4-12-2019

Hope College Abstracts: 18th Annual Celebration of Undergraduate Research and Creative Activity

Hope College

THE 18TH ANNUAL

CELEBRATION OF UNDERGRADUATE RESEARCH AND CREATIVE ACTIVITY

2018–2019 ABSTRACTS

Hope COLLEGE

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WELCOME

April 12, 2019

Dear Friends,

We are pleased to welcome students, guests, and community members to the 18th annual Celebration of Undergraduate Research and Creative Activity at Hope College. This event highlights scholarly accomplishments by talented Hope students working collaboratively with exceptional faculty mentors.

Involving students in faculty-mentored scholarship is a hallmark of Hope's academic program. Through varied research opportunities across campus, students learn more deeply, find meaningful connections between their education and future plans, and develop creativity and skills to succeed in college and beyond.

This year's Celebration includes 202 presentations by 327 students from 27 different departments and programs. Research occurs both during the academic year and summer, spans the four academic divisions, and includes independent study and course-based research. Hope students regularly receive national recognition for their research accomplishments with NSF Graduate Research Fellowships, Fulbright Scholarships, Goldwater Scholarships, and professional society awards.

Hope College is nationally recognized for the extent and quality of its undergraduate research program. Students regularly present their research at regional and national conferences and publish their research as co-authors with their faculty mentors. During calendar year 2018, Hope students made 153 presentations at off-campus conferences and submitted or published 28 journal articles. Hope College currently receives over $12 million in active external grant funding that supports 69 research and educational projects.

Each abstract in this book describes original and creative scholarship arising from research that Hope students and faculty have pursued together. Beyond the development of new knowledge, these projects are among the most transformative learning experiences in a student's academic career. The interaction with caring and dedicated faculty mentors results in expanded awareness and opportunities for student post-graduate plans and career aspirations.

Thank you for your participation in and support of this Celebration. To learn more about research experiences at Hope College, visit the website: **hope.edu/research.**

Sincerely,

William F. Polik

William F. Polik
Associate Dean for Research and Scholarship

ART & ART HISTORY

For Duly Keeping and Preserving Relics

Holle Wade

Mentor:
Dr. Anne Heath,
Art & Art History

This work was supported by the Al and Phyllis Bursma Summer Research Fund in the Humanities & Arts, part of the Nyenhuis family of funds.

This paper concerns itself with the tradition of reliquaries in the 18th century. The paper highlights a specific reliquary from the Kruizenga Art Museum, but the object belongs to a long history of reliquaries. The KAM reliquary's iconography and meaning is explained in the paper, which details how this reliquary fits into the history of not only reliquaries but the history of the region that it comes from.

Photo courtesy Hope College Public Affairs and Marketing. Photo credit: Thomas Renner.

Disability in Black Women's Speculative Fiction

Hannah Barnes

Mentor:
Dr. Kendra R. Parker
English

This presentation will explore disability and disability metaphors in Black women's speculative fiction. It will specifically look into how the characters in the stories attempt to hide their "disabilities" in order to pass as abled within their societies, and how the time period in which the stories were written and published influenced the need for disability passing. It will examine Octavia E. Butler's novel *Mind of My Mind* (1977), her short story "The Evening, the Morning, and the Night" as well as Tananarive Due's *The Living Blood* (2003) and *Blood Colony* (2008), and L.A. Banks' *The Bitten* (2005).

"I don't know, but together we can live"(Mononoke): Mimetic Theory, Levinisian Phenomenology, and Princess Mononoke

Rachel Schaller

Mentor:
Dr. Curtis Gruenler,
English

The intersection between Girard and Levinas is the undercurrent in Hayao Miyazaki's animated epic, *Princess Mononoke*.To Girard, the impulse to imitate one another leads to conflict, and that can lead to both parties to take out this aggression they have on a scapegoat. Society should make a commitment to reducing this impulse through a commitment against the violence, and Girard sees this as the point of many stories. To Levinas, humans are ruled—and ought to be ruled—by the psychological and physiological prosocial impulse that comes with interactions with other people, especially when it comes to face-to-face interaction and physical contact. The daunting otherness of other people creates an obligation to do right by their otherness. These explanations concerning ethics are not mutually exclusive. Students of Levinas have pointed out that one cannot fulfill every obligation proposed to them, and the reality of different points of view functionally limits what ways in which a person understands these obligations. Prioritizing these obligations becomes important, and one can choose by prioritizing allegiances that reduce violence.

In Miyazaki's depiction of medieval Japan, a local enchanted, monstrous forest and an industrial town jostle for possession of the forest's trees. There are many aspects of this industrial town that appeal in terms of inclusion, and there are redeemable aspects to its leader. The forest gods and the humans are simultaneously kind to their ingroup and monstrous to the other faction. This mirroring is not a comfort; it is obstacle. The forest gods are the right side because they advocate for the forest, this scapegoat, to be spared from violence. As a masterful and very picky storyboard artist, Miyazaki uses the intricacies of the interactions between his characters to emulate face-to-face interaction and solidify why nonviolence is hard but also why it is crucial.

ENGLISH

The Fitzgeralds in France: A Life of Splendor and Tragedy

Rebecca Stanton
Kaitlyn Rustemeyer

Mentors:
Dr. Natalie Dykstra,
English

Dr. Marsely Kehoe,
Mellon Scholars Program

This research was supported by the Hope College Mellon Scholars Program.

F. Scott Fitzgerald and his wife Zelda Sayre are well-known for the glamorous life they lived as they roamed throughout America and Europe. They met and befriended many other writers and artists during their travels, but never as many as they met in Paris, the center for expatriate Americans of the Lost Generation. This project is composed of three parts that focused on the Fitzgeralds' lives through specific lenses. The first part is a Pecha Kucha presentation summarizing the lives of the Fitzgeralds and detailing their time in Paris. Part two is a Wordpress website analyzing the relationships that the Fitzgeralds developed with other American expatriates in Paris, accompanied by a story map of their most frequented locations. The artists and authors that we researched were Ernest Hemingway, E. E. Cummings, Gertrude Stein, Edmund Wilson, Sylvia Beach, and Pablo Picasso. The final part of our project is an analysis and comparison of novels written by Scott and Zelda, respectively. Zelda's *Save Me the Waltz* is a fictional recollection of her time with Scott leading up to her mental illness and institutionalization, while Scott's *Tender is the Night* displays his perspective. We each focused on one of the two novels in a ten-page essay, and then together compared our analyses, arriving at a conclusion we had not anticipated: Scott censored Zelda's novel in order to use the material himself. Our project as a whole helped us to understand that the Fitzgeralds' lives were not simply full of frivolity, but of sadness and pain that derived from their own marriage as well as their backgrounds, personalities, and ambitions.

Congolese Education

Madie Lynema

Mentor:
Dr. Lauren Janes,
History

When King Leopold II controlled the Congo Free State, he had a large impact on the lives of the Congolese. Even after he sold his colony to Belgium, life was still extremely controlled for the Congolese people. When the Belgians controlled the Congo, they brought their educational system and beliefs on education with them. However, after the Congo gained independence in 1960, the Congolese were left with very few resources, such as college-level educated individuals. As they tried to piece together a state, the Congolese had to try and determine what education meant to them and how they wanted their educational system to run. When they did try and set up this system, they faced issues with funding, proper job-training, and a lack of health information for their people. These issues are still relevant in present day Congo. This paper seeks to examine how the Belgians used education in the Congo and how that contributed to a weak educational system in the DRC today.

Hope College and the Vietnam War

Halla Maas

Mentors:
Dr. Jeanne Petit,
History

Dr. Pamela Koch,
Sociology and Social Work

This research was supported by the Mellon Grand Challenges grant.

This project focuses on Hope College during the Vietnam War era. During this time, the draft created moral dilemmas for both students and faculty. When it started affecting themselves and people they knew, students felt that they needed to be educated about the war. The draft also meant that students sought deferments through such means as studying ministry, pre-med, and other sciences. Hope students noticed that young men who were able to avoid the draft were usually privileged and not a part of the minority class. This led many Hope students to protest the draft and the war. These protests often led to social justice because they compelled the larger community to reevaluate the United States' participation in the war.

HISTORY

Historical Analysis of Independence in the DRC

McKenna Stam

Mentor:
Dr. Lauren Janes,
History

The chaotic transfer of power from Belgian colonizers to the Congolese people generated a series of circumstances that resulted in the assassination of Congolese Premier Patrice Lumumba. The subsequent military dictatorship of former Chief of Staff of the Force Publique, Joseph Mobutu (later Mobutu Sese Seko) imposed years of corrupt, oppressive rule in the country now known as the Democratic Republic of the Congo. A significant contributing factor to the events that befell the Congo originated from outside forces, specifically, the Central Intelligence Agency and the Belgian government's collusion in eliminating Lumumba.

This paper examines contemporary news sources, assessing the role of foreign powers in Lumumba's assassination and Mobutu's rise to power. The significance of these events occurring in the context of the Cold War will also be examined. Particular attention will be given to persisting American concerns about Soviet encroachment on the African continent that were heightened by worries over Soviet actions to extend communist influence globally.

Photo courtesy Hope College Public Affairs and Marketing. Photo credit: Jon Lundstrom.

An Analysis of Fear in Don Quixote

Jamie Breyfogle

Mentor:
Dr. Tatevik Gyulamiryan,
Modern & Classical Languages

Fear, one of the six basic human emotions, has played a formative role in evolution—signaling threat or danger and waking the "fight or flight" response. In literature, although fear appears in various contexts, it is typically associated with illogical or funny behavior. Notably, fear is a prevalent emotion in Miguel de Cervantes's novel *Don Quixote* and is portrayed as an unreasonable emotion, worthy of its protagonist's scorn. Sancho Panza is often fearful of things Don Quixote is not. This research explores examples of fear in *Don Quixote,* how it is expressed, and a cognitive analysis of potential causes of this discrepancy between the reactions of Don Quixote and Sancho Panza.

Women without Fear: Women in the French Resistance

Carolyn Cooper

Mentor:
Dr. Brigitte Hamon-Porter,
Modern & Classical Languages

During the Second World War, a large resistance movement developed in France to combat the German presence and to protect the citizens of occupied France. This underground operation served many purposes, such as distributing newspapers, serving as guides for the Allies, helping soldiers and French citizens escape the German army, and conducting espionage operations. Working in the Resistance was extremely dangerous, as those who were caught were often killed or sent to concentration camps. Although men held many roles in the Resistance movement, women performed many of the most dangerous jobs. Women comprised a large percentage of those who participated in paramilitary activities, espionage operations, and the vast network of escape lines throughout Europe. Women's participation in these activities amplified the efforts of the French Resistance and accelerated the progress of the war in Europe. Further, women's contributions to the Resistance resulted in greater gender equality and increased opportunities for women in France after the war. This research explores the varied roles held by women in the French Resistance and how women's involvement in this movement affected both the outcome of the war and women's position in French society.

