyze the library and find if we could regulate the size and structure of the iron nanoclusters by varying the temperature and materials used in synthesis. The data was collected with SEM imaging as well as DLS. Should we be able to regulate the size and shape of the MNCs, we can then move forward to integrating other elements into the clusters for many varieties of applications.

This material is funded by Michigan Space Grant Consortium, NASA grant #NNX15AJ20H.

**Preparing Electron-Poor
and Electron-Rich
Quinaldines for
the Tuning of
Long-Wavelength
 BF_2 -Dyes**

Madeline Kokmeyer

Ethan Cramer

Nick Beers

Mentor:

**Dr. Jason Gillmore,
Chemistry**

Acknowledgement is made to the Donors of the American Chemical Society Petroleum Research Fund, for partial support of this research.

Additional support is provided by the Hope College Chemistry Department's Schaap Research Endowment and Schaap Fellows program, and the Hope College Dow Scholars program.

Aprahamian and coworkers first reported their initial accidental discovery (Yang, Y.; Hughes, P.; Aprahamian, *I. J. Am. Chem. Soc.* 2012, 134, 15221-15224) of a novel BF_2 -coordinated azo dye which photoisomerizes at much longer (lower energy) wavelength than conventional azo dyes nearly a decade ago. They subsequently demonstrated that they could tune the spectroscopic and photophysical properties of these dyes (Yang, Y.; Hughes, P.; Aprahamian, *I. J. Am. Chem. Soc.* 2014, 136, 13190-13193) with electron-donating groups on the phenyl moiety before returning to their intended hydrazone chemistry research.

At Hope College, the Gillmore organic photochemistry research group has recently launched a newly funded project to capitalize on our ability to functionalize the quinoline ring of these dyes. This has the potential to allow significantly expanded tuning of the dyes' absorbance spectra. We can create even more electron-rich versions of the dyes bearing electron-donating groups on both the quinoline and the phenyl moieties. Alternatively we can explore "push-pull" analogs with electron-withdrawing groups on the quinoline and electron-donating groups on the phenyl. Thus far our synthetic efforts have focused on the electron-rich or electron-poor quinaldines and quinolinyl acetonitriles necessary to prepare such dyes.

**The Development
of Multifunctional
Nanoparticle Collectors
for Water Filtration
Processes**

Anna Molloy
Lindsey Boltz
Charles Davenport
Liam Diephuis
Luke George
Tristan Porter

Mentor:

Dr. Natalia Gonzalez-Pech,
Chemistry

*This material is funded by
Michigan Space Grant
Consortium, NASA
grant #NNX15AJ20H.*

A large array of nanomaterials have been synthesized around the world with the intent of improving living quality and energy sustainability. The Gonzalez-Pech (Goch) group is working on the development and synthesis of multifunctional nanoparticle collectors (MNCs) that will be implemented in water filtration and CO₂ recycling processes. These MNCs are highly valuable as they maintain properties of both precursors and can thus act more efficiently in remediation practices. Precursor synthesis in the Goch lab has focused on several different materials, including iron oxide, zinc oxide, and titanium dioxide. These materials have then been integrated in different combinations to develop a variety of MNCs. These MNCs were chemically characterized to understand their structure, functionality, and appropriate applications. Upon proper synthesis and characterization, these MNCs will be useful in many ways and create a more sustainable way of living.

**An Iron Porphyrin
Substituted EDOT Film
Acts as a Redox Mediator
to Detect Glucose
Electrochemically**

Nathan Trumble
Terrell Solberg

Mentors:

Dr. Elizabeth Sanford,
Chemistry

Dr. Kenneth Brown,
Chemistry

*Funding from Schaap
Endowed Funds for
Undergraduate Research,
and the Hope College
Chemistry Undergraduate
Research Fund.*

Diabetes mellitus, a disease characterized by insulin deficiency and subsequent hyperglycemia, is a world-wide public health crisis. The ability of patients to accurately monitor and manage hyperglycemia dramatically reduces the associated health complications of diabetes. Although glucose enzyme electrodes have been used successfully, permanent *in vivo* sensors are still not available. Fundamental research in glucose sensing will contribute to the eventual development of improved medical devices. Improving electron flow among the components in an electrochemical sensor can lead to enhanced sensor performance. Most electrochemical glucose sensors use an electrode functionalized with glucose oxidase to detect glucose. Redox mediators facilitate electron transfer between the enzyme and the electrode. We have synthesized an iron-porphyrin functionalized ethylenedioxothiophene (EDOT) monomer and an aminomethyl ethylenedioxothiophene (AMEDOT) monomer. The EDOT substituted iron porphyrin was prepared via a 4-step synthesis. The AMEDOT was synthesized via formation of the azide followed by reduction. These monomers were electropolymerized to form a redox mediating film on a glassy carbon electrode and then functionalized with glucose oxidase. The iron-porphyrin functionalized EDOT provides redox capabilities and the AMEDOT crosslinks the enzyme to the redox mediating film and serves as a crosslinker. The resulting electrochemical sensor detects glucose at 1 mM. Currently we are focused on device fabrication to improve the performance of the sensor.

**Carbon-Carbon Bond
Activation: A New
Chemical Frontier**

**Erik Schoonover
Eric Salisbury
Jacob VanderRoest**

Mentor:

**Dr. Jeffrey Johnson,
Chemistry**

This material is based upon work supported by the National Science Foundation under Grant Nos. 1148719 and 17164118, the Hope College Department of Chemistry, Dow Scholars Program, Schaap Endowed Fund for Undergraduate Research, and by an award from the Henry Dreyfus Teacher-Scholar Award Program.

The purpose of this poster is to present organic chemistry research to a general audience. The research of the Johnson lab focuses on carbon-carbon (C-C) bond activation. Organic compounds are held together by a framework of these C-C bonds. These C-C bonds are notoriously difficult to break in a selective manner. They are nonpolar and thermodynamically stable. One example of activating C-C bonds is the burning of organic compounds, producing water and carbon dioxide. However, this is not selective nor all that useful for making new compounds in a controlled manner. What the Johnson lab looks to do is to activate these bonds selectively. Using a variety of nitrogen-containing directing groups and the transition metal, rhodium, the Johnson Lab has found many routes to synthesize novel compounds through the activation and functionalization of C-C bonds. The Johnson lab studies these reactions by way of general reaction scope analysis to determine the potential of a reaction. The group also looks into how these reactions proceed by looking into the mechanisms. This is done by a variety of kinetic studies. The results have produced a deeper understanding of how directing groups control the reactivity of C-C bonds and new simple pathways to synthetically difficult compounds.



**Pioneer Plant Seeds
Contain Antifungal
Compounds****Nicholas Weigle
Elliott J. Berens****Mentors:**Dr. Elizabeth Sanford,
ChemistryDr. K. Greg Murray,
Biology

This work funded by the Schaap Endowed Funds for Undergraduate Research, Herbert H. and Grace A. Dow Scholars Award, the Sheldon & Marilyn Wettack Summer Research Fund, and the Hope College Chemistry Undergraduate Research Fund.

Phytolacca americana, commonly known as pokeweed, is a pioneer plant native to North America. The seeds of pioneer plants remain dormant in the seed bank until they encounter high light conditions caused by a disruption in the ecosystem, such as a canopy gap. Pioneer plants thrive in the high light conditions and establish growth in the altered ecosystem. To enable longevity in the seed bank, despite constant threats from the environment, pioneer plants contain chemical defenses in the form of biologically active compounds. We seek to isolate and identify the compounds in the seeds of *P. americana* that protect them from fungal attack in the seed bank. Methanolic extracts were used to isolate a broad range of organic compounds from the *P. americana* seeds. These extracts were separated by preparative thin layer chromatography (TLC) into fractions. Antifungal activity for each fraction was assessed using poisoned-medium bioassays with pathogenic fungi. Fractions with antifungal activity were then examined further. Caffeic aldehyde and isoamericanin A were identified using ¹H-NMR, and ¹³C-NMR in the most active fractions. Both caffeic aldehyde and isoamericanin A exhibited significant fungicidal activity in pure form. Other unidentified components of the extract also show significant toxicity. Current efforts seek to better separate and identify the remaining components of the mixture and assess their antifungal toxicity. The work will be extended to identify the active antifungal components in *Phytolacca rivinoides*, a related pioneer plant found in Costa Rica.

**Before the Next Pandemic:
Developing a Framework
for Assessing Online Labs
to Maximize Student
Experience****Grace Zwiers****Mentors:**Dr. William Polik,
ChemistryClayton Piehl,
Chemistry

The year of 2020 affected virtually all strata of the economy. Specifically, education systems around the world suffered from long-lasting shutdowns, requiring schools to innovatively reach and teach their students in an effective and relevant manner. When Elisa Villanueva Beard, the CEO of Teach for America, was asked in *How I Built This* what the future of teaching post-pandemic will look like, she replied, “My hope is that teaching looks very different as a norm than it did before. This is a chance for us to really lean into a reinvention.”

One of these reinventions involves the relocation of centrifuges, scales, and test tubes from the lab bench to the computer screen: virtual laboratories! By exploring the relationship between evaluated learning components and reported student experiences of a remote General Chemistry lab, this educational research study aims to develop a framework for assessing online labs. The framework could be employed by educators around the world to gauge the qualities of learning that online labs possess before a student even opens their screen.

**Calibration of OpenSim
Lifting Full-Body Model
for Dynamic Simulations
of Patient-handling
Maneuvers**

**Barry Bait
Bridget Gagnier**

Mentor:

**Dr. Brooke Odle,
Engineering**

This material is funded by the Michigan Space Grant Consortium, NASA grant #NNX15AJ20H, and the Clare Boothe Luce Research Scholars Program of the Henry Luce Foundation.

Manual patient-handling tasks are associated with lower-back pain and injury. Computational musculoskeletal models may determine forces on the low back, trunk muscle activation during these tasks, and provide insight on how these may result in injury. There are no publicly available models for these tasks. To determine the appropriateness of the OpenSim Full-Body Lifting Model for these tasks, this project calibrated the model with biomechanical data of simulated maneuvers performed by a test subject. Thirty-nine reflective markers were placed bilaterally on bony prominences (forehead, back of head, clavicle, sternum, C7, T10, epicondyle of humerus, styloid process, metacarpal, anterior and posterior iliac crests, calcaneus, toe, upper arm, forearm, thigh, and shank). Ten electromyography (EMG) sensors were attached to the bilateral external obliques, rectus abdominis, thoracic and lumbar erector spinae, and rectus femoris. The subject performed three maneuvers 15 times while standing on two force plates: a twisting motion at the hips, a one arm raise, and a shallow squat. Kinematic data were collected at 100Hz, and EMG and force plate data at 1000Hz. The kinematic and kinetic data were applied to the model to scale and perform inverse kinematics and dynamics. It is recommended that the maximum marker errors be between 2 and 4 centimeters for inverse kinematics and about 2 centimeters for scaling. However, the acceptable error may vary by application. In our trials the maximum errors for inverse kinematics varied between 1 and 10 centimeters. During a lifting trial, the left forehead marker was the only marker with high error. Since that marker is mainly important for scaling, a high error in inverse kinematics shouldn't affect the simulation predictions; so our calibration procedure ignores high errors from non-essential markers. Our calibration procedure will provide a framework for evaluating simulated results and the feasibility of the model for patient-handling tasks.

Synthesis of Cinnamate Derivatives for Liquid Crystal Polymer Alignment Studies**Jacob Kowalski
Abigail LaDuke****Mentor:****Dr. Matthew Smith,
Engineering**

This work partially funded by Michigan Space Grant Consortium, NASA grant #NNX15AJ20H with additional support from the Matthew J. and Anne C. Wilson Fund for Faculty Development at Hope College.

Liquid crystal elastomers (LCEs) are polymeric materials that combine the property of molecular order with rubber elasticity. When the liquid crystal units are aligned, these materials can experience significant, reversible shape changes under exposure to heat or light. Current methods for alignment are limited in their scalability for manufacturing. Some methods are also limited in their ability to pattern certain alignment directions. A method for obtaining LCEs in any possible geometry with little to no restriction on alignment will enable further advancement of the field of programmable polymer materials. The long term approach of the Smith group is to develop a technique for LCE alignment by incorporating UV light responsive constituents into the LCE that can align and crosslink the polymer chains. Cinnamate derivatives are promising candidates for the light responsive constituent. Certain cinnamate derivatives have been shown to influence low molecular weight LC alignment in display technology applications. The goal of the current project is to synthesize a cinnamate derivative with an amine functional group that can be easily incorporated into an LCE via an aza-Michael addition reaction. If successful, knowledge from this work could provide new options for patterning alignments in 2D and 3D adaptive structures.

A Power Series Approach for Heat of Vaporization Predicted by the SRK Equation**Natalie Rowe****Mentor:****Dr. Michael Misovich,
Engineering**

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

Equations of state like the Soave-Redlich-Kwong (SRK) equation are used to predict the thermodynamic properties of various substances. In previous research, a new adjusted temperature variable, η , was introduced to simplify calculations of equilibrium properties. The goal of this project was to continue using the adjusted temperature variable in both the SRK and Clapeyron equations to model heat of vaporization. An existing calculation algorithm for the Clapeyron equation in reduced temperature was modified to express a new variable, the adjusted heat of vaporization, as a power series in the adjusted temperature. Coefficients of the power series consisted of a constant, K_1 , and a second term proportional to the acentric factor function of the SRK equation, $K_2 f(\omega)$. The series using K_1 constants followed the predicted SRK heat of vaporization data to within the same multiplicative factor, which was used as an empirical adjustment. Constants up to the seventh series term were verified; constants for higher order terms were calculated but began to diverge from the predicted SRK data. Work continues to replace the empirical correction with an exact calculation, to find higher order constants which converge to the SRK data, and to evaluate the constants K_2 for the terms proportional to the acentric factor function.