The Importance of Music Programs for At-Risk Youth within Urban Schools

Mikayla Battistone

Mentor:
Dr. Sarah Southard,
Music

It is important to implement and maintain a music program within an urban school containing a high population of at-risk students. With the awareness of mental illness increasing, we are more knowledgeable of the cognitive deficits caused by ongoing abuse and neglect—often called complex trauma. The effects music can have on the brain combats the negative cognitive and emotional impacts of complex trauma, which is essentially the goal of music therapy. Not every child has the opportunity and/or means to experience music therapy. However, if music programs are offered in schools, kids can reap the positive benefits of music by participating in their school's program. The role of the teacher as well as the type of music studied in school can have incredibly positive impacts on the student(s) as well. In order to reach the full potential of the positive effects of music, the teacher needs to take time to get to know and invest in their students. Additionally, they need to be willing to be creative and flexible with the curriculum. This might mean turning to nontraditional genres, including hip hop or rap. There is no formula for the perfect music program in an urban setting, but what is important is that one is implemented and shaped in a way that will best benefit the students and their well-being.

Caring for Difficult Patients: A Workshop Identifying Challenges and Opportunities

Karissa Libson

Mentor:
Dr. Steven Hoogerwerf,
Religion

Healthcare professionals often find themselves working with patients and families of patients they describe as "difficult". This interaction poses an ethical dilemma for the healthcare worker as they consider how to best care for their patients. This study aimed to create a comprehensive understanding of the term "difficult", to collect case stories of challenging interactions, and to identify methods used to address these situations ethically. To accomplish this, a literature review and series of interviews with healthcare workers were conducted. The term "difficult" was found to manifest itself in a variety of ways including, but not limited to, people characterized as: demanding, entitled, abrasive, dependent, self-destructive, manipulative, time-consuming, and dissatisfied with care. Strategies addressing specific characteristics were identified and the findings were formatted into a workshop for healthcare professionals to reflect on their own experiences and to create appropriate solutions to their unique situations.

Stage Management of *Crooked*

Gracen Barth

Mentors:
Reagan Chesnut,
Theatre

Daina Robins,
Theatre

This project will detail the process of stage managing the play *Crooked.* Stage management is the organization and coordination of rehearsals, meetings, and performances of a theatrical production. The work required of a stage manager includes scheduling meetings and rehearsals, tracking set, props, costumes, lighting, and sound, taking blocking notes and line notes, and and during the performances calling the show by cueing the sound and light board operators.

Cry It Out Costume Design

Megan Clark

Mentors:
Michelle Bombe,
Theatre

Richard Smith,
Theatre

Perry Landes,
Theatre

Richard Perez,
Theatre

Dr. Daina Robins,
Theatre

This semester the Hope College Theatre Department produced *Cry it Out* by Molly Smith Metzler and I had the exceptional practical learning opportunity to costume design the production. I read the play multiple times, researched the characters and the modern clothing that each character might wear and presented this as visual research along with character sketches for different costume ideas. I then rendered watercolor drawings of the chosen looks, attended weekly production meetings where the director and the other designers offered feedback on my designs. From this feedback, I pulled costume pieces from our stock and ordered the things we didn't have, set up multiple costume fittings with the actors, made hair and nail appointments for the actors, and attended dress rehearsals to make sure all the costumes were in order, that the actors were aware of each costume piece and knew how to use them, and that every actor was comfortable in each of their costumes.

THEATRE

Cry It Out Stage Management

Katie Joachim

Mentors:
Reagan Chesnut,
Theatre

Richard Perez,
Theatre

Over the course of seven weeks, the Hope College Theatre Department produced the play *Cry It Out* by Molly Smith Metzler. The stage management team led each rehearsal and created rehearsal schedules and reports. This information was then synthesized and communicated with the design and production teams, then later reviewed and discussed in production meetings. As the play moved from standard rehearsals into technical rehearsals, the stage manager oversaw all the backstage crews and technicians. In performance, the stage manager called every lighting and sound cue, while keeping an open line of communication with the Assistant Stage Managers, Light Board Operator, Sound Board Operator, and House Manager. Through the work of the stage manager, the cast, director, and production team is able to easily communicate with one another throughout the rehearsal process, and, in turn, the performances of the production run smoothly.

Stage Management of *The Seagull*

Emmie Sandstedt

Mentor:
Reagan Chesnut,
Theatre

Stage Management is a career in the theatre and entertainment industries that revolves around organizing, facilitating, and collaborating with theatre artists in order to create the best production or performance possible. At Hope College, students have the opportunity to work alongside students and faculty. This project is the compiled paperwork and analyses for the stage management of Hope College's 2019 production of *The Seagull*.

The Forgotten Expedition of the Michigan Polar Bears

Laura Anthon
Jamie Breyfogle
Tim Embertson
Natalie Weg

Mentor:
Dr. Marsely Kehoe,
Mellon Scholars Program

The Michigan Polar Bear expedition saw Allied forces leading a controversial excursion into Northern Russia during the concluding years of World War I. Despite thousands of soldiers being sent to interfere with the Russian Civil War, the Polar Bear Expedition has been lost from collective memory. We publicly inquired about the expedition, then combined this research with a found scholarly consensus about the lack of cognizance relating to the events. This revealed a disconnect, which led us to inquire as to the nature and origin of its historical omission. Our primary sources of research focused on the oral histories of veterans located in the Joint Archives of Holland. After analyzing the first person accounts of the soldiers, followed in turn by the reaction of their respective communities, we created a detailed description of this expedition's impact on the greater Holland area. Understanding this multi-generational oversight will bring forth a greater argument for the importance of people to continue teaching and learning about this significant piece of history.

Found in Translation: The Complexities of Edgar Allan Poe in Translation by Charles Baudelaire

Kellyanne Fitzgerald

Mentor:
Dr. Natalie Dykstra,
English

Literary critics have traditionally lauded Charles Baudelaire's work in translation as the key reason for the success of Edgar Allan Poe in France. While Baudelaire's voice and editorial choices did affect his translations, the success of his Poe translations was not entirely due to his choices. An idiosyncrasy in the relationship between Poe's writing style and the structure of French syntax is one of several factors which elevate Poe in translation, which suggests a more complex situation than critics have previously realized. Understanding the context of a translation and the constituent factors of its success (or lack thereof) allows readers to predict and parse the ways a translation will function in the target culture.

MELLON SCHOLARS

The Art of Moving Across Borders: A Look into Translanguage Literature

Sarah Herrera

Mentors:
Dr. Jesus Montaño, *English*

Dr. Marsely Kehoe, *Mellon Scholars Program*

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

"They might be talking in perfect latin tongue and without warning begin to talk in perfect anglo tongue and keep it up like that, alternating between a thing that believes itself to be perfect and a thing that believes itself to be perfect, morphing back and forth between two beasts until out of carelessness or clear intent they suddenly stop switching tongues and start speaking that other one. In it brims nostalgia for the land they left or never knew when they use the words with which they name objects; while actions are alluded to with an anglo verb conjugated latin-style, pinning on a sonorous tail from back there." (Herrera, Yuri. *Signs Preceding The End Of The World*)

Translanguaging is an emerging field of study that explores the ways Latinx people utilize English and Spanish to create a new language— a third language that also showcases their transcultural lived experience. While translanguaging has applications in language pedagogy, my research looks at the deployment of translanguaging in literature. Specifically, I examine the works of Sandra Cisneros, Junot Díaz, Yuri Herrera, and Erika L. Sanchez for the artful ways they incorporate translanguaging and thus the way they explore culture and identity via language use.

While recent scholarship in this emerging field has been largely devoted to classroom use, my study treats literary works— both fiction and poetry— for evidence of translanguaging and its necessary use by Latinx people in the exploration of their identity.

The Importance of the Virgin Mary as an Icon and the Evolution of Her Representation

Keyshara Hudson
Amelia Waalkes
David Wang
Abigail Venlet

Mentor:
Dr. Marsely Kehoe, *Mellon Scholars Program*

Throughout history the Virgin Mary has influenced the world on a broad scale across many cultural contexts. The Virgin Mary continues to be a widespread symbol with major societal implications, such as gender roles and upheld generational traditions. By further exploring the idea of the Virgin Mary as the Mother of God, the various interpretations can be analyzed as a motherly human figure and as a higher being. In particular, the significance of the Virgin Mary today and in the Italian Renaissance displays how she was developed as the Mother of God during the 15th and 16th centuries and how Mary as the Mother of God is contextualized in present day life and society. Nonetheless, the viewpoints of the Virgin Mary differs. Thus, in her own uniqueness she exemplifies much more to people than just a religious figure and her impact continues to present itself in our world.

Hope College and Ready for Life: Kate's Story

This research was supported by the Hope College Mellon Scholars Program.

This project was an interdisciplinary endeavor between the Department of Sociology & Social Work and The Mellon Scholars Program. See page 129 in the sociology & social work section of this book for full abstract.

The Fitzgeralds in France: A Life of Splendor and Tragedy

This research was supported by the Hope College Mellon Scholars Program.

This project was an interdisciplinary endeavor between the Department of English and the Mellon Scholars Program. See page 8 in the English section of this book for full abstract.

For Duly Keeping and Preserving Relics

Written with the support of a Jacob Nyenhuis Faculty-Student Collaborative Research Grant.

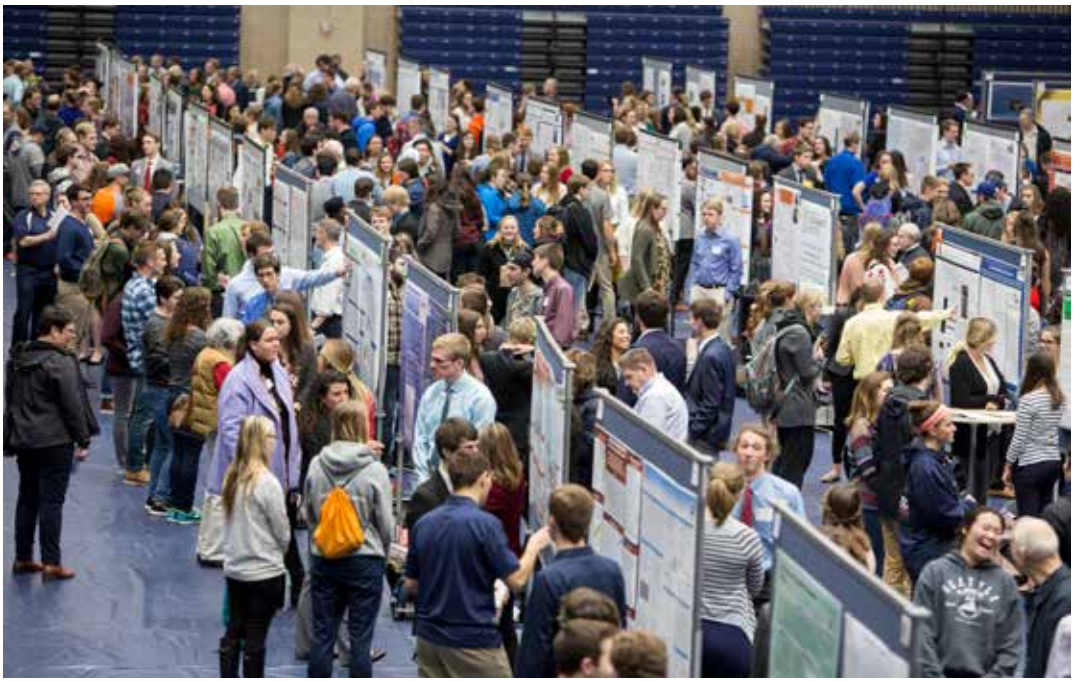
This project was an interdisciplinary endeavor between the Department of Art & Art History and the Mellon Scholars Program. See page 6 in the art & art history section of this book for full abstract.

Testing the Impact of Prebiotics on Anxiety-like Behaviors in Aged Male Rats

Emily Zolman
Elizabeth Woodford
Kenia Urena-Gonzalez
Jared Stygstra
Peter Stewart
Nicholai Shaw
Allison Lindquist
Anna Langholz
Erin English
Marny Ehmann

Mentor:
Dr. Gerald Griffin,
Biology and Psychology

The composition of gut microbiota has direct impacts on neural structure, neurochemistry, and behavior. Specifically, the gut microbiota has been shown to modulate anxiety-like behaviors. In addition, administering prebiotics, compounds that promote the growth of commensal bacteria, has been demonstrated to reduce anxiety and anxiety-related behaviors. However, this effect has yet to be tested in older animals despite anxiety being implicated as a most common disorder in adult populations. Therefore, this study seeks to fill this knowledge gap by investigating the link between prebiotic interventions and anxiety-like behaviors in aged populations. It was hypothesized that older rats treated with the prebiotic fructooligosaccharide (FOS) would display an increase in exploratory behaviors, correlating to a decrease in anxiety, compared to the controls. Behavioral assays such as the open field test (OFT), elevated plus maze (EPM), and a social anxiety (SA) test were conducted. Results demonstrate moderate evidence that rats administered FOS had increased exploration in the center zone of the OFT. This finding suggests that FOS helps to modulate behavior in aged animals. With moderate evidence for increased exploration as evidence for decreased anxiety in FOS treated animals, this study provides a platform for further investigation of the role of modulating gut microbiota in older animals. Investigating the effects of senescence versus prebiotic treatment of the rats in this cohort was dampened by the limitations of the precedent of behavioral assays utilized on smaller, younger animals. As a result, this study calls for a widening of behavioral assay parameters to allow for effective data collection in an aging population.



2018 Celebration of Undergradurate Research and Creative Activity. Photo courtesy Hope College Public Affairs and Marketing. Photo credit: Steven M. Herppich.

Does NMDA Receptor Inhibition Prevent HCA-Induced Manic/Depressive Behavior in Rats?

Nina McAlvey
Mercedes Rede
Samantha VanHoven
Samuel Wolfe

Mentor:
Dr. Leah Chase,
Biology and Chemistry

This project was supported by the Hope College Neuroscience program and also involved students from the Fall 2018 and Spring 2019 Introduction to Neuroscience lab courses.

Previous work in our laboratory has demonstrated that male and female rats that receive daily intraperitoneal injections of the endogenous, glutamatergic agonist homocysteic acid (HCA) from postnatal day 3-21 develop behaviors that are consistent with a mixed depressive/manic phenotype. Specifically, HCA-treated rats exhibit anhedonia in a saccharin preference test and reduced social interactions consistent with a depressive phenotype. In addition, these animals also exhibit increased locomotion and risk-taking behavior in novel environments and increased goal-directed behavior in the Morris Water Maze. We have previously hypothesized that the behaviors elicited by HCA treatment may suggest that we have developed a novel animal model for bipolar disorder. Recently, we have learned that NMDA receptors may play an important role in the pathophysiology of mood disorders, such as major depressive disorder and bipolar disorder. Given that HCA is an NMDA receptor agonist, we hypothesized that excessive NMDA receptor activation during the critical development period may lead to alterations in NMDA receptor subtype expression within brain circuits known to regulate mood. Therefore, we sought to determine if injection of a NMDA receptor antagonist (ketamine) ten minutes prior HCA injection would prevent the development of the mixed manic/depressive phenotype. We created four treatment groups, rats receiving saline injections prior to an HCA injections, rats receiving ketamine prior to HCA injections, rats receiving a ketamine injection followed by a saline injection and rats receiving two saline injections. The injections occurred daily from P3-P21. We are currently testing these animals for motor behavior (Rotarod), hedonistic behavior (sucrose preference), exploratory behavior and anxiety (elevated plus maze and open field test), depressive-behavior (forced swim) and social behavior (social interaction). Our preliminary observations suggest that ketamine does not lead to amelioration of anxiety, but instead may lead to heightened anxiety. However, we will report the results of our Two Way ANOVA once the behavior assessment is complete.

Impact of HSV-1 on an in vitro Model of Traumatic Brain Injury

Noah Weigle
Clare Da Silva
Leslie Perez

Mentor:
Dr. Gerald Griffin,
Biology and Psychology

This work was supported by the Dow Scholar Science Research Fund, the Hope College Department of Biology, and the US Army Office of Scientific Research (Grant #W911NF-17-1-0559).

Infection of Herpes Simplex Virus Type I (HSV-1) has been associated with the exacerbation of neurodegenerative pathologies. More specifically, in vitro and in vivo studies have revealed that HSV-1 can augment levels of the phosphorylated form of tau, a modified cytoskeletal protein that is enriched in neurofibrillary tangles and forms of dementia such as Alzheimer's Disease. HSV-1 is a neurotropic virus that establishes and maintains latency in sensory neurons. Physiological and emotional stressors have been shown to reactivate the virus from this latent stage and spread to the central nervous system. In an *in vitro* model of Vero cells, our data has shown increased levels of hyperphosphorylated tau as a result of HSV-1 infection. Ongoing analysis is being performed to further understand the impact of HSV-1 infection on the phosphorylation of tau in rat hippocampal neurons.

PHELPS SCHOLARS

Phelps Scholar Alumni Project

Ernesta Cole

Mentor:
Yolanda Vega,
Phelps Scholars Program

This research was supported by the Dean for Social Sciences.

The Phelps Scholars Program is in 20th year and has grown from 39 students at its inception to 90-100 students. While its commitment remains to provide first-year students with an intentional and diverse living and learning experience focused on race, culture and community, this project set out to review its impact on participants' lives over the years. Through a survey and interviews, data was gathered regarding how the program shaped participants' Hope College experience, career trajectory and life choices. This information will be used to tell the story of the Phelps Scholars Program while informing and strengthening this important first-year experience program.

Photo courtesy Hope College Public Affairs and Marketing

The Alternative Black Girl in Popular Culture: An Examination

Ester Fletcher

Mentor:
Dr. Lynn Japinga
Religion

Dr. Kendra Parker
English

The purpose of this work is to dive into the diverse world of African American culture. While many see this group of people as stereotypically loud, rude, and violent, there are multiple faces of the Black culture that is often not explored or presented in media. This work explores the other side of Black culture—a culture outside of rap music, expensive clothes, and grills—through images in the media, TV shows, and video games to acknowledge the different narratives of Black.

Hysteria: A Look at Sexism in Medicine

Cadence Jones

Mentor:
Dr. Lynn Japinga
Religion

The history of sexism in medicine spans across time and cultures, dating back as far as ancient Egypt. Women's illnesses were often attributed to the movement of their uteruses throughout their bodies, which caused a wide array of possible symptoms that were categorized as *hysteria.* While hysteria is now understood as a mistake of sexist medicine, the same sexist ideologies continue to create serious problems in the medical world. Women are regularly misdiagnosed and continually have their pain dismissed in serious medical situations. In a 2000 study in *The New England Journal of Medicine,* researchers found that women are seven times more likely than men to experience a misdiagnosis and be discharged without proper medical care while experiencing a heart attack. This is due to the fact that most medical understandings of disease come from research on male physiology, while women often experience different symptoms than men with the same diagnosis. Similar to heart attack research, most studies on chronic pain are conducted on men and male mice, yet the majority of chronic pain sufferers are women. This leads to the conclusion that women may suffer more from chronic pain and for longer periods of time. These same women are less likely than men to recieve pain killers for their conditions, and experience longer wait times for analgesic drugs in U.S. ER's than men. This research explores the depth of sexism in medicine both in history and modern time.

Legalized Abortion and Women's Health: The True Defender of Life

Kamryn Ramsay

Mentors:
Dr. Lynn Japinga
Religion

Dr. Fred Johnson III
History

The tension surrounding abortion in the United States has arguably dominated the political sphere for many times. The Pro-Choice community expresses its continued support of the ruling and the necessity for legal abortion. In contrast, the Pro-Life community has called for the overturning of the 1973 Supreme Court ruling of Roe v. Wade for reasons based in religion and the right to life; however, legalized abortion has protected the lives of women through safer procedures, legal autonomy over one's body, and the preservation of mental health.