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

**Josephine Surel
Elizabeth Cutlip**

Mentor:

**Dr. Jeffrey Christians,
Engineering**

*This research was supported
by the Hope College Dean of
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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 a user 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 phase halide perovskites, as well as into mixed 2-D/3-D perovskite films. 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 crystal phase. We find that in some 2-D perovskite systems, deintercalation of the methylamine gas is incomplete, resulting in the formation of some $\text{CH}_3\text{NH}_3^+\text{PbI}_3$; 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. When integrated into a hybrid 2-D/3-D structure of the type $\text{A}'_2(\text{CH}_3\text{NH}_3^+)_n\text{Pb}_n\text{I}_{3n+1}$, where A' is a strongly binding $\text{R}-\text{NH}_3^+$ moiety such as phenethyl ammonium (PEA), these materials show promising reversibility for methylamine intercalation/deintercalation. This work reveals the relative affinity of various $\text{R}-\text{NH}_3^+$ molecules for the halide perovskite lattice, showing that many of these are not replaced by methylamine, and indicates that templating the 3-D $\text{CH}_3\text{NH}_3^+\text{PbI}_3$ structure with long-chain ammonium cations could lead to better reversibility in dynamic photovoltaic windows. On the other hand, some of the same features which could lead to better intercalation/deintercalation of methylamine should result in improved thermal stability in mixed 2D/3D materials. Characterization by x-ray diffraction revealed significant variation in degradation rates for mixed 2D/3D materials upon exposure to dry heat. Work continues to connect thermal stability to the methylamine intercalation and deintercalation reversibility, to develop improved guidelines for the design of 2D/3D halide perovskite materials for an array of applications.

Vapor Induced Phase Transition of Cesium Lead Halide Perovskite Thin Films for Novel Use in Solar Cells

**Zachery Wylie
Peter Ruffolo**

Mentor:

**Dr. Jeffrey Christians,
Engineering**

This work was funded by Michigan Space Grant Consortium, NASA grant #NNX15AJ20H, the Department of Engineering at Hope College, and the Hope College Dean of Natural and Applied Sciences.

In recent years, perovskite solar cells have emerged as a promising new alternative to the current silicon-based panels which have dominated the market. Research was done to characterize the black to clear phase transition undergone by thin films of cesium lead halide perovskite when exposed to various solvent vapors. The thin films of a cesium lead halide perovskite were exposed to a constant partial pressure of different solvent vapors, and the kinetics of the transition from the perovskite phase to the non-perovskite δ -phase were tracked by absorption spectroscopy. We find that other common solvents, in addition to the previously known water and alcohols (MeOH and EtOH), will catalyze this phase transition. Interestingly, we find sigmoidal kinetics for this process, indicating a cooperative nature whereby the transition of one domain further catalyzes the subsequent transition of other domains. Furthermore, we find that the rate of the phase change appears to be affected but not wholly governed by molecular dipole strength. This foundational work yields deepened understanding of the mechanisms of the clear to black phase transition in halide perovskites. In future, perovskite solar cells could be designed to resist undergoing this phase transition, so that they remain black and photovoltaically active, or they could potentially be designed to exploit this transition in a product such as a dynamically switching photovoltaic window.



**Analysis of Heavy Metals
in *Ictalurus punctatus*
(channel catfish) and
Perca flavescens (yellow
perch) in Lake Macatawa,
Holland, Michigan**

**Ashish Duvvuru
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Mentor:

**Dr. Jonathan Peterson,
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by the Macatawa Area
Coordinating Council, the
City of Holland, and the
Department of Geological
& Environmental Sciences
at Hope College.*

In this study performed by Hope College Department of Geology and Environmental Sciences, 184 fish were taken from Lake Macatawa and the Black River from 6 different locations between July and November, 2019; 85 fish were analyzed as target species (Channel Catfish and Yellow Perch). Fish tissues were analyzed for 14 different metals, including Antimony (Sb), Arsenic (As), Barium (Ba), Cadmium (Cd), Cerium (Ce), Chromium (Cr), Copper (Cu), Iron (Fe), Lead (Pb), Magnesium (Mg), Manganese (Mn), Nickel (Ni), Selenium (Se), and Zinc (Zn). Metal concentrations in yellow perch tissues are statistically higher than the results of one study which reported averages for yellow perch in the Great Lakes Area. Metal concentrations measured in the current study are similar to values reported from lakes in Ontario with a high potential for metal contamination. On average, Se and Cr levels in fish tissue are above World Health Organization (WHO) recommended guidelines by approximately 2x to 5x, the applicability, implications, and significance of which were not investigated in this study. The recommended next step in this project is to analyze freshwater drum (a.k.a., sheepshead), *Aplodinotus grunniens*, for heavy metals, including mercury (Hg). A longer term project should be to incorporate data from perch, catfish and sheepshead into a systematic investigation of the bottom sediment chemistry at the six sampling locations. This integrated information would provide a basis of understanding to help determine the potential anthropogenic sources of metal contamination in Lake Macatawa.

**Effects of Differences in
Cell Wall Biochemistry
on the Microbial
Decomposition of
Sphagnum (Peat Moss)**

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Mentor:

**Dr. Michael Philben,
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Globally, peatlands store twice as much carbon as there is in the atmosphere as CO₂. As average global temperatures continue to rise, the growth or decay of these carbon stores will play an important feedback for future climate change. This study examined the mechanisms behind the rate of decomposition in *Sphagnum* mosses, specifically the differences in cell wall chemistry between species. We hypothesized that mosses from different microtopographies will differ in rate of decomposition, as previous studies have shown that hummock mosses have higher concentrations of recalcitrant structural carbohydrates in their cell walls compared to hollow mosses. The *Sphagnum* moss was collected from the Miner Lake Bog in Allegan Township, Michigan. We sampled three sites for each species and a site for one terrestrial *Polytrichum* species for comparison of a non-*Sphagnum* moss. Moss was cleaned of all extra organic matter and separated into 15 replicate incubation bottles for each type of moss. The moss was adjusted to 70% of its water holding capacity and a native microbial inoculum was added. The incubation bottles were wrapped in foil to prevent further photosynthesis and stored to begin decomposition. The moss samples were analyzed by gas chromatography to measure the rate of CO₂ production during decomposition. Our data shows the rate of decomposition of the Hollow moss was significantly higher than the hummock and the non *Sphagnum* moss. This is consistent with our hypothesis that structural carbohydrates in hummock mosses reduce their rate of decomposition. The control had no moss and was treated with inoculum but did not exhibit CO₂ production, demonstrating that decomposition of organic matter in the inoculum did not affect the results. Our continuing work is using gas chromatography/mass spectrometry to determine the specific carbohydrates responsible for the observed differences in decomposition.

**Seasonal Geochemistry
of an Intertidal Wetlands
at Saugatuck Harbor
Natural Area, Michigan**

**Amelia Waalkes Hanson
Alexis Koehl
Christian Lundy
Lauren Bryan**

Mentors:

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and Environmental Sciences
at Hope College.*

Intertidal wetlands (slacks) form where the wind scours the sand to the water table within the dune complexes along Lake Michigan's shore. Numerous slacks lie in a coastal dune complex at Saugatuck Harbor Natural Area, Allegan County, Michigan. We collected groundwater samples from a monitoring well network in and around the largest slack, ~1.25ha, and surface water samples from multiple locations within the slack in summer 2019 and winter 2021. Summer samples were analyzed for dissolved oxygen (DO) and pH. Winter samples were analyzed for DO, pH, selected cations (calcium, magnesium, potassium), anions (chloride, nitrate, sulfate), and organic acids (formate, acetate, propionate, butyrate). Surface water DO values averaged 11.8ppm and pH averaged 6.6ppm in winter. Summer surface water DO values averaged 1.8ppm, pH averaged 8.9. Colder water slows the decomposition of organic matter, lowering the demand for DO within the water. With summer's warmer temperatures, photosynthesis increases, removing carbonic acid from and adding oxygen to the water, thereby increasing pH. However, warmer temperatures also increase vegetation decay, thus greatly decreasing DO. Calcium, magnesium, potassium, and chloride concentrations in groundwater and surface water were comparable. For example, calcium concentrations in groundwater and surface water averaged 40ppm and 43ppm, respectively. However, sulfate and nitrate concentrations decreased along a gradient from outside the wetland into the wetland. Nitrate decreased from 4.87ppm outside to 0.96ppm inside the wetland. Sulfate decreased from 1.89ppm to 0.66ppm along the same gradient. Decreasing sulfate suggests anaerobic degradation of organic matter by microorganisms. Decreasing nitrate points towards uptake by plants and/or denitrification by microorganisms, indicating the wetlands are a nitrogen sink. Organic acid concentrations varied widely, reflecting localized and dynamic conditions within and around the wetland. Hence, the amount of anaerobic respiration and the potential for methanogenesis requires additional sampling during varying conditions and seasons to assess.

Designing a Theory-Based Physical and Educational Intervention to Promote Strength in Adolescent Girls

Rachel Dohm

Mentors:

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Evidence reveals most adolescent girls are physically inactive and many are also overweight or obese. Interventions aimed at increasing physical activity (PA) among youth often involve promoting cardiovascular fitness while neglecting strength building. The purpose of this study was to design theory-based physical and educational intervention components for the “Be Strong” themed week of the larger proposed Intervention to Support Physical Activity Independence and Routine Everyday (INSPIRE) pilot randomized controlled trial. Intervention components were developed using the Information-Motivation-Behavioral Skills (IMB) Model, a social psychological model that emphasizes three components leading to behavioral change: information, motivation, and behavioral skills. A literature review was conducted focusing on effective teaching strategies, barriers that prevent exercise, and methods to increase muscle strength in adolescent girls. The 8-week INSPIRE study will be conducted at a Midwest undergraduate institution with the intervention group consisting of 36 inactive eighth grade girls. Results showed that adolescents learn best in supportive and active environments. Primary barriers to PA for adolescents include distractions and lack of confidence, and resistance training is most effective in increasing muscle strength of adolescents. This study also produced intervention components involving activity and demonstration to teach information, guest speaker and group discussion to increase motivation, and demonstration and participation to promote behavioral skills. Overall, the “Be Strong” intervention week is ready for implementation. Limitations include lack of published literature regarding strength building among inactive adolescent girls. Nursing interventions should emphasize the importance of meeting PA guidelines, including strength building, for the long-term health of adolescents.

Development of the “Be Physical” Intervention Protocol for the INSPIRE Randomized Control Trial

Maria Egloff

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Nursing

Evidence shows that adolescent girls are less active than boys, putting them at greater risk for cardiovascular disease and other chronic illnesses. Most interventions aimed at increasing physical activity (PA) among this population have been unsuccessful in effecting lasting change. The purpose of this project was to develop the intervention protocol for one week of the Intervention to Support Physical Activity Independence and Routine Everyday (INSPIRE) pilot randomized control trial (RCT). This RCT involves an 8-week summer program for inactive adolescent girls that incorporates the Fitbit Inspire activity tracker and application. The Information-Motivation-Behavioral (IMB) Skills Model guided this project, as its central components focus on how information and motivation directly and indirectly impact an individual’s health behaviors. Methods used to develop the weekly theme of “Be Physical” involved conducting a literature review and incorporating national PA guidelines. The curriculum focuses on increasing knowledge of PA opportunities, motivation to be active with others, and the behavioral skill of habit formation. The “Be Physical” curriculum will be delivered to adolescent girls (n=36) in the intervention group at an undergraduate institution in West Michigan during week 5 of the 8-week intervention. Results demonstrate a curriculum incorporating: 1) five effective teaching strategies; 2) four benefits of being active with others; and 3) four ways to promote habit formation. The intervention protocol is ready for implementation. Limitations include limited literature concerning habit formation in the adolescent population. Results can be utilized by nurses to provide effective interventions that promote lasting PA routines among adolescent girls.