The topic of this essay will analyze the pre-Roe and post-Roe United States through the lens of women's rights and health to give the reader a better understanding how legalized abortion has affected the lives of women in the United States. This paper will look at the dangers of illegally performed abortions, the mental trauma caused by forced birth, and the right of women to have autonomy over their bodies. Evidence from the personal experiences of women comes from an article in the Journal of Civil War Medicine titled "What Abortion Was Like in the 19th Century" by Kate Manning and an article in the Journal of Women in Culture and Society titled "Reproducing Jane: Abortion Stories and Women's Political Histories" by Kelly Suzanne O'Donnell. This essay also includes some rhetoric from Lawrence Lader, one of the founders of what is now the National Abortion and Reproductive Rights Action League. Statistics are taken from studies found in Reproductive Health Matters journal and an article from The University of Chicago Press Journal titled "State Implementation of Supreme Court Decisions: Abortion Rates Since Roe v. Wade" by Susan B. Hansen.

Effects of VACM-1/Cul5 Gene Knockout in T47D Breast Cancer Cells Using CRISPR-Cas9

Sarah Bonema

Mentor:
Dr. Maria Burnatowska-Hledin,
Biology and Chemistry

This work was supported by the Department of Biology.

The VACM-1 gene codes for the VACM-1/Cul5 protein, which is a part of the ubiquitin E3 ligase system responsible for ubiquitin-dependent protein degradation. VACM-1/Cul5 dependent E3 ligases are known to decrease cellular proliferation, and lack of regulation in this pathway can lead to cancer. The CRISPR-Cas9 system is a bacterial immune system that functions by targeting specific sequences of DNA. It can be programmed to target genes of interest, enabling specific gene editing in eukaryotic cells. We have used this system to knockout VACM-1/Cul5 in a T47D breast cancer cell line. Confirmation of the knockout was achieved through a T7 Endonuclease 1 mismatch cleavage assay proving a homozygous mutation of both alleles was achieved. AlamarBlue® growth assays support that VACM-1/Cul5 knockouts allows cells to proliferate at an increased rate. The immunostaining results of control and CRISPR-transfected cells indicate knockout of VACM-1. Genomic DNA sequencing was performed and was a final confirmation of VACM-/CUL5 knockout. Together, these results suggest that VACM-1/CUL5 is an important regulator of cellular growth.

Photo courtesy Hope College Public Affairs and Marketing.

Post-Translational Modifications of Mitochondrial Proteins MRPL12 and POLRMT as a Potential Regulatory Mechanism for Mitochondrial DNA Transcription

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This research is based upon work supported by the National Science Foundation Division of Molecular and Cellular Biosciences under Grant No. 1814845, by a Beckman Scholars Program award from the Arnold and Mabel Beckman Foundation, and through the ASBMB Undergraduate Research award.

Mitochondrial DNA (mtDNA) encodes 13 protein subunits required for oxidative phosphorylation, the pathway that produces the majority of cellular ATP. Mitochondrial dysfunction is associated with numerous diseases, making mitochondrial biochemistry an important area of investigation. However, there lacks an understanding of elements of this biochemistry, including the mechanisms that regulate mtDNA transcription. mtDNA is complexed to various proteins in structures known as nucleoids. Some nucleoid proteins are members of the mtDNA transcription machinery. These include the mitochondrial RNA polymerase (POLRMT) and mitochondrial ribosomal protein L12 (MRPL12), which maintains POLRMT stability and promotes mtDNA transcription. We hypothesize that reversible post-translational modifications (PTMs), such as phosphorylation of threonine, serine, or tyrosine residues or acetylation of lysine residues within these and other nucleoid proteins, may play a role in regulating mtDNA transcription. The objective of our study is to determine the effects of MRPL12 and POLRMT PTMs on the activities of these proteins in the context of mtDNA transcription in order to assess the roles of such modifications in regulating this process. To test this, we performed mutagenesis on MRPL12 and POLRMT genes to replace the sequence encoding an amino acid at a PTM site with a sequence encoding a modified or unmodified amino acid mimic (T, S, Y $\rightarrow$ E/A, phosphorylated/dephosphorylated mimic; K $\rightarrow$ Q/R, acetylated/deacetylated mimic). We optimized bacterial expression and protein purification conditions and purified wild-type and mutant MRPL12 proteins, as well as wild-type POLRMT. We performed preliminary in vitro transcription assays to assess POLRMT functionality and found that our protein successfully transcribed short mtDNA templates. We performed protein-protein binding assays to determine the effects of MRPL12 modifications on MRPL12's ability to bind POLRMT, and in vitro transcription assays to measure the effects of MRPL12 and POLRMT modifications on mtDNA transcription.

Use of Site-Directed Mutagenesis to Probe the Cystine Binding Site within System x_c^-

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Mentor:
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This research is supported by Schaap Endowed Funds for Undergraduate Research.

The Chase lab studies System x_c^-, which is a heterodimeric transporter that functions as a Na+-independent antiporter exchanging extracellular cystine for intracellular glutamate. The transporter functions as an obligate heterodimer and is comprised of two proteins, xCT, which functions specifically in amino acid exchange, and 4F2HC, which appears to play a role in transporter stability. System x_c^- belongs to the SLC7 family of transporters, which is further subdivided into the cationic amino acid transporters (CAT) and the L-type amino acid transporters (LAT), the latter of which is the subfamily which includes System xc-. In recent years, there have been advances in our understanding of the structure of the SLC7 transporters as crystal structures of bacterial homologs of CAT and LAT transporters have been published. As a result, we can now begin to ask important questions about the mechanism by which System x_c^- exchanges cystine and glutamate across the membrane. Previous studies in the Chase lab have demonstrated that System x_c^- is a Cl^--dependent transporter that transports cystine and glutamate in their anionic form. This substrate specificity is novel among the SLC7 family of transporters, therefore, the goal of this study is to identify the amino acids within xCT that are important in Cl^--binding and substrate binding and exchange. Previous studies have suggested that Cys 327 is important for transport activity and this residue is also conserved in the bacterial homolog. Therefore, we selected amino acids near cysteine 327 and within the apparent binding pocket for mutagenesis. Primers were designed to create the point mutations at S326A, T195A, F322A, Y149A, S322A, V141S and M331A, and we intend to test these mutants for transport activity. We hypothesize that mutants which lead to diminished transport activity or changes in substrate affinity are likely to be important in Cl^--binding, substrate binding and/or translocation.

Use of the CRISPR/Cas9 Gene Knockout System to Study the Effects of VACM-1/Cul5 on Cellular Proliferation

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Mentor:
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This research was supported by the Hope College Departments of Biology and Chemistry.

The VACM-1 gene codes for the VACM-1/CUL5 protein, which is a part of the ubiquitin E3 ligase system responsible for ubiquitin-dependent protein degradation. The activity of VACM-1/Cul5 dependent E3 ligase complexes are known to decrease cellular proliferation. Lack of regulation in this pathway can lead to cancer. The CRISPR-Cas9 system is a bacterial immune system that functions by targeting specific sequences of DNA. It can be programmed to target genes of interest, enabling specific gene editing in eukaryotic cells. We have used this system to knockout VACM-1/Cul5 in a human umbilical vein endothelial cell line (HUVEC). Genomic DNA has been sequenced for a final confirmation of VACM-/CUL5 knockout. Growth assays on Matrigel® support indicate that VACM-1/Cul5 knockout allows cells to proliferate at an increased rate. In addition, Matrigel® imagining indicates that phenotypic changes have occurred in cells following VACM-1/CUL5 knockout. Together, these results suggest that VACM-1/CUL5 is an important regulator of cellular growth.

Development of a Rapid Screening Assay to Detect Trafficking Defective Mutants of System x_c^-

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This research is supported by Schaap Endowed Funds for Undergraduate Research.

System x_c^- is a membrane transporter that exchanges extracellular cysteine for intracellular glutamate. The transporter is a heterodimer consisting of a transport specific protein, xCT, and a heavily glycosylated associated protein, 4F2HC. Recent studies in the Chase lab have shown that the cell surface expression of this transporter may be regulated by trafficking motifs localized to the C-terminus of the xCT protein. Currently, we use a cell surface biotinylation assay, which is expensive and labor intensive, to measure relative cell surface expression of xCT. The goal of this project is to develop a fluorescence-based assay that will allow for rapid screening of potential trafficking-defective mutants of the transporter. A similar assay has been successfully employed to study trafficking behavior of the Cystic Fibrosis Transmembrane Conductance Regulator (CFTR) (Holleran, J.P., et al., 2012). This assay required the construction of a fusion protein in which an extracellular fluorogen-activating protein (FAP) was attached to the N-terminus of xCT. Since the N-terminus of xCT is intracellular, the FAP domain is linked to xCT through a single-transmembrane domain of the Platelet-derived growth factor receptor. Currently, we are expressing this construct in a mammalian cell line to insure that it shows the same activity and expression pattern as the wild-type transporter. Once these controls are completed, we will develop a fluorescence-based assay to measure cell surface localization of the transporter. Specifically, xCT localized to the cell surface will be labeled in real time by adding a membrane-impermeable fluorogen which only will fluoresce when bound to FAP. The relative fluorescence of the sample will be measured (or imaged using a confocal microscope). Finally, a membrane-permeable fluorogen will be added to the cells which will label the total pool of expressed xCT protein, and the relative fluorescence will be measured again, thus allowing one to calculate the percent cell surface expression of xCT. Eventually, we plan to adapt this assay to 96 well plates to allow for rapid screening of putative-trafficking defective mutants.

Development of an Assay to Measure Ubiquitination Status of System x_c^-

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This research is supported by Schaap Endowed Funds for Undergraduate Research.

System x_c^- (xCT) exchanges intracellular glutamate for extracellular cystine across the membrane of many cell types. Its activity directly regulates the synthesis of the antioxidant glutathione and the extracellular concentration of glutamate in the brain. We recently demonstrated that oxidants acutely upregulate System x_c^- activity by triggering the rapid redistribution of the transporter from intracellular compartments to the cell surface. Our current work suggests that the trafficking of the transporter may be regulated by ubiquitination and that oxidant exposure directly influences the ubiquitination of the transporter. Since increased ubiquitination tends to decrease the cell surface expression of many membrane transporters, we sought to test the hypothesis that System x_c^- is ubiquitinated and that the ubiquitination status of the transporter regulates both its cell surface expression and activity. We have used a mutagenesis approach to disrupt putative ubiquitination sites and a putative ubiquitin ligase binding site within a myc-tagged System x_c^- construct so that we can understand the role ubiquitination plays in regulating the cell surface expression of System x_c^-. There are seven highly conserved lysine residues within xCT that are located on the cytoplasmic side of the membrane that may serve as a site of ubiquitination and regulate xCT cell surface expression. These residues are located at positions 4, 37, 41, 43, 422, 472, and 473. We created multiple mutants of xCT containing single or multiple lysine to arginine mutations and found that mutation of the N-terminal lysine residues (K4, K41 and K43, but not K37) increases transport activity and cell surface expression of the transporter. Currently, we are developing an assay that will allow us to measure xCT ubiquitination status using a His-tagged ubiquitin pull-down approach. Thus far we have successfully co-transfected xCT and His-Ub into Cos-7 cells, and we have determined the optimal conditions for multichannel visualization of xCT and ubiquitin using a Western-blot approach. We are now working to inhibit cellular deubiquitination enzymes and proteasome function to continue to optimize the ubiquitination assay.