**Maternal Provision of
Mother's Milk and Birth
Trauma in the Neonatal
Intensive Care Unit:
A Grounded Theory
Analysis**

**Emma West
Samrawit Kelkay**

Mentor:

**Dr. Anita Esquerra-Zwiers,
Nursing**

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Development Fund*

Less than half of very low birth weight (VLBW, < 1500 grams) infants are discharged from the neonatal intensive care unit (NICU) receiving mother's own milk (MOM), despite its demonstrated importance. Nevertheless, few studies have explored the impact of maternal perceived trauma (MPT) on infant feeding outcomes. The purpose of this study is to describe MPT among mothers of hospitalized VLBW infants and examine infant feeding outcomes with MPT. This analysis is derived from a grounded theory study exploring the maternal provision of milk among a convenience sample of mothers with VLBW infants at a Midwest NICU. This study utilized semi-structured interviews and content analysis to identify common themes (n=30). Data were analyzed using Dedoose, web-based data management and analytical software. A preliminary analysis identified trauma as a prominent theme. Trauma was defined as a mother's perceived inability to process an experience at the time of the event, a lack of understanding during the time of an event, and the rapid decline of either maternal or infant health. The occurrence of MPT (n=865) was reported most frequently in women described as Black (46%), multipara (57%), married (75%), and ages > 30 (57%). The MPT frequency was greater with cesarean (54%) and hypertensive (71%) births. The MPT frequency with MOM was 63%, but only 23% with exclusive MOM at discharge. This study's limitations include using a single hospital location and only English-speaking mothers, making the results less generalizable. Additionally, the interviewer's Latina racial identity may have led to a sense of kinship with some mothers. A better understanding of MPT and those at risk for MPT will allow providers the opportunity to identify interventions to increase MOM feedings at discharge proactively.

Simulation and Measurement of the Microgap Threshold Electric Field**Miguel Castelan Hernandez**
William Zywicki**Mentor:****Dr. Stephen Remillard,**
Physics

This material is based upon work supported by the U.S. Department of Energy, Office of Science, Office of Fusion Energy Sciences Award Nr. DE-SC0019062 and the L.T. Guess Physics Summer Research Fund.

Gases were excited by the high electric field of a microgap (gap size < 500 μm) using a microwave resonator placed inside of a vacuum chamber. Over a range of chamber pressures and microgap dimensions, the ionization of argon gas was examined with respect to a collisional model. Using an electromagnetic field simulator, the electric field strength inside the microgap was computed in order to determine the threshold electric field (at breakdown). A relationship between gas pressure and the threshold electric field was observable and was found to depend strongly on microgap size, and understood in light of a model previously developed by our group for microwave driven plasma. A fitting program using a transcendental method, which was written in order to analyze this model, illuminates sensitivities to fit parameters in the pressure regime in which the fit is applied. Different breakdown behaviors were found to dominate in two different pressure regimes. The lower pressure regime is more sensitive to changes in the collision frequency per Torr, while the upper regime is controlled by changes in the sensitivity of the threshold electric field to pressure. This is consistent with the physical understanding of the system.

Determining the β -Decay Intensity Functions of ^{62}Cr and ^{65}Fe **William von Seeger****Mentor:****Dr. Paul DeYoung,**
Physics

This material is based upon work supported by the National Science Foundation under Grant No. 1911418.

The rapid neutron-capture process, known as the r process, is one of several processes that predict the formation of elements heavier than iron. The β -decay intensity function reveals key nuclear structure properties that are necessary to accurately model the r process. Measurements of ^{62}Cr and ^{65}Fe , nuclei involved in the r process, were made at the National Superconducting Cyclotron Laboratory. A beam of multiple exotic nuclei with similar charge to mass ratio, known as a “cocktail” beam, was created in the A1900 fragment recoil separator and delivered to the experimental station. The beam was implanted on a Double-sided strip detector (DSSD), which also detected β particles from the decay of the exotic nuclei. Coincident γ rays were detected in the Summing NaI(Tl) (SuN) detector. The nuclei of interest were unique because the half-lives of the daughter nuclei were shorter than, or comparable to the half-lives of the parent nuclei. To account for this, a novel process for correlating the implantation of particles to the decay of both the parent nuclei and the daughter nuclei was established. Along with the novel correlation method, the analysis method of Total Absorption Spectroscopy was employed to extract the β -decay intensity functions.

**Exploring Techniques
of Synthesizing Prussian
Blue Analogues****Kamaron Wilcox
Forest Rulison****Mentor:****Dr. Jennifer Hampton,
Physics**

This material is based upon work supported by the National Science Foundation under Grant Nos. 1608327 and 0959282. Additional support made possible by the Howard R. And Margaret E. Sluyter Faculty Development Fund at Hope College.

Prussian blue analogues (PBAs) are a crystalline substance ($MFe(CN)_6$ where M is a metal) that derive from Prussian blue (PB) ($FeFe(CN)_6$). While PB has been used as a blue pigment for paintings, its crystalline structure permits the intercalation of cations when immersed in electrically conducting solutions for use as a battery material. Given the relative scarcity of Li compared to Na or K, it may prove useful to conduct research in developing the cathodic sides of batteries capable of intercalating ions larger than lithium. When paired up with the anodic side, these batteries would fall under the name sodium-ion or potassium-ion batteries. Due to their inexpensive production, composition of abundant elements, and porous structure, PBAs prove useful candidates for future sodium-ion or potassium-ion batteries. Two general methods exist for direct electrochemical synthesis of PBAs: the first is a two-step method involving the deposition of a high-spin metal layer followed by a modification with a hexacyanoferrate ($[Fe(CN)_6]^{3-}$) solution, and the second is a one-step method involving deposition of the high-spin metal concurrent with modification by $[Fe(CN)_6]^{3-}$. We explored the one-step method by subjecting indium-tin-oxide (ITO) samples to varying potentials in a solution containing Na^+ , Ni^{2+} , and $[Fe(CN)_6]^{3-}$. Cyclic voltammetry (CV) as well as energy-dispersive x-ray spectroscopy (EDS) were used to characterize these samples. In CV, we observed varying peak shapes that indicated the quality of the sample and quantity of deposited PBA. Additionally, EDS provided a rough estimate of Ni:Fe ratio and the quantity of PBA present in the samples. This research illuminated our understanding and practice of the one-step method, although the problem of efficiently and controllably synthesizing PBA with this method still stands. We continue to explore this technique in an effort to more effectively synthesize PBA materials for potential use in sodium-ion or potassium-ion batteries.

Racism Exists and America Isn't Looking**Elizabeth Bassett**

Mentor:

Dr. Sarah Kornfield,
Communication

This Is America (2018), a music video by Donald Glover, exposes viewers to a brutal reality of racism in America. In a close analysis of *This is America*'s video, lyrics, and musicality, I argue that *This Is America* prompts its audience to wrestle with their own discomfort as they engage with an unfiltered portrayal of American racism. *This Is America* utilizes archetypes, polyvocality, and visual rhetoric to respond to conversations on race that recur in American media and history. By supplying an honest and often-ignored perspective of Black Americans, this music video thereby encourages viewers to replace ignorance with urgent antiracist action.

The Beauty in Being a Boy**Ellie Jankowski**

Mentor:

Dr. Sarah Kornfield,
Communication

The 2018 film *Beautiful Boy* directed by Felix Van Groeningen is a true story about a boy's struggle with addiction and the ways in which it affected his family's life. I argue that this story helps to shed light on the issue of addiction and build empathy towards it, but it only does so for straight, white, middle-class men. This ultimately furthers ideas of white supremacy and patriarchy. This is done through several important themes and storylines that run throughout the film, as well as several specific film techniques.

**Voices of Humanity:
Rough Translation's
"El Hilo: Walking to Venezuela" and
Reframing Refugee Crises****Hailey Schumann**

Mentor:

Dr. Sarah Kornfield,
Communication

"El Hilo: Walking to Venezuela" which aired on NPR's podcast *Rough Translation* (July 22nd, 2020), offers an apt example for how news coverage can reframe refugee stories. By examining the text's portrayal of an individual refugee and the implications of the podcast medium on storytelling, I assert that "El Hilo: Walking to Venezuela" counteracts common anti-immigrant rhetoric, which places migrant people as dangerous strangers, and instead presents its protagonist's story as an epic narrative. This depiction of a refugee hero facing opposing obstacles redirects attention to the plight of refugees, thereby inviting listeners to value refugees as individual human beings.

**How Does Terrorist Activity Affect a Country's Tourism Receipts?****Cameron Geddes**

Mentor:

Dr. Sarah Estelle,
Economics & Business

According to the Global Tourism Database, worldwide confirmed deaths from terrorism rose to an all-time high in 2014, reaching 44,490 in a single year. Terrorism as a political mechanism is designed to change the behavior of governments. To this end, terrorists may seek to impose economic burdens on target countries including damage to the target's tourist centers. Established economic theory reveals a number of causal paths by which terrorist acts might reduce international travel to a country. If the utility a tourist derives from a locale is positively related to its perceived safety, the number of open attractions, or the accessibility of popular tourist sites, then increased terror attacks can reduce the benefits associated with a particular location. This research estimates how a change in a country's frequency of terror attacks affects its tourism receipts in the subsequent years. Using World Bank data and the Global Terrorism Database for the years 1995 to 2017, this research makes causal inference by controlling for multiple confounding factors as well as country-specific fixed effects. A lagged variable strategy demonstrates the delay between an increase in terror attacks and its effect on tourism. While extant research focuses on a limited set of countries and correlations between terrorism and tourism, this paper contributes to knowledge in this area by seeking a causal estimate using data from a larger set of countries around the world.

The Implications of Post-Secondary Vocational Training for Employment Stability**Joshua Getz**

Mentor:

Dr. Sarah Estelle,
Economics & Business

This paper estimates the effects of post-secondary enrollment and completion on employment stability. If successful completion of a vocational program requires work ethic, commitment to a trade, and specific aptitudes, then vocational certifications can signal to potential employers that an applicant possesses traits that would be otherwise difficult if not impossible to observe accurately at the time of hiring. Vocational post-secondary education, even falling short of completion or certification, may also build human capital by providing training for applicable skill sets. While on-the-job training is a likely occurrence in any field, potential employees with established skillsets are more valuable to employers who then will not incur the additional time and labor costs associated with training. The National Longitudinal Study of Youth 1997 (NLSY97) provides 20 years of repeated cross-section data on individuals including the amount and type of education they received. Additionally, detailed employment data also allows various measures that reflect different concepts of employment stability, namely time spent in job search, tenure with an employer, and the number of jobs held. This research aims to ascertain whether these employment measures differ significantly for post-vocational training young adults compared to contemporaries who have pursued other post-secondary paths.

**Do Higher Ranked Colleges Reduce the Risk of Overeducation?****Yiwei Jiang**

Mentor:

Dr. Sarah Estelle,
Economics & Business

Overeducation, defined as the difference between individuals' educational attainment and the educational requirements of their jobs, is potentially costly to individuals as well as society at large. If individuals accept work that does not make the fullest use of their skills, then it can mean a loss of income or even fulfillment for the individual. If the individual, then, is repeatedly looking for a better match of employment, there are search costs and waiting time associated with labor market frictions. From a social welfare perspective, leaving resources underutilized or skills unused is inefficient. This research aims to better understand the factors that explain the probability of overeducation, especially the possible moderating influence of college ranking. We might expect to observe lower rates of overeducation among those graduating from higher ranked colleges for several reasons. First, if highly ranked colleges provide students enhanced platforms and networks that help with the job search process, then graduates may be more likely to search until they find jobs that match their education level and skill. Second, if a higher ranked college better facilitates human capital investments by students, then higher productivity among graduates will reduce the probability of mismatch in employment, relative to other college graduates. Additionally, if higher ranked colleges provide more precise signals of graduate ability, then employers may be more willing to hire their graduates. Data from the National Longitudinal Survey of Youth 1997 (NLSY97) include individuals' levels of completed education, post-graduation occupations, and the school IDs of the college attended. Merging published school rankings as well as the Bureau of Labor Statistics' data on the typical educational requirement by occupation, this project identifies overeducation and ultimately the potential moderating role of college ranking in the experience of overeducation.

The Effects of Fuel Taxes on the Annual Sales of Passenger Vehicles**Jacob Moore**

Mentor:

Dr. Sarah Estelle,
Economics & Business

In an attempt to slow global climate change, governments are enacting a wide variety of policy instruments aimed at decreasing emissions of greenhouse gases. Since the implementation of these policies, there has been debate about the effectiveness and costs of these policies. In order to properly implement effective green policy, policymakers should understand the costs associated with them. Using data from 25 European countries, this study examines the effects of national gasoline taxes on the annual sales of new passenger vehicles. In a simple model of supply and demand, an increase in the price of one complementary good, say fuel, decreases the demand for its complement, automobiles. Conversely, increasing fuel prices could lead some rational individuals to purchase new vehicles sooner in an attempt to upgrade to better fuel economy. The European Commission's annual reports provide annual fuel tax rates by country and Global Data provides country-specific annual sales of passenger vehicles, from 2005-2020. In order to account for unobserved factors that may confound the causal relationship between (non-random) fuel taxes and automobile sales, this research employs country and year fixed effects.

**The Effects of Early Childhood Education on Crime****Arinze Nwike**

Mentor:

Dr. Sarah Estelle,
Economics & Business

This paper examines the effect of early childhood education on crime. Most notable among the studies of early childhood education and crime are experimental analyses based on the Perry Preschool Project, a study of the short and long term effects of engagement in a highly-intensive preschool program. While the study considered crime, finding that those in the treatment group committed fewer crimes before age 40, the experiment was conducted in a suburb of Ann Arbor that was largely African American and otherwise not statistically representative of the state or national population. Still, consistent with results from the Perry Preschool Project, the economic literature supports the finding that individuals who attend a high quality preschool are more likely to secure employment in the future. If steady employment increases the opportunity cost of committing a crime (particularly crime that would involve incarceration), then crime rates among the consistently employed should be lower. The current project employs nationally representative data from the Early Childhood Longitudinal Study (ECLS) and an appropriate econometric methodology to obtain causal estimates between preschool enrollment and crime, recognizing that preschool enrollment is not a random treatment. That there are other factors affecting a person's propensity to engage in criminal activity that are likely correlated with preschool access as well is a serious challenge for this work.

The Effects of the Hospital Readmissions Reduction Program on Non-Targeted Interventions**Anna Kate Peterson**

Mentor:

Dr. Sarah Estelle,
Economics & Business

According to the Healthcare Cost and Utilization Project, the rate of hospital readmissions for Medicare patients fell from 18.3 percent in 2010 to 17.1 percent in 2016. Still, since avoidable readmission within 30 days of discharge is a negative healthcare outcome and costly, whether the readmission is due to low-quality care or random complication, it captures the attention of healthcare cost-conscious policymakers. The Hospital Readmissions Reduction Program (HRRP), implemented in 2012, aims to decrease readmission following selected procedures. This research analyzes the effect of the HRRP on readmission rates that were not a part of the HRRP's intended scope, referred to as non-targeted readmission rates. If hospital administrators are sensitive to payment changes, they have an incentive to reduce the probability of avoidable readmissions, potentially shifting resources, adopting new practices, and utilizing new technologies to improve health outcomes for targeted treatments. Moreover, if hospitals learn from their new practices or can make use of the improved technology in treating non-targeted conditions, the direct and intended effects of HRRP may spillover to readmission reductions for non-targeted procedures. Readmission spillover effects, if they exist, would provide suggestive evidence that HRRP can have an even broader benefit by shifting hospitals toward so-called "value-based care" thinking. With data from CMS Hospital Compare data archive and the American College of Surgeons National Surgical Quality Improvement Program surgical patient readmission data, this research models both targeted and non-targeted intervention readmission rates before and after the HRRP for hospitals bound by the HRRP and those that are not. Since hospitals that already exhibit lower than national average readmission rates in the targeted procedures face no incentives from HRRP, they provide a plausible control group for HRRP-treated hospitals and an opportunity for causal inference through a Difference in Differences approach.



The Environmental Effects of Not Having a Tailpipe: A New Look at the Determinants of Vehicle Miles Traveled with Special Attention to Electric Vehicles

Clay Purvis

Mentor:

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Economics & Business

The EPA reported in 2021 that the transportation sector, or the movement of people and goods, accounts for the largest share of greenhouse gas emissions in the United States. Vehicle miles traveled (VMT), a strong correlate of fossil fuel consumption and thus contributor to local and global pollutants, is a popular proxy for auto emissions and a predictor of environmental degradation. Consequently, a large economic literature considers the determinants of VMT including highway capacity and vehicle type. Increased highway capacity, officially measured by the Federal Highway Administration, has the benefit for drivers of decreasing congestion while also having the potential social—or environmental—costs of increasing the amount of vehicles on the road at a given time. Decreased congestion also has a time-savings benefit for individuals by allowing for faster traveling speeds. We can theorize analogously with regard to vehicle types, considering how the type of vehicle and the implications for fuel costs affect an individual's marginal costs and benefits of driving one more mile. Extant literature incorporates vehicle type into the model using average fuel economy, a metric of relevance for vehicles with internal combustion engines. However, a more accurate assessment of the explicit costs associated with VMT would account for the increasing proportion of electric vehicles which do not run on gas. This study incorporates this improvement and estimates how the proportion of electric vehicles, as reported by state registration, affects the VMT observed in a state, thereby reflecting a more flexible understanding of the costs and benefits of driving an additional mile.

How Does an Individual's Underlying Medical Conditions Affect Flu Vaccine Take-up?

Natalie Rosenquist

Mentor:

Dr. Sarah Estelle,
Economics & Business

Flu vaccination prevents tens of thousands of hospitalizations each year, serving as one of the most well-known public health tools to mitigate the effects of flu season. Among those vulnerable to serious illness from the flu are individuals with chronic diseases, also referred to as underlying medical conditions. This research estimates how having an underlying medical condition affects an individual's decision to take-up the flu vaccine. If individuals who are aware of their underlying medical conditions make choices about flu vaccination in predictable ways, this may inspire additional research about the effect of overall health on participation in preventative health measures. There are several reasons why underlying medical conditions may affect the proclivity to be vaccinated. If an individual has a higher risk of getting seriously ill from the flu due to their underlying conditions, then they may perceive the benefit of vaccination as greater (reducing a more serious threat) and be more likely to receive a flu vaccine. Similarly, living with underlying conditions may raise concern for one's health, increasing vaccine take-up. Alternatively, individuals with underlying medical conditions may find their attentions and efforts focused on more pertinent medical interventions to their health, in which case vaccine take-up may be reduced. This research utilizes data from the National Health Interview Survey (NHIS) which contains responses of adult Americans on health-related behaviors. Particularly helpful are indicators of flu vaccination (in the past year) and diagnoses of asthma, cancer, diabetes, and high blood pressure, all of which are classified as underlying medical conditions by the Center for Disease Control and Prevention as they pose serious threats to health when another illness is present. A careful econometric approach and these data, including individual-level health and demographic characteristics, allow for causal inference of the relationship between underlying medical conditions and taking-up the flu vaccine.

**The Effects of Welfare Participation on Religious Engagement****Drew Schmitz**

Mentor:

Dr. Sarah Estelle,
Economics & Business

According to Gallup, church attendance in America has declined by nearly 20 percentage points since the turn of the century. Social scientists continue to debate the cause of this decline in engagement with religious institutions, with possible causes including increases in income, decline of family life, urbanization, the rise of public education, and the growing social safety net. Concurrent with this rapid decline in religious engagement, in fact, government expenditure on social welfare has grown by 12 percentage points of the total United States federal spending (OECD). Traditionally, including historically in the U.S., churches have provided their own safety net for congregants. This research, inspired by the idea of crowd-out, asks whether the government may be replacing some of the roles traditionally played by communities of faith in the form of public assistance. If those in need of assistance now face the possibility of public assistance in addition to or instead of private benevolence, including church mercy ministries, then recipients may no longer need to commit to a congregation to qualify for support. Using longitudinal data, this study measures the effect of welfare receipt on religious participation, providing suggestive evidence about the relationship between government welfare strategies and the influence of private voluntary associations.

Is Foreign Aid Improving the Provision of Education? The Effect of Official Development Assistance on the Quantity and Quality of Teachers in Developing Countries**Bekah Segrist**

Mentor:

Dr. Sarah Estelle,
Economics & Business

According to the World Bank, in 2019, \$167.8 billion in Official Development Assistance (ODA) was received across the world. While there is no consensus about the effectiveness of such aid, the economics literature is conclusive about the role of education in economic development. Other things held constant, if ODA is to increase human capital/skill and thus lead to economic growth, developing countries will likely need to make investments in the supply side of the education market. This research, therefore, examines the first causal link in the chain, the effect of ODA on supply-side measures of education. The simplest theoretical construct illuminating a possible link between aid and education provision is the easing of the budget constraint faced by public officials. If public officials value education or are incentivized by citizens who do, then one would predict some amount of new financial resources would go to education services. However, it is theoretically ambiguous whether largely fungible aid will increase education expenditures and, even if it does, whether schools and the public officials who direct them will employ more teachers (quantity) or invest resources into training or hiring skilled teachers (quality). In the extreme, if developing countries remain underdeveloped due to broken institutions (e.g., lack of democracy, pervasive corruption, etc.) then favor-granting and nepotism may result in hiring more teachers without much consideration of their effectiveness. Using data from the World Bank and the Organisation of Economic Co-operation and Development in models controlling for country and year fixed effects, this research considers separately the causal relationship between ODA and two measures of a country's education provision, the pupil to teacher ratio and the percentage of trained teachers.

**The Effects of Hours Worked on Time Spent Preparing Food****Victoria Spring**

Mentor:

Dr. Sarah Estelle,
Economics & Business

Since the late 20th century, eating patterns in America have changed substantially. While at-home food preparation was once the norm, the growth of female labor force participation and hours worked has increased the consumption of “convenience food,” including meals from restaurants, fast food, and prepared food items. If these foods are less nutritious than meals prepared at home, then there are public health motivations for better understanding why this trend continues. In fact, observedly, over the same time period obesity rates have surged in the U.S. This paper considers how an individual’s hours of work affect her propensity to prepare food at home, with a particular focus on differences by socioeconomic status. If an individual is working longer hours, then they have less time for leisure and homemaking activities, and consequently may spend less time preparing food than someone working fewer hours. The economics literature provides evidence that low-income households are especially likely to eat cost-effective convenience food, such as fast food, which is calorie-dense even if not nutritionally beneficial. Data from the American Time Use Survey include a measure of household time spent preparing food and hours worked over multiple years. By further controlling for household income and household composition by age, gender, and marital status, this research will consider the effect of hours of work on food preparation time for households located along different points of the income distribution.

The Effect Of Parent's Religiosity on Their Child's Future Religiosity**Chapin Thiel**

Mentor:

Dr. Sarah Estelle,
Economics & Business

According to the Pew Research Center, 87 percent of parents and their teenage children attend worship services with the same frequency, but when it comes to prayer frequency, the parent-child commonality drops to only 45 percent praying daily and only 26 percent when praying weekly. Despite the dearth of economics literature on this particular dimension of intergenerational transfers, faith formation may be a real concern for religious parents and the divergence between their children’s public versus personal faith practices troubling. The current project goes beyond the teenage years of children and into adulthood as it analyzes the effect of parents’ religiosity on their children’s future religiosity. Using 2018 data from the International Social Survey Programme, this research controls for parent religion and estimates the degree to which parental religious service attendance transfers to adult children’s religiosity as indicated by the frequency of prayer and of reading religious scripture.

**The Effect of Business Size on the Gender Wage Gap****Nathan Thomas**

Mentor:

Dr. Sarah Estelle,
Economics & Business

Passed by Congress and signed into law by President Kennedy in 1963, the Equal Pay Act legally prohibits gender-based wage discrimination. And while there has been a downward trend in the wage gap, it has not been eliminated. Economic literature about gender pay differentials establishes explanations for these persistent differences including sex-differences in the amount of education and work experience, occupation choice, and the possibility of discrimination. One dimension that has been previously neglected is the size of the employing business. If small businesses have fewer recruiting resources, they may place a greater reward on education and experience than their larger counterparts and, thus, have a wider gender wage gap because women on average are less experienced and educated. Additionally, if women value some of the non-pecuniary aspects of small businesses more than their male coworkers, perhaps small businesses offer more flexible hours to address family emergencies or feature less work-related travel, they may willingly accept lower pay consistent with the theory of compensating wage differentials. This study utilizes data from the Panel Study of Income Dynamics (PSID) from 1990 to 2004 to estimate the effects of business size on wages for women and men. Since many states have passed their own legislation prohibiting sex-based wage discrimination, with eight allowing exemptions for small businesses, this research can exploit state-level policy variation to form a causal inference. This research aims to provide evidence for lawmakers attempting to narrow the gender wage gap through changing state legislation and/or evidence of compensating wage differentials that women would prefer not to surrender.

How Do State Housing Benefits Influence Veteran Interstate Migration?**Camryn Zeller**

Mentor:

Dr. Sarah Estelle,
Economics & Business

Economic research measuring the effects of entitlement programs on interstate migration is mixed. Some economic studies find no evidence of disproportionate mobility to states with more generous benefits, and others find that state variation in benefits induces modest migration. This paper adds to this body of literature by analyzing veteran migration, specifically whether VA home loans and state housing benefits for veterans induce interstate migration. The Tiebout mobility hypothesis asserts that consumer-voters choose communities that best serve their preferences for public goods. If consumer-voters are fully mobile, able to choose from many different communities, and understand the differences between each community, then consumer-voters will reveal their preferences for public good offerings through geographic mobility. This research applies the Tiebout theory to veteran benefit programs which, if valued by consumer-voters, change the costs and benefits they face when they consider communities. For example, housing benefits, such as lower-interest home loans, refinancing, and down payment assistance, offered through the VA decrease the financial burdens of homeownership. If veterans value the benefits that lower these costs and the difference in VA benefits across states outweighs the cost of moving, then, other things held constant, a rational individual will move to a state with relatively more generous benefits. This research utilizes survey data from IPUMS that include a variety of demographic, education, employment, health, and geographic mobility variables. Additionally, the sample of individuals allows for the construction of representative in-migration rates of veterans to each state from 2009 to 2019. The National Center for Veterans Analysis and Statistics and Veterans United provide benefit expenditure and home loan expenditure data by state. These datasets contain the necessary control variables to plausibly capture the causal effect of VA housing benefit offerings in each state on the in-migration rates of veterans.

**Naturalistic
Developmental
Behavioral Intervention:
Perceptions of Michigan
Preschool Teachers
Serving Children
with Disabilities**

Sofia Byrum

Mentor:

Dr. Sophia D'Agostino,
Education

This study investigates the perceptions and use of Naturalistic Developmental Behavioral Intervention that represent the merging of applied behavioral and developmental sciences. Naturalistic Developmental Behavioral Interventions (NDBI) are implemented in natural settings, involve shared control between child and therapist, communicative temptations, modeling of appropriate language, utilizing natural contingencies, and use a variety of behavioral strategies to teach developmentally appropriate skills. We focus on these main elements of NDBI in this study. Survey data from preschool inclusion teachers and early childhood special education teachers throughout Michigan was collected to understand their training experiences, frequency of use, and perceived social validity of NDBI. The majority of teachers agree that NDBIs are a socially valid intervention for use with young children in the early childhood classroom context. Results also indicate that training may be needed to support use of the applied behavior analysis-based elements of NDBI and bring to light important implications for preparation and practice.