Regulation of Mitochondrial DNA Transcription by Post-Translational Modifications of Mitochondrial Transcription Factor B2

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

Mitochondrial DNA (mtDNA) encodes for 13 protein components required for oxidative phosphorylation (OXPHOS), the primary cellular energy production pathway. While the critical roles of mitochondria in metabolism and cellular function are well established, the mechanisms regulating expression of mtDNA-encoded genes are poorly understood. Defects in the regulation of mtDNA transcription are implicated in numerous pathologies such as neurodegenerative disorders and cancers. mtDNA is complexed to proteins in structures known as nucleoids, of which some proteins play critical roles in transcriptional regulation. Our objective is to determine whether reversible post-translational modifications (PTMs) of nucleoid proteins, including lysine acetylation and serine/threonine/tyrosine phosphorylation, regulate mtDNA transcription. Our central hypothesis is that PTMs alter the function of these proteins and provide a means of regulating mitochondrial gene expression. We highlight our work on the characterization of mitochondrial transcription factor B2 (TFB2M), focusing on the mutagenesis, bacterial expression, purification, and analysis. Site-directed mutagenesis was used to alter the amino acids known to be post-translationally modified to amino acids mimicking either the modified or unmodified state. Purified mutants and wild type TFB2M were analyzed in a mtDNA binding assay to determine the effects of PTMs on TFB2M function. Initial data suggest that TFB2M relies on modified or unmodified states of key PTM sites to regulate its ability to bind to mtDNA. Characterization of these sites is critical for determining TFB2M's role in mtDNA transcriptional regulation. Future work involves additional screening of TFB2M mutants, optimization of the mtDNA binding assay for analysis of other nucleoid proteins, and in vitro transcription assays to assess mutant protein functionality on mtDNA transcription.

The Regulation of Cellular Proliferation by VACM-1/CUL5 is Dependent on its Posttranslational Modifications by NEDD8

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This work was supported by the Arnold and Mabel Beckman Foundation Scholar Award and by the Schaap Endowed Fund for Undergraduate Research.

VACM-1/CUL5 acts as the scaffold protein in the E3 ligase complex in the ubiquitin-dependent protein degradation pathway. The overexpression of VACM-1/CUL5 is known to inhibit proliferation, whereas inhibition of VACM-1/CUL5 expression induces cellular proliferation. Thus, VACM-1/CUL5 is implicated in cancer pathways. The effect of VACM-1/CUL5 on cellular proliferation is dependent on its post-translational modification (PTM) by NEDD8 protein (neddylation). The relationship between NEDD8 and VACM-1/CUL5 is important for cell cycle regulation and offers a target for cancer therapy. This work explores the structure-function relationship between VACM-1/CUL5 and its neddylation. VACM-1/CUL5 was mutated at the putative neddylation site Lysine (K) 724 and at three potential neddylation sites, K724, K727, and K728 (3K mutant). Our work suggests that the expression of the K724 mutant induces growth whereas expression of the 3K mutant does not affect cell growth. Interestingly, Western Blot analysis indicates that the 3K VACM-1/CUL5 mutant is still neddylated, which suggests that VACM-1/CUL5 may be neddylated at additional lysine sites. Our current work focuses on characterizing cells transfected with the mutated VACM-1/CUL5 cDNAs to elucidate how site-specific neddylation may control alternative signaling pathways.

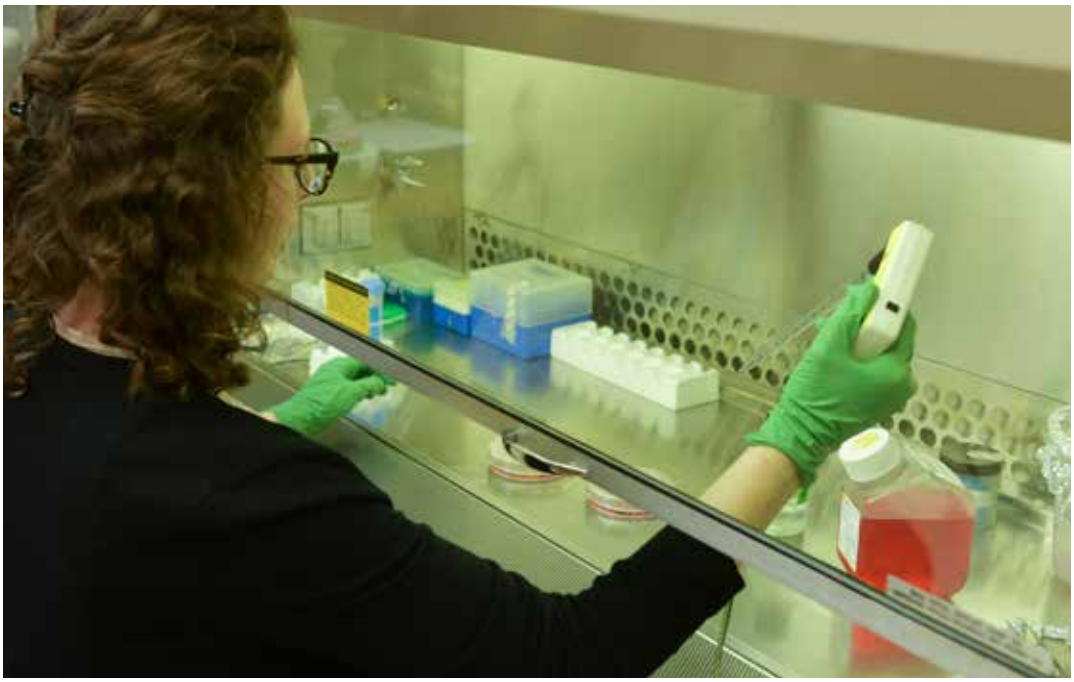

Photo courtesy Hope College Public Affairs and Marketing. Photo credit: Jon Lundstrom.

BIOLOGY

Genomic and Physiological Characteristics of Novel Escherichia Strains Isolated from Freshwater Sources

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This material is based upon work supported by the National Science Foundation under Grant No. 1616737.

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Environmental Value of Trees in the City of Holland

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Funding for this project provided by the Hope College Department of Biology, Holland-Hope College Sustainability Institute, City of Holland Sustainability Committee, City of Holland Parks and Recreation Department, and Holland in Bloom.

As urban development continues to replace natural forests at a rapid pace, urban forests are becoming increasingly important in providing beneficial ecosystem services to people. Trees remove carbon dioxide and pollutants from the atmosphere, they mitigate erosion and stormwater runoff, and they reduce the costs of heating and cooling. This project aims to quantify the benefits that urban trees in the City of Holland provide through completion of a tree inventory. We have surveyed 4,588 trees and identified 99 different tree species, just over half of which are native to Michigan. Climate- and pollution-related benefits of native and non-native species are similar, except for the largest trees. The mean tree diameter is 14 in. A sugar maple this size would provide $5.17 of benefits yearly by removing pollution and carbon dioxide, and by interfering with stormwater runoff. The annual value of the inventoried trees relative to these same 3 "ecosystem services" is $20,240. In the future, the ability of this population to sequester carbon will increase by over 10 tons as the trees increase in mass. In addition, the City of Holland has potential to further increase the Urban Tree Canopy's benefits through new plantings of particular species with high climate- and pollution-mitigation value.

A student working on the Environmental Value of Trees in the City of Holland. Photo courtesy Michelle Seppala Gibbs.

BIOLOGY

Cross Regulation of Phospholipid and Unsaturated Fatty Acid Biosynthesis

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Mentor:
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We acknowledge the support of the Hope College Department of Biology, and the Hope College Dean of Natural and Applied Sciences.

Considering the requirement for unsaturated fatty acids (UFAs) to produce phospholipids, we investigated the potential cross regulation of phospholipid and UFA biosynthesis. The Δ-9 desaturase, encoded by *OLE1*, is the sole source of endogenous UFAs in Saccharomyces cerevisiae. Inspection of the *OLE1* promoter revealed several sequences that are close matches to the regulatory sequence, UASINO, found in many phospholipid biosynthetic genes, and is the target of regulation by Ino2p, Ino4p and Opi1p. We then examined if these proteins also play a role in regulation of *OLE1* expression. Reporter gene analysis showed that when uracil prototrophy was placed under control of the *OLE1* promoter, poor expression was observed in an opi1 mutant. When lacZ was placed under control of the *OLE1* promoter, reporter assays confirmed that expression was poor in the opi1 mutant. Fatty acid analysis revealed that normal down regulation of *OLE1* expression occurred in response to UFA supplement in the opi1 mutant, indicating that post-transcriptional regulation is still functional. Finally, the 2-hybrid assay was used to examine potential interactions between Opi1p and Ole1p, Ino2p, Ino4p and known *OLE1* regulators Mga2p and Spt23p. While no unexpected Opi1p interactions were detected, we observed that Ino4p interacts with Mga2p in this assay. This preliminary work indicates that phospholipid regulators also play a role in regulating *OLE1* expression.

How Pre-Service and In-Service Teachers' Philosophies Affect Their Perceived Value of STREAM School

This research was supported by a Nyenhuis Grant and the Dow Scholars Program.

This project was an interdisciplinary endeavor between the Departments of Education and Biology. *See page 96 in the education section of this book for full abstract.*

Arv1 Influences the Regulation of Stearoyl-CoA Desaturase

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Biology

We acknowledge the Hope College Department of Biology, the Dean of Natural and Applied Sciences, and the Koeppe-Kolean Fellowship for their generous support.