**What Alternative
Schools Get Right:
Lessons from The Field**

**Adolfo Magarin
Michael Bonagura
Wendy Wilkinson**

Mentor:

Dr. Laura Pardo,
Education

Alternative schools, also commonly known as academies, continue to perpetuate negative stigmas towards students who attend. A common misconception is that alternative schools are for students who are delinquents, wicked, and troubled. The objective is to investigate alternative schools through the characteristics of good schools. We classified good schools by four characteristics: the first characteristic is climate, particularly the emotion of entering a particular school. Secondly, the number of resources the school has for students. The third quality of good schools is a strong-supportive staff. And the final characteristic is students having a student-focused directive. The examination rigidly concentrates on middle adolescence, students, parents, and school faculty, specifically teachers and administrators who currently attend or work at alternative schools. Our research anticipates that alternative high-schools establish practices that exhibit characteristics of good schools to refute the stigma of alternative schools. Investigating alternative schools through opposing views provides more all-inclusive recognition of what occurs in alternative schools because institutions and classrooms are complex organizations that merely cannot rely on numerical data. Henceforth, we intend to move forward with the research using grounded-theory by combining qualitative and quantitative data to uncover theories and hypotheses in which students can benefit.

A Comparison of a Portable Whole-body Vibration Machine, a PowerPlate Vibration Machine, and No Machine on Muscular Leg Strength in Untrained College-aged Individuals

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Mentor:

**Dr. Maureen Dunn,
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*This research was supported
by the Hope College
Department of Kinesiology.*

In response to the 2020 COVID-19 pandemic, at-home exercise equipment sales significantly increased. The purpose of this study was to compare the effects of an at-home portable whole-body vibration (WBV) platform (Pinty Fitness Vibration Platform) to a clinical vibration platform (PowerPlate Next Generation) to no platform on lower body muscular strength (leg press one-repetition maximum, 1RM) in untrained college-aged students (ages 17-23) over a 5-week training period. It was hypothesized that the portable machine would provide similar results to the clinical machine in the improvement of lower leg strength and that both platforms would increase leg strength more than the no platform group. Participants attended 15 exercise sessions over 5 weeks consisting of a short, aerobic warm-up, a mobility section, a strength workout on the corresponding WBV platform (or on the ground for control) made up of bodyweight exercises focused on leg and core strength (8-15 minutes), and a short cool-down focused on stretching the muscles used in the workout. Leg press 1RM was assessed before and after the five-week training period. All three groups showed significant improvement in leg press 1RM ($p<0.0001$). The clinical WBV group showed a $28\pm10\%$ increase, the at-home WBV group showed an $18\pm12\%$ increase, and the control group showed a $28\pm12\%$ improvement. There was no significant difference between groups in change in leg press 1RM over time ($p=0.21$). Therefore, results suggest no effect of WBV on strength gain following 15 bodyweight resistance training sessions in untrained college students. Further study is necessary to assess the clinical benefits of the portable WBV platform.

TBI with Persistent Cognitive, Visual, and Emotional Challenges of a 24 Year Old College Graduate

Taryn Bushong

Mentor:

**Tonia Gruppen,
Kinesiology**

A 24-year-old female experienced a fall and was diagnosed with TBI and is experiencing cognitive and emotional challenges. These effects have lasted a year, despite undergoing multiple treatments and therapies. The patient experiences a lightheaded sensation early in the morning, feeling faint once she gets out of bed, chronic fatigue, and persistent anxiety. The patient continues to move through the grieving process of the injury. A TBI is a Traumatic Brain Injury that occurs when the brain is violently shaken or when there is a blow to the head and causes damage. Due to the damage of the brain, patients may experience problems that involve cognitive, emotional, behavioral, mood, whole body, visual, and speech. The most common symptoms that can occur within hours may be headaches, light sensitivity, noise sensitivity, difficulty concentrating, and confusion. A patient may experience delayed onset of symptoms. The goal of this case study is to look at the long-term effects of a TBI, as well as how it affects the patient's activities of daily living.

The Effect of the Chirp Wheel and Other Ergogenic Aids on Back Flexion and Recovery

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Mentor:

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

Foam rollers are used frequently as tools by health professionals and athletes to increase joint range of motion, tissue temperature, and blood flow, providing myofascial relief to areas targeted by the user. Standard foam rollers have been the subject of many studies, with limited work regarding foam rolling of the spine, despite this technique being a common practice among athletes. The chirp wheel is a foam rolling product with a groove down the middle, made to increase pressure on deep back muscles which may act to decrease muscle tension and soreness while optimizing perceived recovery. To our knowledge, this is the first study examining the effectiveness of the chirp wheel. Hope College football players were recruited to take part in this 4-week, 5-session counterbalanced study. The first data session consisted of participant information collection and familiarization while the final four sessions involved weightlifting regimens followed by structured recovery and sit and reach tests. Recovery treatments included the application of either a standard foam roller, chirp wheel, or yoga block to muscles in the gluteal, lumbar, thoracic, cervical, and full back regions. Additionally, in each session perceived relief was recorded immediately after working out, post-treatment (standard foam roller, chirp wheel, or yoga block), and 24 hours after the session. The yoga block was used as a placebo to reduce expectancy error. It was hypothesized that the chirp wheel would provide the greatest increase in lumbar flexion and perceived relief, followed by the standard foam roller and yoga block conditions. Significant results would validate company claims regarding the chirp wheel and would support the preferential use of the chirp wheel in foam rolling of the back. This study is ongoing, results will be available during the celebration.

The Effect of Cadence on Total Push-Up Repetitions in College Students

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Mentor:

Dr. Olufemi A. Oluyedun,
Kinesiology

Purpose: The FitnessGram Push-up Test is one of the most popular tests used around the world to assess muscular endurance. The FitnessGram Push-up Test uses a 1.5s up/1.5s down cadence; however, it is unknown if this is the optimal pace for achieving maximal repetitions. Therefore, this study investigated the effects of a variety of cadences on total push-up repetitions completed in college students. We hypothesized that the self-paced push-up cadence would show the highest number of repetitions followed by the 1s down/1s up, 1.5s down/1.5s up, and 2s down/2s up cadences, respectively. **Methods:** 20 participants (12 women, 8 men) were counterbalanced across 4 total trials (1 cadence per trial) with a 72-hour rest period between each session. The cadence order was randomized, and repetitions were counted during each trial. **Results:** The self-paced cadence produced a significantly greater ($p < .01$) amount of repetitions ($M = 27$; $SD = 11$) than the 1.5s up/1.5s down ($M = 18.9$; $SD = 8.80$) and 2s up/2s down ($M = 17.2$; $SD = 6.82$) cadences on average. The 1s up/1s down cadence produced an average of 22.75 ($SD = 8.58$) repetitions, which was not significantly different ($p > .05$) compared to the other cadences. **Conclusion:** Findings show that a self-paced cadence is the most optimal for completing a maximum number of push-up repetitions in a single bout. Our work is informative for practitioners in the health and fitness industry and future research should continue to explore the mechanisms that can help explain why a self-paced cadence is optimal for max push-up performance.

The Acute Effect of Beetroot Juice on Muscular Endurance during a Back Squat in Women

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*This research was supported
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Beetroot juice (BRJ) is a dietary nitrate supplement that previous research has shown to increase vasodilation, and reduce oxygen use, blood pressure, and PCr degradation. Extant literature shows these effects on men in cardiovascular and resistance training exercise tests, however the literature on women is considerably limited. Therefore, the purpose of this study is to examine the acute effect of BRJ supplementation in women during the follicular phase of their menstrual cycle. College females were given doses of BRJ and placebo during the follicular phase of their menstrual cycle, and were tested on their repetitions to fatigue at 70% of their 1 repetition maximum (1RM) in back squat. The dosage of BRJ was 400mg, taken over the course of three days, with the final dose taken approximately 2.5 hours prior to testing. Each dose was taken at the same time of day. The placebo followed the same procedures. The participants were asked to meet on three occasions for testing. Once for familiarization, and the second and third time for testing days, consisting of a total of three in person sessions. To ensure all participants felt comfortable with the protocol, familiarization consisted of showing the participants how to properly perform a back squat. Testing days occurred after consumption of the third dosage of BRJ, and on those days participants completed a back squat to fatigue (e.g., repetitions to failure). Participants were counterbalanced to the experimental and placebo conditions. We hypothesized that muscular endurance measured through repetitions to fatigue at 70% of a 1RM back squat would increase after supplementation with BRJ compared to placebo. This work can provide insight into the use of BRJ supplementation in women which has historically been an understudied area. The research is ongoing, and results will be available during the Celebration of Undergraduate Research event.

**Physiological Responses
to the Boost Antigravity
Treadmill****Zackary Murphy****Mentor:****Dr. Mark Northuis,
Kinesiology**

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Lower-body positive pressure (LBPP) treadmills have previously been used as a means of rehabilitation for individuals who have suffered lower extremity injuries. Recently it has become more popular as a training tool. Therefore, this study determined if there were any significant differences in the physiological responses when performing a ramped running graded exercise test on the Boost Treadmill at three different percentages of body weight (100%, 90% and 80%). Twenty Hope College cross-country athletes (11M, 9F) completed the three testing conditions in a counterbalanced order. It was hypothesized that there would be lower physiological responses at lower percentages of body weight at all submaximal velocities. Additionally, men would have larger absolute and relative values for VO_2 than women. Results showed that men at 80%, 90% and 100% BW had significantly higher values for absolute and relative $\text{VO}_{2\text{max}}$ than women. Additionally, at 9 mph and 10 mph the absolute VO_2 differed significantly between percent body mass ($p<0.001$ and $p=0.002$). Specifically, the difference in VO_2 at 9 and 10 mph was between 80% and 90%BW as well as 80% and 100% BW. No differences were observed between 90 and 100%BW for either speed. RER (Respiratory Exchange Ratio) was shown to differ significantly between BW% 80 and 100 ($p=0.018$) but did not differ at 9 mph. Additionally, the mean maximal velocity was significantly greater at 80%BW than 90%BW and 100%BW as well as 90%BW greater than 100%BW. Using the data on speed and absolute VO_2 at the different BW% a plot was created indicating the speed necessary at a given BW% to simulate normal 100%BW physiological responses. From the results obtained, it can be concluded that exercising at a lower BW% results in lower physiological values and that the Boost Antigravity treadmill can effectively be used at varying velocities as an endurance training tool.

**The Effect of Various
Facial Coverings on One
Mile Run Performance****Mackenzie Ralston
Emma Schaefer
Hope Reynolds
Katie Newcomer
Zackary Murphy
Emma Gilkey****Mentor:****Dr. Maureen Dunn,
Kinesiology**

*This research was supported
by the Department of
Kinesiology.*

The COVID-19 pandemic has led to the requirement of facial coverings during exercise, yet little is known regarding the effect of mask-wearing on performance. This study evaluated the effect of wearing various masks on one-mile run time. Twenty-one NCAA Division III cross-country athletes (11M, 10 F) completed three, one-mile timed runs on an outdoor track under no mask (NM), surgical mask (SM), and neck gaiter (NG) conditions. It was hypothesized that running without a mask would elicit the fastest time, followed by the surgical mask, and the neck gaiter with the slowest time. It was also predicted that the same relationship would exist between conditions for heart rate (HR) and rate of perceived exertion (RPE, NM<SM<NG). Results showed a significant difference in completion times between conditions with NG leading to significantly slower times than both other mask types with no significant difference between SM and NM conditions ($\text{NM}=5:22.9 \pm 0:07.6$, $\text{SM}=5:24.6 \pm 0:07.5$, $\text{NG}=5:27.5 \pm 0:07.9$ min; $p=0.01$). A significant difference was also found in RPE between conditions with the SM eliciting a higher RPE than both other mask conditions and no significant difference between the NG and NM condition ($\text{NM}=16.1 \pm 0.25$, $\text{SM}=16.74 \pm 0.27$, $\text{NG}=16.46 \pm 0.27$, $p=0.047$). Masks did not affect HR during exercise ($p=0.36$). The results indicate that wearing a mask influences running performance with the neck gaiter having the largest effect on 1-mile runtime and the surgical mask having the largest effect on RPE in trained collegiate runners.

Examining the Feasibility of Optical Heart Rate Monitoring During Swimming of Different Intensities and Styles

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

The purpose of this study was to determine the feasibility of wearing an optical HR monitor (OHR) against an individual's temple to monitor HR when compared to a traditional chest strap (THR) across different swimming styles and intensities. Nineteen collegiate swimmers (7M, 12F) completed two swimming protocols while wearing the OHR and a THR with HR recorded continuously on both devices. Part one (P1) consisted of 75m freestyle swims, four completed at low intensity, three at moderate intensity, and two at high intensity. Participants then rested for two minutes before completing part two (P2), which consisted of two 100m swims of their preferred stroke, one at moderate and one at high intensity, with one minute rest between. The chosen strokes included freestyle (n=7), backstroke (n=5), breaststroke (n=4), and butterfly (n=3). A repeated measures ANOVA (RM ANOVA) with post hoc analysis was completed between the OHR and THR. The overall mean significant difference between OHR and THR (OHR: 150.7 ± 17.0 vs. THR: 155.9 ± 19.0 bpm, $p=0.02$). Post hoc analysis indicated significant differences during the recovery stage between P1 and P2 (OHR: 126.1 ± 17.8 vs. THR: 122.3 ± 18.0 bpm, $p=0.007$) and the first 100 meter swim of P2 (OHR: 148.3 ± 21.3 vs. THR: 159.1 ± 20.1 bpm, $p=0.002$). Additionally, the OHR monitor captured $99.9 \pm 0.1\%$ of the HR data whereas the THR captured only $58.98 \pm 31.3\%$. The OHR underestimated HR compared to the THR. The OHR more consistently captured HR. This device holds promise as a tool for monitoring HR during swimming.



**Examining the Validity
of the Fibion Activity
Monitor**

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Mentors:

Dr. Brian Rider,
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Dr. Alex Montoye,
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Prolonged periods of sitting are associated with negative health outcomes. Some have gone so far to label sitting as the “new smoking.” Often, people do not realize how much they sit throughout the course of the day so an objective measurement of their seated/sedentary time could be useful in enacting positive physical activity behavior change. The Fibion is a new accelerometer-based device capable of identifying different postural positions (sitting vs. standing) by measuring an individual’s thigh position. It can be worn in the front pant pocket or secured to the thigh. Previous research has validated this new device in a laboratory setting, but not in a free-living environment. Therefore, the purpose of this study was to examine the validity of the Fibion during a three-day free-living period. Hope College students and faculty performed postural tests (laying, sitting, standing) and exercise tests (treadmill walking/jogging and cycling) in the DeVos Laboratory while wearing two Fibion devices and two ActivPAL devices secured around each leg. The ActivPAL is a previously validated device that accurately measures body position and therefore served as the gold standard. Each test was performed for two minutes with a one-minute standing interval separating each test. The participants were then instructed to wear the devices on each thigh for three consecutive days. They were instructed to only remove the devices before bathing or swimming and while sleeping. Participants were also expected to wear the devices against the skin and under pants whenever possible. It was hypothesized that the Fibion would accurately detect posture, movement, and provide similar data to the ActivPAL. We hypothesize that the Fibion will be an accurate and easy-to-use consumer device for tracking posture and movement. This study is ongoing, and results will be available during the research celebration.

**Management and
Interventions of Multiple
Knee Injuries in a Division
II Women’s Volleyball
Player Unremoved
from Competition**

Hana vander Galien

Mentor:

Tonia Gruppen,
Kinesiology

This case study presents the management and intervention of multiple left knee injuries and conditions in a 22 year old all-American Division II women's volleyball player who was not removed from in-season competition regardless of her injury status. Initially, the patient suffered an acute infrapatellar fat pad impingement injury after a valgus mechanism on her left knee, which was treated for pain the remainder of the season while she continued participation. The injury was surgically intervened in the postseason after the irritation persisted, but a second surgery was conducted after little improvement was seen. During the following season, the patient continued to complain of left knee pain and stiffness. She was diagnosed with a medial and lateral meniscal injury, was not removed from competition, and played the remainder of the season with pain management and therapeutic exercise. In the postseason, a conservative approach was taken toward the tear. The pain and edema showed little improvement, and she was diagnosed with a chondral defect on the medial patellar facet. During her most recent season she continued to play with a conservative approach and pain management. The goal of this case study is to investigate the various pain management strategies and treatment interventions of multiple knee injuries in an athlete not removed from participation.

The Effects of Caffeine on Vertical Jump

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

Purpose: Caffeine has shown to be an ergogenic aid for improving athletic performance. The purpose of this study was to examine the effects of varying concentrations of caffeine (e.g., 6 mg*kg⁻¹, 3 mg*kg⁻¹, placebo) on static vertical jump (SVJ; a vertical jump from a squatted position that is held for 3 seconds with no dropping of the hips or swinging of the arms prior to the upward motion) performance. **Methods:** Collegiate basketball players (14 M, 11 F) completed a total of three jump trials, tested across a 72-hour recovery period. For each trial, a different concentration of caffeine (6 mg*kg⁻¹, 3 mg*kg⁻¹, placebo), was assigned through counterbalancing. Participants were asked to ingest the caffeine treatments with 8 oz of water, one hour before performing a jump trial. The three highest properly performed jump heights were recorded using a Vertec vane. **Results:** Findings suggest no significant main effect of dose or time ($p > .05$) on jump height. There was no significant interaction between dose and time for female or male participants. Independent T-test results did show that male participants jumped significantly higher ($M = 27.87$ inches; $SD = 3.41$) than female participants ($M = 19.35$ inches; $SD = 2.05$) on average. **Conclusion:** Overall, our findings did not provide support for the effect of caffeine on SVJ when examining varying concentrations. The main notable finding was that males jumped significantly higher on average than females, which corroborates previous research. Future research should attempt to examine the mechanisms for the link between caffeine consumption and jump height performance.

The Acute Effect of Whole Body Vibration using a Clinical Platform Compared to a Portable Platform and No Platform on Balance and Flexibility in Collegiate Dancers

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Mentor:

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

Whole body vibration (WBV) training has been reported to enhance athletic performance. The clinical PowerPlate platform is an effective WBV treatment to acutely improve balance and flexibility in various populations. The Pinty platform, a commercially-available portable WBV platform, has been recommended as a more cost-effective option to clinical platforms; however, it has not yet been validated. Therefore, the purpose of this study was to examine whether there would be a significant difference in the effectiveness of 2 minutes of vibration on the Power Plate WBV machine compared to the Pinty WBV machine or no machine on improved flexibility and balance in collegiate dancers. Flexibility was assessed using the sit and reach test, while functional balance used the Y-Balance Test, and static balance was determined through postural sway measures during quiet standing on a forceplate. 20 Hope College dancers were recruited and testing of each task was completed prior to and following each WBV platform session. Experimental trials followed a familiarization session, and trial order was counterbalanced. This study is ongoing, and results will be available at the time of the CURCA event.

Examining Shifts in Public Support For LGBTQ Individuals, 1990-2015**Ruth Holloway**

Mentor:

Dr. David Ryden,
Political Science

This research was supported by the Wickers Fund for Faculty Development at Hope College.

Since the early 1990s, LGBTQ issues have made their way to the front lines of the oft-cited “culture wars” between the Evangelical right and social progressives. In 1989, an estimated 47% of Americans associated with sodomy, as evidenced by the startlingly high frequency of positive responses to the prompt: “AIDS might be God’s punishment for immoral sexual behavior.” However, by 2007, only 23% of all initial respondents agreed with the same statement. It is evident that the early 2000s saw a massive shift in public opinion on the topic of LGBTQ non-discrimination. In the realm of judicial activism, courts have ended state sodomy laws (*Lawrence v. Texas*, 2003), struck down the defense against marriage act (*U.S. v. Windsor*, 2013), and made same-sex marriage legal in all 50 states (*Obergefell v. Hodges*, 2015).

In 25 years, the entire socio-political landscape has been reformed. The mid 1990s were a time when “Don’t Ask, Don’t Tell” was both federal policy and an unsaid rule of the then-conservative social contract, whereas the 2000s saw the rise of a movement that brought about the legalization of same-sex marriage and LGBTQ non-discrimination rights. This rapid change has left political scientists wondering what exactly prompted such a massive social revolution, most notably among the American left. This project would seek to answer the following question: what substantive changes occurred between the early 1990s and 2015 such that public support for same-sex marriage increased more than 120%?

The Stated Goals and Outcomes of the US and China Trade War**Brooke Kale**

Mentor:

Dr. Joel Toppen,
Political Science

The presidency of Donald Trump was greatly characterized by its relationship with China, especially on the matter of trade. The trade relationship between the US and China, spurred by the Trump administration’s actions, has been widely regarded as a “trade war.” The objective of this project is to research the stated goals of the Trump administration regarding the trade relationship with China and compare them with the outcomes of political action taken in order to determine whether or not the administration’s trade war was successful. So as to avoid any partisan bias in the research and conclusions of this project, only the explicitly stated goals of the Trump administration and quantitative outcomes of implemented policies are included. The research expects to find to what extent the Trump administration’s goals regarding US and China trade relations were achieved through the examination of direct quotes from former President Trump and members of his administration in comparison to the quantitative effects of policies put in place expressed through the data.

**When a Woman
Was President****Valeria Lee**

Mentor:

Dr. Annie Dandavati,
Political Science*Funding provided
by the Department
of Political Science.*

This research focuses on the two terms of the first female president of Chile, Michelle Bachelet. We wish to examine whether the policies that emanated during her two terms were in fact unique to the fact that she was a female president. We are seeking to look at the gendered aspects of policy making that emerged from 2006 to 2010 (first term) and 2014 to 2018 (second term). During her first term, Bachelet established more child care centers for low income families, the bill for emergency contraceptive pills was passed, and sex education was integrated in the Chilean educational system. One of the main components of Bachelet's agenda however, was to push for greater representation of women in her cabinet. During her second term, abortion was legalized but gender representation became less of a concern. In addition, El Servicio Nacional de la Mujer (the National Service of Women), a public service organization, adjusted its name to El Ministerio de la Mujer y la Equidad de Género in 2015 to follow a more gender focused agenda. Critics believe that Chile's new laws benefiting women were due to the female representatives Bachelet appointed and closely worked with to bring forth such policies. The legalisation of bills became difficult without the support of the right, further declining the number of women represented in the Chilean government. Although Bachelet's presidency was successful in a number of areas, it was not isolated from challenges like immigration laws and the backlash she experienced as a consequence from disregarding the needs of indigenous Mapuche women. Overall, there is no doubt that her role as the first female president of Chile marked a novel period in Latin America.

College Students' Attitudes toward the Outdoors: Trends during the Pandemic

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*This work supported by
the Hope College
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COVID-19 changed many people's lives, especially in the realm of being outdoors. Spending time outdoors was one of the safer options of activities, in regard to the safety of being with others due to the way COVID-19 is spread. Furthermore, several of the common indoor ways people would exercise (gyms, recreation centers) and socialize (restaurants, movie theaters) were shut down, making the outdoors the most viable option. Many people were working from home or had transitioned to online school, causing them to be cooped up in their house all day long, making the outdoors a nice escape from a place that was both home and work. Lastly, outdoor activities were deemed more accessible because they simply involved opening up the front door and taking a few steps. As such, in this study, we were interested in seeing whether peoples' attitudes towards the outdoors had changed during the pandemic. The Outdoor Foundation (2019) study reported that almost half of the U.S. population didn't participate in any outdoor recreational activity in 2018 and that Americans undertook one billion fewer outdoor outings in that year than they did in 2008 (p.3). This shows that before the pandemic, in 2018, people were involved in fewer outdoor activities than in prior years. For our own study, data was collected through an online survey sent to undergraduate students that consisted of questions regarding time outdoors, desire to be outdoors, attitudes towards spending time outdoors, and other questions regarding those ideas. Trends among the data collected were analyzed. Due to the pandemic factors discussed above, we wanted to explore whether this trend reversed during the pandemic, with people's attitudes towards the outdoors growing more positive.



**Forgive to Rest:
Implications of Rumination
and Compassionate
Reappraisal for Improving
Sleep Quality and
Quantity**

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*This work supported by
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Department of Psychology.*

Sufficient sleep quality and quantity are essential components of human flourishing. Sleep disturbance is part of mental illnesses such as anxiety and depression, and rumination about adverse events may play a role.

Research on sleep and forgiveness points to the importance of measuring the impact of ruminating about interpersonal offenses (Toussaint, Gall, Cheadle, & Williams, 2020). Will rumination about a real-life offense negatively affect sleep quality or quantity? How might a coping strategy, such as compassionate reappraisal, affect sleep? Whereas rumination focuses on the negative aspects of the event, compassionate reappraisal involves conceptualizing an offender as a human in need of a positive transformation, desiring their good change. We tested the hypothesis that compassionate reappraisal would lead to improved sleep quality and quantity, higher levels of forgiveness, increased empathy, and less anger as compared to rumination.

Undergraduate students completed online surveys on two consecutive nights and mornings. On the first night, participants ruminated about a past, unresolved interpersonal offense before going to bed. On the following night, participants engaged in compassionate reappraisal of the same offender. Immediately following these conditions and the morning after, participants completed surveys assessing sleep quality and quantity as well as measures of forgiveness, emotion, and flourishing.

Findings show that compared to the rumination condition, compassionate reappraisal was associated with improved sleep quality and quantity. Specifically, bed times were significantly earlier and participants felt more refreshed following the compassionate reappraisal condition compared to the rumination condition. After compassionate reappraisal, participants were also less angry and more empathic and forgiving of their offender. Therefore, compassionate reappraisal--which acknowledges the humanity of wrongdoers and desires their good change--has the potential to promote forgiveness and also significantly improve sleep health and emotional health.