The ARV1 gene in both mice and yeast affects expression of OLE1, the gene that encodes the Δ9 desaturase. Transcriptional regulation of OLE1 was tested in wildype and arv1 mutant yeast strains with an OLE1-lacZ reporter gene assay, where it was determined that mutation in arv1 significantly decreased desaturase expression. However, analysis of fatty acid composition determined that regulation of desaturase expression by unsaturated fatty acids appeared to be intact in the arv1 knockout yeast, indicating that the defect in regulation is at transcriptional regulation and not post-transcription. To examine Arv1's role in mammals, wildtype and arv1 knockout mice were fed normal chow and high fat diets, and fatty acid profiles of the different tissues was determined to provide insight to desaturase expression. Several types of adipose tissue; brown adipose tissue (BAT), mesenteric white adipose tissue (WAT), epididymal WAT (eWAT), liver and small intestine were examined. Differences are evident between the wildtype and arv1 knockout mice indicating that expression of SCD1 gene (the mouse orthologue of OLE1) is affected by the arv1 mutation. The results indicate that arv1 affects desaturase expression in both mice and yeast, as evidenced by experiments with mutant strains in both species. The exact mechanism through which the ARV1 encoded protein is exerting this effect is under investigation.

Genomic Analysis of Novel Mycobacteriophage Paphu

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Research supported by the Hope College Department of Biology.

Sixteen 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 32°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, Paphu, was chosen as one of three phages for complete genome sequencing and comparative genomic analyses. The predominant plaque produced by Paphu after 48 hours at 32°C was circular and was approximately 2-3 mm in diameter. The plaque morphology was clear with a turbid ring resulting in a halo visual. The complete genome sequence for Paphu revealed a relationship to mycobacteriophages of cluster A, subcluster A1, which now contains 153 sequenced members. Paphu is most similar to the A1 phages AFIS and Blue. The genome size of Paphu is 50,864 bp, placing it at the smaller end of all sequenced A1 mycobacteriophages. However, it has one of the highest GC contents of A1 phages at 64.1%. Auto-annotation of the Paphu genome indicates it contains at least 89 protein-encoding genes and no tRNA genes. Despite their genomic sequence similarity, phages of subcluster A1, including Paphu, are still quite diverse. For example, auto-annotation of Paphu identified several Orpham genes (genes with unique sequences and no representatives in the databases) in a highly variable region of A1 phage genomes. A detailed analysis of the complete genome sequences and comparison with sequenced mycobacteriophages is the subject of the second semester of this yearlong course and is presented.

The Developmental Time Course of Photoreceptors in Ducks

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This project was supported by Agriculture and Food Research Initiative Competitive Grant no. 2018-67016-27616 from the USDA National Institute of Food and Agriculture.

The Pekin duck is a valuable agricultural commodity in the U.S. Pekin ducks are seasonal breeders; they are sensitive to light and thus, research on the neuroendocrine and behavioral responses are needed to overcome technological limitations. There is compelling evidence that specific wavelengths of light are required to improve the growth and welfare of meat (grow out) ducks. For example, blue light may not be ideal for grow out ducks due to considerably increased motor activity, significantly decreased body weight and increased serum corticosterone (cort) levels. Therefore, our objective is to determine the role of both deep brain photoreceptors (DBPs) and retina photoreceptors (RPs) during duck development. Two groups of ducks were raised with and without light over 21 days from egg laying, embryonic day zero. We then collected brain and retinal tissues of ducks at embryonic days 3, 7, 11, 16, and 21. To examine DBPs, we designed and created primers for 4 genes: OPN4, VAL-opsin, OPN5, and rhodopsin. For RPs, we designed and created primers for genes responsible for both cones (RH2, SWS1, SWS2, LWS opsins) and rods (rhodopsin, MAFA, IRBP in duck eye development. qRT-PCR was performed utilizing listed primers for DBP, RP rods, RP cones and reference gene, using 10 samples each for ducks raised in both light and dark conditions. RNA was then extracted from the tissue collected and qRT-PCR was performed. Understanding when these specific genes are upregulated across development will help the husbandry of duck by providing an ideal time for light usage during duck development. Future directions will determine which wavelength of light, at a specific time of development, is most suitable for grow out ducks.

Wildlife Activity Patterns at a Constructed Wetland Based On Trail Cam Monitoring

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This project funded in part by the Outdoor Discovery Center Macatawa Greenway and the Hope College Department of Biology.

Wetland habitats fill vital environmental roles because they potentially increase wildlife diversity and provide important ecosystem services. During 2015, the Outdoor Discovery Center (ODC) in Holland began reconstructing a wetland from an agricultural field, hoping to improve wildlife diversity. However, this site is near a regional airport, which raised some concern regarding the potential for increased aviation collision risk. In order to evaluate the success of the wetland in attracting wildlife and the potential wildlife hazard to aviation, we analyzed over 600,000 trail cam photos from 4 camera stations operating continuously through the 2015 wetland construction, and for 2 years thereafter. The most common species captured in photos were White-tailed Deer, Wild Turkeys, ducks and geese, a variety of small bird species, and small mammals such as coyotes. Each trail camera took both motion-activated photos and timed photos (taken every 5 minutes regardless of animals present from sunrise to sunset). Motion-activated photos provide important insights into the activity patterns of larger animals, especially at night, whereas timed photos have allowed us to discern distinct seasonal patterns in the abundance of large flocks of potentially "hazardous" animals such as Canada Geese. Results thus far suggest that wildlife has flourished in the new wetland; we have documented 13 species of mammals and 27 species of birds, as well as a few reptiles and amphibians, through trail cam photos. In addition, the camera trap project has provided unique glimpses into the activity patterns of various species. Our wildlife census information has been used to advise wildlife management decisions, and can be used in the future to alert airport personnel to dates and times of potentially heightened risk.

Dominican Republic Water Quality Study Using Point-of-Use Water Filters

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This work is supported by Sawyer, Inc.

Abstract not available online.

BIOLOGY

Genomic Analysis of Novel Mycobacteriophage Philly

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Research supported by the Hope College Department of Biology.

Sixteen 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 32°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, Philly, was chosen as one of three phages for complete genome sequencing and comparative genomic analyses. The predominant plaque produced by Philly after 48 hours at 32°C was small and fairly clear (the relative clarity of the plaques is difficult to assess due to their small nature). The diameter of one plaque is approximately 1 millimeter and the plaques were not perfectly circular. The complete genome sequence for Philly revealed a relationship to mycobacteriophages of cluster B, subcluster B3, which now contains 31 sequenced members. Interestingly, all but a few B3 phages have been isolated between Michigan and Washington, D.C. The genome of Philly is 68,523 bp, which is smaller than most of the sequenced B3 mycobacteriophages. It has a GC content of 67.5%, similar to the host M. smegmatis (67.4%). Auto-annotation of the Philly genome indicates it contains 101 protein-encoding genes and no tRNA genes. Phages in subcluster B3 share very high sequence identity throughout the genome lengths. Philly maintains this pattern, being nearly identical to mycobacteriophages Heathcliff, Athena, and Bernado despite their isolation in different years (2003-present)and in different geographical locations. Like all B3 phages, Philly also contains many short sequence repeats throughout its genome. The function and derivation of these repeated sequences is not known. Philly does contain some genomic variability involving genes 2, 5, and 56. These differences might offer explanations on how this genome was constructed and how it evolved. A detailed analysis of the complete genome sequences and comparison with sequenced mycobacteriophages is the subject of the second semester of this yearlong course and is presented.

Role of Phosphatidylcholine in Viral Replication

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Mentor:
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Biology

Supported by the Hope College Department of Biology and the Towsley Research Scholars Award at Hope College.

Positive-strand RNA [(+)RNA] viruses are significant human pathogens. A universal feature of (+)RNA viruses is that they replicate their genomes in association with host intracellular membranes. This association may be a target for broad spectrum antivirals against (+)RNA viruses. The (+)RNA virus used in our studies is Flock House virus (FHV). FHV is a simple (+)RNA virus with a 4.5 kb bipartite genome that replicates in insect cells. FHV replicates its RNA genome at the outer mitochondrial membrane of infected cells where it forms 50-70 nm in diameter invaginations that are membrane-bound RNA replication complexes. Previous work by others has shown an increase in the amount of phosphatidylcholine, a phospholipid, in FHV infected cells. We hypothesize that phosphatidylcholine is involved in membrane-bound replication complex structure and formation. To test this hypothesis, we incubated infected Drosophila S2 cells with choline analogs (propargyl choline or 1-azido-choline), which are biosynthetically incorporated into phosphatidylcholine. These analogs allow phosphatidylcholine to be conjugated to fluorescent dyes for imaging. Confocal fluorescence microscopy showed an enrichment of phosphatidylcholine at sites of viral replication. Additionally, decreasing the amount of phosphatidylcholine in Drosophila cells through targeted down regulation of biosynthetic genes using RNAi decreased FHV replication. To further investigate, we generated genetic knockouts of phosphatidylcholine synthesizing enzymes using Crispr/Cas9. Genome editing was evaluated using a T7 endonuclease assay. We also hypothesize that the enzymes required for the formation of phosphatidylcholine may localize to sites of viral replication. To test this hypothesis, we transfected Drosophila cells with mCherry tagged CDP-choline pathway enzymes and visualized the location of these enzymes using confocal fluorescence microscopy. Interestingly, our results indicate that the CDP-choline enzymes cct1 and cct2 are not localized to viral replication sites in Drosophila S2 cells, which would be a different mechanism than has been observed for other (+)RNA viruses.

BIOLOGY

Understanding the Impact of Chronic Low-Dose, Low Energy, Proton Radiation on Systemic Inflammation and Anxiety-Like Behaviors in Mice

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Mentor:
Dr. Phillip Rivera,
Biology

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

A major component of NASA's 2018 strategic plan was to send astronauts to and beyond our lunar orbit within the next couple of decades. A risk to mission success is an astronauts' exposure to galactic cosmic radiation (GCR), a mixture of chronic low-dose, high-energy, high-charge ion particles (HZE). Previous high-energy radiation proton studies show lasting inflammation in the eye in humans treated for uveal melanomas. In mice, HZE particles also showed deficits in cardiac physiology, brain electrophysiology, and memory. Of particular interest to long-term mission success are low-dose, low-energy protons due to their high abundance in the space environment. Given the detrimental physiological and cognitive impact on humans and rodents after high-energy proton studies and a lack of low-energy proton studies on skin and inflammation, knowledge of how inflammation might respond to chronic low-dose, low-energy proton radiation is warranted. In our experiment, mice were put into a 50mL conical tube; half were irradiated using the Hope College Pelletron accelerator at a low-dose (50 mGy/wk) of protons. After 10 weeks, half the irradiated mice and half the non-irradiated mice were euthanized for molecular studies. Levels of inflammatory cytokines like tumor necrosis factor, which are associated with increased depression, bipolar disorder and schizophrenia were assessed. The other half underwent behavioral tests that looked at stress behaviors. Therefore, the proposed study aimed to test the hypothesis that chronic low-dose, low-energy proton radiation negatively impacts mental health due to lasting systemic inflammation. Future directions are to examine HZE particles (e.g. Fe, Si, and C) at Brookhaven National Laboratories in Long Island, NY, to compare chronic low-energy low-dose particles and high-energy low-dose protons which will help future NASA missions to and beyond lunar orbit.