**Like Father, Like Partner?
The Influence of Parental
Traits on Implicit and
Explicit Mate Preferences**

**Emily Dodge
Alexx Irwin**

Mentor:

**Dr. Carrie Bredow,
Psychology**

*This project was funded by
the Matthew J. And Anne C.
Wilson Foundation Faculty
Development Fund at
Hope College.*

Despite the popular belief that people are drawn to partners who “act like” their parents, little is known about the role of non-physical parental characteristics in human mate choice. Research has shown some effects of eye color (Bressan & Damian, 2017) and ethnicity (Heffernan et al., 2010) of one’s opposite-sex parents affecting partner preference. However, only recently have there been studies examining how parental attachment, particularly a more secure attachment, may increase the likelihood of one’s parent influencing partner choice (Akao et al., 2017). One explanation for these findings is one’s own mate value and an implicit preference for a partner resembling oneself. Our study examines whether people’s parents’ traits predict their implicit and explicit preferences for these traits in a partner. Parent-child relationship quality will also be analyzed to determine its effect on partner preferences. Data were collected from 427 unmarried participants (136 men and 291 women). Participants completed a series of three single category implicit association tests (SC-IAT) to determine unconscious associations with three trait dimensions (warmth/trustworthiness, attractiveness/vitality, status/resources). Participants then completed a survey where they indicated their explicit preferences and rated themselves, both parents, and their current partner (if applicable) on the same variables. Currently, we have 100% of the data collected and cleaned. Results thus far have found that the link between parental attributes and explicit preferences was stronger among participants who enjoyed higher quality relationships with their parents and among those with more relationship experience. Links between parental attributes and implicit preferences have been more sporadic. Next we will run linear regression analyses with controls for mate value. Finally, a moderated regression analysis will be used to examine parent relationship quality.

**Accountability Mindsets
about Supervisor
Feedback: Linguistic
Analyses of Thoughts
and Feelings**

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Ashley Hayden
Katrina Beltz**

Mentors:

**Dr. Charlotte
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**Dr. Lindsey Root Luna,
Psychology**

The project described was made possible through the support of a grant from the Templeton Religion Trust. The opinions expressed here are those of the authors and do not necessarily reflect the views of the Templeton Religion Trust. We would also like to thank the interdisciplinary Human Accountability Scale development grant team: Charlotte vanOyen Witvliet, Sung Joon Jang, Jack W. Berry, C. Stephen Evans, Byron R. Johnson, Robert C. Roberts, John R. Peteet, and Andrew Torrance.

Adopting different mindsets yields distinct responses to receiving feedback from one's supervisor. Specifically, when individuals welcome corrective feedback, they reported increased empathy and accountability (Clayton et al., 2019; Hayden et al., 2020). In healthy relationships, accountability provides a framework for carrying out one's responsibilities to others, making corrections and improvements that give another person what is due. Accountability is aided by empathic perspective-taking towards another and responsibility for regulating one's own responses, leading to flourishing (Evans, 2020; Witvliet et al., 2019).

In this repeated measures experiment, participants first anticipated receiving corrective feedback from a real-world supervisor and then engaged in two counterbalanced and contrasting conditions—welcoming and resisting supervisory feedback. Welcoming feedback instructions encouraged participants to value learning from the supervisor's feedback and believe oneself capable of change. Resisting feedback instructions devalued the supervisor's feedback and emphasized participants' lack of need to change. Participants completed self-report measures (empathy, self-regulation, accountability, and flourishing). They also wrote descriptions of how they would want to respond to their real-life supervisor—What did you actually want to say or do?—for each experimental condition. Linguistic Inquiry and Word Count software computed the proportion of words participants used in their responses for the categories of negative emotion, positive emotion, social, and gratitude words.

Main effects of mindset occurred across dependent variables. Even stronger than the beneficial impact of a welcoming mindset was the adverse effect of a resistant mindset for decreasing empathy, self-regulation, accountability, and flourishing compared to baseline responses. Linguistic analyses of written responses featured the beneficial impact of a welcoming mindset; compared to baseline and the resistant mindset, a welcoming mindset toward receiving corrective feedback elevated use of gratitude and positive emotion language, while decreasing negative emotion language use. Findings commend focusing on the value of a supervisor's perspective and one's own capacity to adapt.

Investigating the Genetic Underpinnings of Empathy and Relational Accountability

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Dr. Gerald Griffin,
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The project described was made possible through the support of a grant from the Templeton Religion Trust. The opinions expressed here are those of the authors and do not necessarily reflect the views of the Templeton Religion Trust. This project was also made possible through the contributions of Jonah Oman, Matthew Schuiling, William Lake, Isabelle Matthews, Emily Peterson, Amanda Schultz, Hannah Bugg, Lucy Cousins, and Victoria Gardner. We would also like to thank the interdisciplinary Human Accountability Scale development team: Charlotte vanOyen Witvliet, Sung Joon Jang, Jack W. Berry, C. Stephen Evans, Byron R. Johnson, Robert C. Roberts, John R. Peteet, Andrew Torrance

Relational accountability requires empathy and self-regulation, as those who welcome accountability are responsive to others in fulfilling their responsibilities within these relationships (Witvliet et al., 2019). Previously the oxytocin receptor gene, single nucleotide polymorphism (SNP) rs53576, was associated with empathy, where individuals with a homozygous G genotype, compared to A carriers, self-reported higher empathy. Because empathy is an integral component of relational accountability, this study sought to examine the genetic influence of SNP rs53576 on accountability, indirectly through empathy.

In this study, 311 undergraduates (160 F, 150 M, 1 Other; 81.0% White, 11.3% AHANA only, 7.4% White and AHANA, & 0.3% Other; Age M = 19.27, SD = 1.32) completed accountability, empathy, self-regulation, and other trait and state measurements using Qualtrics. Additional analyses are reported elsewhere given the scope of the present study. This presentation focuses on the methods of collecting genetic material and genotyping.

Participants provided a saliva sample using a DNAGenotek-Oragene Discover Kit by passively salivating into the collection tube. DNA was extracted from saliva samples by 1) removing impurities from the saliva supernatant by adding Prep-it and centrifuging the sample, 2) adding 100% ethanol to the supernatant and centrifuging the solution to form a DNA pellet, 3) discarding the supinate to rinse the DNA pellet using 70% ethanol, and 4) resuspending the DNA in TE buffer. Next, the NanoDrop 2000 was used to perform spectrophotometry to assess DNA quality and purity for each sample. Saliva samples were not genotyped if they did not include genetic material ($260/280 < 1.60$ or > 1.99). Accordingly, 299 samples and 1 internal control were sent to the University of Arizona Genetics Core Lab (UAGC) to undergo Sanger sequencing, the gold standard method of genotyping. Findings are forthcoming.

The Role of Accountability in Civic Life**Andrea Koh**

Mentor:

Dr. Charlotte vanOyen-Witvliet,
Psychology

How does a sense of accountability to a higher power for one's impact relate to engagement in civic life? Featuring data from a nationally representative survey of spirituality in the United States, we focused on how perceived accountability to a higher power is associated with civic involvement. The survey conducted by the Fetzer Institute and the University of Chicago's National Opinion Research Council from January 16 to February 3 of 2020 consisted of a demographically representative sample of 3,609 adults (18+ years) in the United States. This presentation will highlight findings on accountability in relation to civic attitudes and actions, such as volunteering, giving to or supporting organizations, welcoming strangers, community involvement, and political participation.

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the Fetzer Institute.*

**A Virtue of Success:
Exploring the Role of
Humility in Leadership**Yuki Kojima
Alissa Sweeney
Taylor Richmond
Carolyn Priebe
Matthew Severino

Mentor:

Dr. Daryl Van Tongeren,
Psychology

This project was made possible through the support of a grant from the John Templeton Foundation. The opinions expressed in this publication are those of the authors and do not necessarily reflect the views of the John Templeton Foundation.

Although humility is an essential virtue, it is one that is often overlooked and undervalued. Humility is an essential quality that leads one to grow, reflect, and change (Crigger & Godfrey, 2010). The purpose of this literature review is to understand the relevance and role of humility in leadership. We predict that humility will help strengthen individuals' leadership performance. By analyzing previous research, we aim to gain deeper insight into the role of humility and identify the areas that require further exploration.

Utilizing the APA PsycINFO database, we collected data for a literature review using the keyword search: "humility AND leadership." We sought to examine only peer-reviewed journal articles. The "humility AND leadership" search returned 176 published results, and we retained 166 peer-reviewed publications. We examined these research articles to better understand the role humility plays in leadership.

Three themes were identified based on the existing literature. First, as we hypothesized, humility is positively associated with better leadership outcomes (Van Tongeren et al., 2019). Most scientific research in this area supports the idea that humility is a crucial attribute for a leader. Second, leader humility positively influences follower creativity (Wang et al., 2018; Wang et al., 2017; Gonçalves & Brandão; 2017). Team creativity seems to be higher when the leader is humble. Third, leader humility is associated with lower stress among followers (Liborius, 2017). The results could have significant social implications: for example, leaders should be trained using humility-based training in order to maximize leadership skills. We might need to reconsider ways to incorporate humility into group activities to bring out follower's creativity. Moreover, if leader humility reduces workplace stress, employers might have a solution for creating a more comfortable work environment.

A Holistic Approach to Physical Activity and Indicators of Overall Health: A Retrospective and Prospective Study**Corine LaFrenier****Andrea M. Rocco****Elijah H. Maxwell****Mikenna K. Davidson****Hannah R. Meade****McKenna Bartley****Natalie A. Ramsay****Mentor:****Dr. Sonja Trent-Brown,
Psychology***This project was supported
by the Hope College
Department of Psychology.*

Previous research suggests that physical activity is associated with both positive physical and mental health outcomes. According to the Physical Activity Guidelines for Americans, 2nd edition (2018), approximately half of all U.S. adults have chronic conditions for which physical activity would be beneficial. Furthermore, a large cross-sectional study found that adults who engaged in physical activity reported fewer poor mental health days than those who did not (Chekroud et al., 2018). Despite evidence that supports the benefits of physical activity, 80% of adults do not meet the recommended guidelines for muscular strength and aerobic conditioning (U.S. Department of Health and Human Services, 2018, p. 2). The present study aims to investigate the relationship between physical activity, attitudes, and how they relate to a holistic assessment of health from both a retrospective and prospective standpoint. Specifically, the present study examined how past, current, and future behavior patterns impact physical activity and measures of overall health, both physiologically and psychologically. College students answered a survey that assessed attitudes towards physical activity from childhood, emerging adulthood, and during the COVID-19 pandemic. The survey also assessed indicators of health using the Patient Health Questionnaire-9 (PHQ-9); General Anxiety Disorder-7 (GAD-7); as well as self-reported measures of Body Mass Index (BMI). We anticipate that college students who retrospectively report positive attitudes towards outdoor activity will have greater overall health, and will be more likely to express these same behavior patterns in the future. The implications of our findings will gauge prospective preferences, practices, attitudes, and health, thereby guiding future decisions and providing a mechanism to develop interventions that will facilitate positive attitudes towards the outdoors and physical activity in future generations. As a consequence, these attitudes will yield protective measures for health and stewardship of the outdoors.

Does Religious Deidentification Predict Risky Health Behaviors and Poor Mental Health?

Amy Osterbaan

Mentors:

Dr. Alyssa Cheadle,
Psychology

Dr. Daryl Van Tongeren,
Psychology

This project was made possible thanks to the Hope College Mellon Scholars Program.

Substantial literature suggests that religiousness and spirituality are associated with better mental and physical health. These associations are likely mediated by social, behavioral, and psychological mechanisms. In addition, research demonstrates that religious and spiritual people generally engage in more health promoting and fewer health compromising behaviors (Cheadle & Dunkel Schetter, 2017). New research in psychology and religion has demonstrated a lasting effect of religiousness among formerly religious people. Specifically, the religious residue hypothesis contends that formerly religious people more resemble always religious people than never religious people in terms of psychology and behavior (Van Tongeren et al., 2021). To test whether religious residue effects are evident in the religiousness-health link, we analyzed differences in health between people of different religious identifications. Secondary data analyses of the National Longitudinal Study of Adolescent to Adult Health Waves III and IV were conducted. Wave III was collected in 2001-2002 and included 4,882 Americans 18-26 years old. Wave IV was collected in 2008 and included 5,114 Americans 24-32 years old. We tested whether there were significant differences in health and health behaviors between the religious identifications and compared the health status and behaviors of respondents who deidentified from religion between Wave III and Wave IV. Formerly religious people displayed higher rates of risky sexual behavior, drug use, risky alcohol use, depression, suicidal thoughts, and eating disorders compared to always religious people, never religious people, and converts. Respondents who deidentified from religion between Waves III and IV displayed an increased likelihood to have smoked a cigarette and increased likelihood of having a depression diagnosis. These results suggest boundary conditions of the religious residue effect and indicate that religiousness-health benefits extend only to the currently religious.

**The Effects of
Religiousness and
Spirituality on COVID-19
Health Behavior
Compliance**

Kimberly Paquette

Mentor:

**Dr. Alyssa Cheadle,
Psychology**

Work on this project was supported by a Howard R. and Margaret E. Sluyter Faculty Development Fund to support student research and the Towsley Research Scholar program to support the work of Alyssa Cheadle.