Utilizing qPCR Methods to Investigate *Escherichia coli* Replication in Freshwater Environments

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Shannon Smith
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This material is based upon work supported by the National Science Foundation under Grant No. 1616737.

Abstract not available online.

Generation of Viral Vectors for Gene Expression in Avian Species

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Mentor:
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Biology

Supported by the Hope College Department of Biology and the Towsley Research Scholar Award at Hope College.

Adeno-associated viruses (AAV) are being utilized for gene therapy and research for delivering genes to target tissues. A gene therapy using AAV was approved in 2017 for treatment of a form of blindness. AAV is an attractive system for gene therapy because it is replication-incompetent and can be manipulated to target specific tissues (e.g., muscle, neurons). AAV is also commonly used in basic research to elucidate important processes and pathways, for example neural circuits. Although multiple AAV serotypes are available for mammalian systems, few exist for other organisms. In collaboration with Dr. Greg Fraley, we are attempting to generate AAV vectors for transduction of avian species, specifically ducks. The approach we are taking is to use an AAV system developed by Matsui, Tanabe, and Watanbe that used avian adeno-associated virus (A3V). Matsui previously demonstrated targeting of chicken neurons using this system. To generate A3V vectors for testing in ducks, cells were transfected with plasmids for A3V viral vector production. Three days post-transfection, A3V was harvested and purified by ultracentrifugation and filtration. The titer of each preparation was determined using qPCR. Two viral vectors were produced, one expressing green fluorescent protein and another the red-fluorescent protein mCherry. These vectors will be injected into ducks to determine infection and expression of reporter genes in neural tissue.

BIOLOGY

Testing the Impact of Neuronal Damage on HSV-1 Latency

Kayla Russell
Noah Weigle

Mentor:
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Biology and Psychology

This work was supported by the Dow Scholar Science Research Fund, the Hope College Department of Biology and the US Army Office of Scientific Research (Grant #W911NF-17-1-0559).

Herpes Simplex Virus Type I (HSV-1) has been known to increase levels of amyloid beta, a toxic protein that forms plaques within the central nervous system. These plaques are currently recognized as a leading cause of dementia. In humans, HSV-1 develops a latent infection, but can reactivate—killing host cells and spreading virus particles to once uninfected cells. This work tested the hypothesis that physical damage to dorsal root ganglion neurons would prompt the reactivation of HSV-1 from its latent stage. To test this, we cultured dorsal root ganglia neurons and then induced viral latency by co-treating neurons with the F strain of HSV-1 (MOI:1.5) and the antiviral compound acyclovir. Current results reveal that we have successfully produced an *in vitro* model of HSV-1 latency. Ongoing work is testing if structural damage via sonication to dorsal root ganglion neurons prompt the increase of expression of viral genes necessary for HSV-1 reactivation.

Assessing Hemlock Wooly Adelgid Impact on West Michigan Dune Forests

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Biology

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Biology

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Biology

This work was supported by the Andrew W. Mellon Foundation Faculty Development Fund, part of the Nyenhuis family of funds, and the Hope College Department of Biology.

The hemlock woolly adelgid (*Adelges tsugae;* HWA), an invasive insect that has recently spread to West Michigan, poses a serious threat to the survival of Eastern hemlock (*Tsuga canadensis*) populations along the lakeshore. Eastern hemlock's dense evergreen canopy alters the understory environment of West Michigan dune forests and provides overwinter habitat and food for animals. Little is known about hemlock's population dynamics in dune forests and how the decline will impact these communities. During 2018, we censused hemlock population status and HWA infestation in multiple forest stands and found that 0-12% of hemlocks were infested with HWA. We also measured soil moisture, leaf litter invertebrate diversity, understory light intensity, and photosynthetic activity of hardwood seedlings beneath hemlock and hardwood canopies to predict the likely effects of HWA-driven hemlock decline. Eastern hemlock significantly alters the growth conditions for other species in the understory, especially in the early spring, through its effect on the light environment. Early spring light conditions beneath hemlocks suppress seedling recruitment, as only 7.16% of photosynthetically active radiation reaches the forest floor, while 31.2% reaches the understory beneath hardwoods. Hemlock death is projected to increase incident understory light and change recruitment patterns of tree species. Future work will explore the differences in leaf litter invertebrate diversity and aim to construct light energy budgets for different seedling species.

Environmental Factors Affecting Bacterial Community Composition in the Hypereutrophic Macatawa Watershed

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This material is based upon work supported by the National Science Foundation under Grant No. 1616737 and through a grant from the Herbert H. and Grace A. Dow Foundation.

Abstract not available online.

BIOLOGY

Bacteriophages Known for Broad Mycobacterial Host Range Also Appear Well-Adapted for Growth on the Soil Microorganism *Mycobacterium smegmatis*

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Geordan Stukey
Angela Vito
Adam Krahn

Mentor:
Dr. Joseph Stukey,
Biology

Mycobacteriophages are viruses that infect mycobacterial hosts. Over 1600 mycobacteriophages are organized into 37 distinct clusters based on genetic similarity. Some cluster A and K mycobacteriophages can also infect *Mycobacterium tuberculosis*, a distinction of potential medical importance. Hope College SEA-PHAGES students have been isolating possible cluster K mycobacteriophages at a higher frequency (≈ 2x) after lowering the isolation temperature from 37°C to 32°C. These 32°C-isolated phages were unable to propagate at 42°C. PCR analysis supported cluster K classification for many possible cluster K phages isolated at 32°C (23 of 30 tested of a total of 43), but few isolated at 37°C (3 out of a total of 23). All 3 PCR-supported K phages isolated at 37°C grew at 42°C. We sequenced 16 of the possible cluster K phages, and found that all PCR-supported phages, including the 3 isolated at 37°C, belong to cluster K. We hypothesize that the observed higher Cluster K phage isolation frequency is at least partly due to a relative growth advantage at lower temperatures that is fully compromised at 42°C. Results from experiments testing specific growth parameters, including phage thermostability, adsorption rate, latent period, and burst size, are consistent with our hypothesis. In an effort to determine the step of the lytic cycle blocked at 42°C, a temperature down-shift experiment (42°C shifted down to 32°C) was performed on Hyperbowlee, a cluster K phage isolated at 32°C and growth inhibited at 42°C. Assays were performed testing two different 42°C hold time lengths. Both assays produced a consistent shift in time to first release of new Hyperbowlee phage, to a point about 85 minutes following the temperature down-shift. These results and subsequent tests indicated that phage infection was blocked, post DNA transfer, at about 20-30 minutes into the 32°C lytic cycle. Phage growth competition assays are underway.

Photo courtesy Hope College Public Affairs and Marketing. Photo credit: Jon Lundstrom.

Does Genome Structure Influence Bacteriophage Fitness?

Angela Vito

Mentor:
Dr. Joseph Stukey,
Biology

This work was supported by the Hope College Natural and Applied Sciences Division, Department of Biology, the Hope College Summer Research Program, the Michigan Space Grant Consortium, NASA grant #NNX15AJ20H.

Bacteriophage (phage) genomes exhibit several interesting structural features. First, phage genomes have high gene density. That is, phage genes are often found end-to-end with little or no non-coding sequences between them. Also, phage genomes contain a large number of novel genes with no recognizable function; they have no apparent relations in existing databases other than those in closely related phages. Comparative analyses also reveal they have a modular architecture, sometimes with unique gene sequences found between otherwise highly conserved flanking genomic segments. Further, studies such as the one performed on mycobacteriophage Giles suggest that many predicted novel genes are not essential for phage growth, at least under laboratory conditions[1]. This raises the question of how these genes became present in the genome and if their presence contributes advantages to the phage. These observations suggest that phage genomes may serve as a "gene nursery" where novel genes encoding proteins with no initial biological function, are first generated and later screened for utility. However, it is unknown how the original novel genes are produced and how they are maintained before acquiring biological function. This project was designed to test the hypothesis that phages maintain high gene density genomes because they have reproductive advantages over phages with relatively more open genomes. The project aims to generate model phage genomes to represent locally tightly-packed (high density) and open genome structures. Existing gene sequences from phages Giles and D29 are being used to generate pairs of novel DNA segments, where one is a "scrambled" protein-coding, but biologically irrelevant gene, and the other a non-coding DNA segment in which all start codons were removed. Using the Bacteriophage Recombineering with Electroporated DNA (BRED) protocol, the novel DNA segments are being inserted into the Giles and D29 genomes (each pair inserted at a different genomic position but both members of a pair inserted at the same genomic position), to create a test pair of modified phage genomes, one representing a tightly-packed genome model, and the other an open genome model. The reproductive characteristics of the modified phages will be tested and compared. We predict to see results that suggest the modified phages with tightly packed genomes have reproductive advantages over the phages with open structures.

BIOLOGY

Knockout of Truncated VACM-1(KLB22) in HUVEC Using CRISPR-Cas9

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Schuylar Brunink
Sarah O'Mara
Philip Versluis

Mentor:
Dr. Maria Burnatowaska-Hledin,
Biology and Chemistry

VACM-1/CUL5, a cullin gene family protein member, acts as a E3 ligase scaffold protein in the ubiquitin-proteasome system. This system is critical for degrading proteins and maintaining cellular homeostasis. The truncated form (KLB22) overlaps with the open reading frame (ORF) of VACM-1/CUL5. KLB22 is located approximately 1200 base pairs downstream of the start site of VACM-1/CUL5. Contrary to wild type VACM-1/CUL5, the overexpression of KLB22 increases cellular proliferation, indicating a role in cancer pathways. The goal of this study was to knockout KLB22 and VACM-1 using CRISPR-Cas9—this knockout is referred to as the double knockout. Single guide RNA (SgRNA) sequences were designed to target KLB22. These sequences were annealed and ligated into the Px459 plasmid that contained a puromycin selection marker. HUVEC cells were transfected with a Px459 plasmid and sequencing analysis confirmed the double knockout and successful insertion of the designed sgRNA. Our future work will examine how the HUVEC cell lines function after the double knockout via CRISPR-Cas9.