Just a little over a year ago, our lives changed as our country fell into panic and all around us businesses and organizations shut down. Everyone but essential workers were supposed to stay home to prevent the spread of the deadly novel coronavirus. Like workplaces, places of worship also closed their doors, which for some was unprecedented. Organizational decisions and norms within these places of worship such as whether to follow executive orders, socially distance, and cleaning may have influenced individuals' opinions on how to react to the pandemic. If religious communities chose not to follow these guidelines, telling parishioners that God will protect them and bring cure, for example, this could have given false hope and put individuals at risk (Levin, 2020). If this occurred, individuals could have been influenced to take the pandemic and guidelines less seriously while in public as well, thereby putting others at risk. On the other hand, religious communities that promoted social distancing and cleaning to "protect thy neighbor" would be promoting behaviors that would contribute to preventing spread (VanderWeele, 2020).

Though there are varying ways religiousness could impact health during the pandemic, we hypothesize that more religious and spiritual individuals will better comply with COVID-19 health behaviors to protect the common good due to religiousness and spirituality. Our sample included 1,382 participants involved in a national panel managed by the Harvard Digital Lab for the Social Sciences. The participants completed a survey once between April and May 2020. A 3-item measure was used to assess COVID-19 compliance behaviors, a 1-item measure was used to assess religiousness, and a 1-item measure was used to assess spirituality. Daily spiritual experiences were assessed by a 2-item measure and concern for worship activities being cancelled was asked through a 1-item measure. Religious coping was assessed through a 4-item measure. Preliminary results indicate that self-rated religious identity and combined measures of religiousness are associated with compliance to COVID related health behaviors. However, this association is opposite of our hypothesis and indicates that as compliance increases, religious identity and religiousness decrease. This could indicate that religiousness does not have benefits on preventative health during the pandemic and differs from previous research. This research will help to determine whether there are important associations due to religiousness and spirituality during the pandemic and whether there are characteristics that improve compliance with COVID-19 health behaviors.

The Effect of Religious Priming on Attitudes Toward Immigrants

**Carolyn Priebe
Taylor Richmond
Matthew Severino
Alissa Sweeney
Yuki Kojima**

Mentor:

**Dr. Daryl Van Tongeren,
Psychology**

This project was made possible thanks to the Hope College Mellon Scholars Program.

Many world religions emphasize the importance of charity and hospitality toward those in need, so one may expect there to be greater levels of helpfulness toward immigrants among the religious. However, several social psychological perspectives have found that people are more willing to help in-group members than out-group members (e.g., Tajfel & Turner, 1979). Research has found that reading biblical passages about a violent God led participants to be more aggressive (Bushman, Ridge, Das, Key, & Busath, 2007), whereas having participants read Biblical peace-based passages reduced negative attitudes toward religious out-group members (e.g., Christians and Muslims; Rothschild, Abdollahi, & Pyszczynski, 2009).

The purpose of this study is to examine the effects of priming religious texts on attitudes toward refugees in the United States. Undergraduate participants ($N = 148$) were first randomly assigned to one of five priming conditions (i.e., religious inclusion, religious exclusion, general religion, secular inclusion, or neutral). Then, they were randomly assigned to rate their attitudes toward Christians or Muslim refugees.

The results indicated that there was a significant main effect in the religious condition on pro-immigration attitudes. The inclusive prime produced significantly lower pro-immigration attitudes than all the other conditions combined. Surprisingly, the religious inclusion prime caused people to become less tolerant.

The concept of moral licensing could help explain this result, which posits that those who perform immoral behavior are excused due to prior moral behavior (Merritt, Effron, & Monin, 2010). In our study, participants who read the inclusive prime might have agreed with it, thus giving them the license to be less tolerant toward immigrants. With replication, one possible implication could be that religious groups with a goal of trying to promote inclusion could think more about how to make their messages more effective, so as to reduce the effect of moral licensing.

College Students' Screen Time in the Midst of a Pandemic

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Mentor:

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Hope College Department
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Before the pandemic, constant use of technology/screen time was very much discouraged in most households and in education systems. Classes were stepping away from tech use, prohibiting cell phones, asking students to take handwritten notes instead of typing them. The CDC has been recommending less and less screen time for children over the years and parents have been encouraging their kids to go outside more, spending less time online with devices like tablets used for leisure purposes. Pre-COVID, on average, college students spent 8-10 hours daily on smartphones (Roberts et al., 2014). At the start of March of 2020, the entire U.S., and most of the world, was placed under a stay-at-home order and because of this young adults across the world were forced into online schooling and prohibited from seeing other people in person, opening the door to more technology time. Institutions purchased software for video chatting, classrooms were updated to accommodate virtual learning, and more time was spent on a screen. Due to the increasing nature of online classrooms and educational activities being made virtual, our interest aligns in analyzing the trends of technology use and screen time alongside COVID-19 and its impact on leisure activities and educational uses. One question that arises has to do with the total amount of daily screen time accounted for by cell phone activities and the additional contributions of other screen interface devices. Another question of interest is the extent to which screen time patterns were influenced by the stay-at-home orders and remote working and learning conditions during the COVID-19 operations of 2020. We are investigating COVID's impact on the amount of screen time young adults spend weekly through an online survey sent to undergraduate students. We will discuss technology use patterns pre- and amidst the pandemic.

**Examining First
Responders' Mental
Health**

Taylor Richmond

Mentor:

**Dr. Daryl Van Tongeren,
Psychology**

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Terror Management Theory describes the existential angst that humans feel with the understanding that death is truly inevitable and it assists in explaining why humans develop and maintain religious beliefs, how numerous religious orientations address universal existential concerns, and what the social costs and benefits are (Vail et.al, 2010). The purpose of our research was to understand the role of religion (or various coping mechanisms) in terror management processes and managing existential concerns in a community sample (mTurk) and in a sample of participants who regularly face mortality concerns (first responders).

We collected two samples. Participants were randomly assigned to a standard mortality salience induction or dental pain prime and completed measures of mental health, such as anxiety (death anxiety and clinical anxiety), depression, and PTSD. Next, participants reported on their religious coping. We predicted a main effect for intrinsic religiousness (IR), a main effect for mortality salience (MS), and an interaction between IR and MS. In Sample A ($N = 176$), we sampled community members from mTurk. Our predictions were not supported. The depression and anxiety measure means were higher for dental pain than death, which could have been because the COVID-19 pandemic makes morality perpetually salient. In Sample B ($N = 211$), we gathered data from first responders (e.g., ambulance staff, police officers, firefighters) via the snowball method. We predicted that first responders' religious coping would be higher than the mTurk Sample, and we also predicted that the first responder's mental health scores would be poorer than that of the general population. Results indicated the opposite of both of these hypotheses. We posit that this could be a protective measure because first responders are routinely exposed to death, they may become either better at coping with the trauma or they become habituated to it.

**Filled and Unfulfilled Hope:
The Effect of Imagery on
Self-Regulatory Resources
and Emotion**

**Isabel Santos
Delaney Groves**

Mentor:

**Dr. Lindsey Root Luna,
Psychology**

An important element of human cognition is the ability to imagine and hope for future outcomes. Imagining the future may result in states of hope or hopelessness. Hypertension, respiratory tract infections (Richman et al., 2005), and depression in adolescents (Waszczuk, Coulson, Gregory, & Eley, 2016) have been correlated with hopelessness, whereas positive emotions (Snyder et al., 1991) and lower levels of anxiety and depression (Feldman & Snyder, 2005) have been associated with states of hope. Using an experimental approach, hope evocation decreased anger and anxiety, along with heart rate, compared to rumination following a stressful event (Chadwick et al., 2016). In the current study, we attempt to evaluate the impact of forecasting the future regarding a hoped-for outcome. This between-subjects experiment tested the impact of hopeful and hopeless thinking on self-regulatory resources, depression and anxiety symptoms, rumination, and flourishing. Participants (undergraduate psychology students, anticipated N=105) complete individual difference measures, and self-reported, hope, hopelessness, optimism, satisfaction with life, and flourishing. Additionally, the participants' depressive and anxiety symptoms, along with emotion regulation tendencies and trait self-regulation are measured. Participants then identify a meaningful hoped-for outcome for the next month and are randomly assigned to a control, hope-filled, or hope-unfilled condition using Qualtrics. Next, researchers assess the hope, flourishing, and self-regulatory resources of participants. Researchers expect that imagining a hoped-for outcome unfulfilled will result in decreased positive emotion and flourishing and increased negative emotion compared to imagining the hoped-for outcome unfulfilled. This study builds on previous research regarding the value of hope and explores the impact of hope fulfilled and unfulfilled imagery on self-regulatory resources and emotional processes.

College Life and Religious Change

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Attending college is an important period of growth and identity development for many young people. This time period is highly correlated with religious change or disaffiliation (Brañas-Garza et al., 2013). Further research supports the theory that one's first experience with trauma may also predict some sort of religious change (Falsetti et al., 2003). The way in which one holds religious beliefs is another factor; for example, those with security-focused religious orientations were found to be less tolerant of those with differing religious beliefs than those with growth-focused religious orientations (Van Tongeren et al., 2016).

The purpose of our study is to gain more insight into the process of religious disaffiliation. Specifically, we hope to further examine possible predictors of religious change, as well as the effect that COVID-19 has on religious change. We conducted a three-part longitudinal study with Hope College students enrolled in introductory Psychology courses. Sixty nine participants were surveyed at three time points: a baseline date (T1), three weeks after baseline (T2), and three weeks after Time 2 (T3). All three surveys are identical, and include measures for predictors of religious change, general religiousness, existential humility, trust in God, etc. We hypothesize that participants' doubt will predict religious struggle and participants who are experiencing stressful events will be more likely to undergo religious change. Likewise, we predict that participants with more defensive religious beliefs will show less religious change following low-stress events, but will show significantly more religious change following extremely stressful events. Since Hope College is a religiously affiliated institution, this may also have an effect on one's likelihood to undergo religious change. We hope that our results will offer insights into which types of beliefs are associated with enduring faith, which factors may predict religious change, what the outcomes of religious change may look like, and how COVID-19 plays a role in the process of religious change.

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Differences in Pre-Health Undergraduate Descriptions of the Ideal Self**Kaitlyn Lein****Mentor:****Dr. Aaron Franzen,
Sociology**

This longitudinal study aims to explore factors related to the retention of students on pre-health tracks during their undergraduate years. We surveyed Hope students from the classes of 2022 (Cohort 1, n = 164) and 2023 (Cohort 2, n = 197) who expressed an interest in health professions as freshmen, and asked them to describe their ideal professional self. We asked Cohort 1 as sophomores if their ideal professional self had changed since last year. We found that students who described their ideal self as specific medical professionals were more likely to be confident in their goal of becoming a medical professional than students who used aspirational character descriptions, including character descriptions that emphasized being helpful. In addition, within Cohort 1, first generation students were more likely to change their major from their first to second year, report lower levels of social support from their first to second year, and compartmentalize their professional identity. These results suggest that there is a correlation between confidence in becoming a health professional and their view of the ideal self as well as significant differences in undergraduate experiences between first generation and continuing generation undergraduates. Through this study we hope to develop strategies to aid undergraduate students from underrepresented populations in healthcare persist in their pre-health tracks so as to increase representation of these populations within healthcare professionals.



**Immigrant and Refugee Youth: Stories Shared by Professionals****Jazmin Serrano****Mentor:****Dr. Deborah Sturtevant,
Social Work**

The purpose of this oral history project is to learn from professionals about their work with refugees and immigrants. My learning goals are: 1) to learn more about refugee children and families from the professionals who work directly with this population and 2) to learn more from about the culture, history, politics, and institutional and social structures thereby obtaining a greater understanding of ways to serve these children and families.

In recent years, federal policy concerning refugees and immigrants has directly impacted the services that children and families are able to receive. Additionally, federal policies have brought many unanticipated barriers for families and professionals bringing forward feelings of confusion, disappointment, and at times hopelessness. According to reports from Refugees International (2018), President Trump implemented a zero-tolerance policy that stated that all individuals crossing the southern US border from anywhere other than an official port of entry were to be detained and criminally prosecuted. This policy led to a family separation with more than 2,737 children being separated. Additionally, under the Trump administration, there was a policy instituted called the Migrant Protection Protocols, which left approximately 25,000 children including asylum seekers to wait at the Mexican border. Furthermore, the number of refugees permitted in the US reached a record low of 8,000 in fiscal year 2020 of the 11,814 refugees arriving. This was complicated further during the COVID-19 pandemic in 2020 when immigrants seeking asylum were turned back at the border; children were also detained in Mexico. Under the new Biden administration (2021), Biden plans to increase the numbers of refugees permitted to enter the United States and to revoke Trump administration protocols.

Bethany Christian Services (BCS) serves refugee and immigrant youth through their programs, including the Unaccompanied Refugee Minor (UMI) and the Unaccompanied Child Transitional Foster (UCTFC) care programs. Statistics from client records at BCS indicate that there were 8,660 refugees served in 2019. From these 8,660 individuals, 1,632 were unaccompanied youth. These youth have experienced trauma prior to their journey to the US during their journey, and continue to face trauma once in the US. Lessons learned from interviews with UMI and UCTFC caseworkers and supervisors will be discussed at the Celebration of Undergraduate Research and Creative Activity.

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“Beauty of a simple bubble. The vivid colors reflected on the bubble allures your eye as if it’s mirroring your soul. Taken with Sony A6300”

—H.Jang, '21

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