The Value of Outdoor-Based Programs on Students' Growth: Does PBL-Based Learning Actively Enhance Students' Soft Skills?

This project was an interdisciplinary endeavor between the Departments of Education and Biology. *See page 97 in the education section of this book for full abstract.*

Development of an Electrochemical Glucose Sensor Using Iron Porphyrin Substituted Polymer Films

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Derrick Obiri-Yeboah

Mentors:
Dr. Elizabeth M. Sanford, *Chemistry*

Dr. Kenneth L. Brown, *Chemistry*

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

Ethylenedioxythiophene (EDOT)-substituted iron porphyrin and an aminomethyl EDOT monomers (AMEDOT) were synthesized and electropolymerized to form a redox-active mediation film between glucose oxidase enzyme and an electrode as part of the fabrication of an electrochemical glucose biosensor. The EDOT-substituted iron porphyrin was prepared in a four-step sequence from hydroxymethyl EDOT (HMEDOT) while the AMEDOT monomer was synthesized via a reduction of an azide. Polymerization of the two monomers was done electrochemically on a glassy carbon electrode which was then functionalized with glucose oxidase and used for the electrochemical sensing of glucose solutions at various concentrations. An electrochemical response to the analyte glucose was seen. Strategies to improve the response by crosslinking the EDOT film to the glucose oxidase enzyme are ongoing.

Parameterizing Fluorescent Protein Chromophores for Molecular Dynamics Simulations

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Andreana Rosnik

Mentor:
Dr. Brent Krueger, *Chemistry*

This material is based upon work supported by the National Science Foundation under Grant Nos. 1039925, 1058981, and 1263097, MU3C, Schaap Research Fellows Program, Schaap Endowed Fund for Undergraduate Research, and the Hope College Department of 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.

Thiol-Yne Reactions for Incorporating Longer Wavelength Azo Dyes into Polymeric Photomechanical Materials

Marcus A. Brinks

Mentor:
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Chemistry

Dr. Matthew L. Smith
Engineering

Dr. Jason G. Gillmore
Chemistry

This research was supported by awards from the Michigan Space Grant Consortium NASA grant #NNX15AJ20H, the Henry Dreyfus Teacher-Scholar Award Program, Hope College Department of Chemistry's Schaap Research Fellows and IDF programs, Hope College Departments of Chemistry and Engineering and the Office of the Dean of Natural & Applied Sciences.

The Smith research group in mechanical engineering has an interest in photomechanical materials, which convert light to mechanical work through the photoisomerization of oriented azo dyes in polymer or liquid crystalline networks.[1] The Gillmore research group in organic photochemistry has expertise in organic photochrome synthesis and isomerization. Together they are working to prepare polymerizable monomeric analogs of the BF_2-coordinated azo dyes reported by Aprahamian and coworkers.[2],[3] These dyes are of interest due to their ability to absorb and isomerize at longer wavelengths (orange to near IR) than conventional (UV to green) azo dyes. Once synthesized these dyes may be incorporated into polymer networks forming a photo responsive material. The use of longer wavelengths should minimize competitive absorption and photodegradation of materials and devices, and may allow future biocompatibility. Multiple paths have been explored by each group for incorporating the long wavelength dyes into a polymer network. Thiol-yne polymerizations[4] are one such option due to their good precedent in similar photoresponsive polymeric materials. With this chemistry, the Gilmore and Smith group intend to incorporate dyes as both cross-linked and pendent monomers. In this present work I will report progress toward ethynyl and diethynyl substituted BF_2-azo dyes, and model studies related to their incorporation into polymer networks.

[1] White, T.J.; Broer, D.J. Nat. Mater. 2015, 14, 1087-1098.
[2] Yang, Y.; Hughes, P.; Aprahamian, I. J. Am. Chem. Soc. 2012, 134, 15221-15224.
[3] Yang, Y.; Hughes, P.; Aprahamian, I. J. Am. Chem. Soc. 2014, 136, 13190-13193.
[4] Chan, J.W.; Shin, J.; Hoyle, C.E.; Bowman, C.N.; Lowe, A.B. Macromolecules 2010, 43, 4937-4942.

Rhodium-Catalyzed Carbon-Carbon Bond Activation Utilizing Removable Amide Directing Groups

Gregory Cahill
Matthew Olson

Mentor:
Dr. Jeffrey Johnson,
Chemistry

This material is based upon work supported by the National Science Foundation under Grant Nos. 1148719 & 1764118, an award from the Henry Dreyfus Teacher-Scholar Award Program, and the Schaap Endowed Fund for Undergraduate Research.

Carbon-carbon bonds are known for their relative stability. Past research has shown that certain metal catalysts are capable of breaking carbon-carbon bonds but require a directing group. Methods involved in breaking carbon-carbon bonds could be greatly expanded with the use of a removable directing group.

This project focuses on the use of amides as removable directing groups. These rhodium-catalyzed reactions involve successful activation of the amides followed by coupling with a variety of substrates including Michael acceptors, boronic acids, and alkenes. Ongoing studies are required to optimize the reaction, to explore the substrate scope, and to determine the mechanism.

Kinetics of Strontium Leaching from Doped Nanoparticles

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Karissa Libson

Mentor:
Dr. Amanda Eckermann,
Chemistry

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

Osteoporosis is a disease that affects millions of people worldwide and is thought to be characterized by an imbalance of osteoblast and osteoclast activity in bones. Strontium (Sr) has been shown to balance the activity of both of these cell types. Strontium-doped hydroxyapatite nanoparticles (Sr-nHAps) present a biocompatible method of strontium delivery to bones in affected individuals. Sr-nHAps were synthesized with various ratios of calcium to strontium and characterized by SEM, EDS, and P-XRD. Leaching studies were carried out in both phosphate buffer saline (PBS) and simulated bodily fluids (SBF) to determine the effect of ionic solutions on the leaching rate of strontium ions. SBF contains di-cations, including Ca^{2+} and Mg^{2+}, that can replace Sr^{2+} in the hydroxyapatite lattice. The rate of strontium leaching from the hydroxyapatite lattice was evaluated by ICP-OES. This study shows that the majority of strontium cations leached out of the lattice in the first 24 hours. Further, the leaching rates were dramatically decreased if the particles were sintered at 800 °C for two or more hours.

Ethynyl-functionalized Azo Dye Monomers for Photomechanical Applications

Brandon Derstine
Addison Duda
Sean Gitter

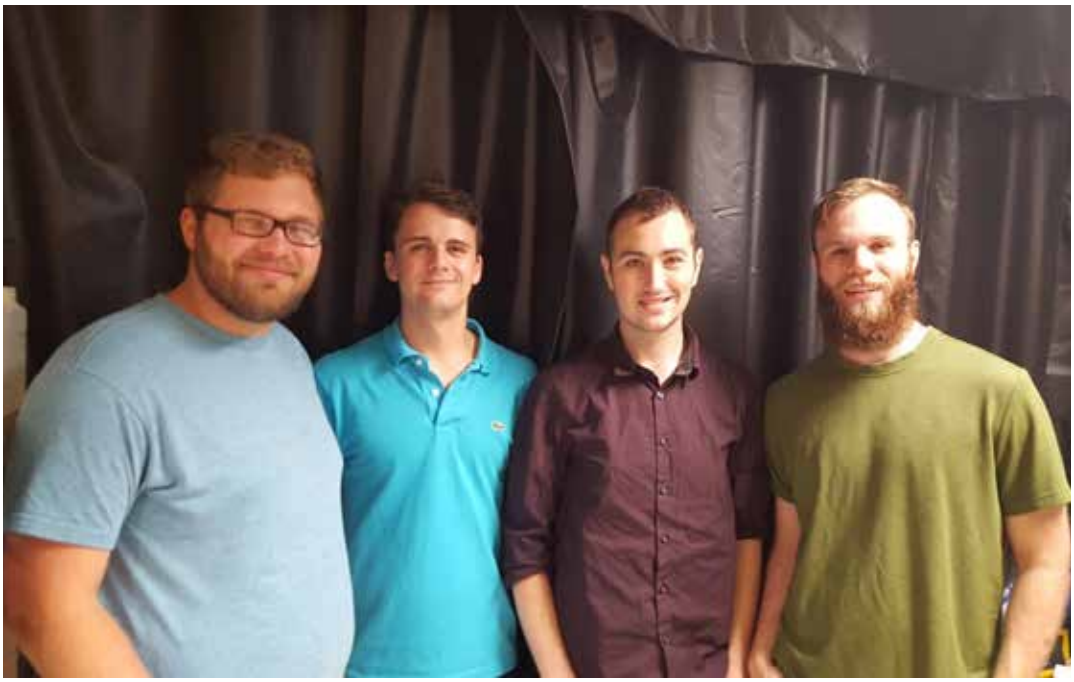
Mentors:
Dr. Jason Gillmore, *Chemistry*

Dr. Matthew Smith, *Engineering*

This work was supported by a Beckman Scholars Program award from the Arnold and Mabel Beckman Foundation, the Michigan Space Grant Consortium NASA grant #NNX15AJ20H, an award from the Henry Dreyfus Teacher-Scholar Award Program, and the Hope College Department of Chemistry and its Schaap Research Fellows and IDF programs.

Azo dyes are a class of organic compounds that undergo reversible photochemical *trans-* to *cis-* isomerization. They have shown promise in photomechanical applications.[1] Typically, azo dyes isomerize by absorbing ultraviolet to blue-green light. In this region of the electromagnetic spectrum, competitive absorption by other organic molecules is at a maximum, and these relatively higher energy wavelengths provide a greater likelihood of photodegradation of the material. Aprahamian and coworkers have reported a class of BF_2-coordinated azo dyes that absorb red-orange to near infrared light.[2,3] These lower energy wavelengths minimize both competitive absorption and photodegradation, and could allow biocompatibility. Efforts in the Gillmore group have been made to incorporate a polymerizable substituent on the BF_2-azo dye, that the dye can be incorporated into a polymeric system for photomechanical applications by our collaborators. An ethynyl-substituted BF_2-coordinated azo dye has been prepared for incorporation into a polymer. This could be possible by Sonogashira coupling onto either a monomer or a polymer, by copper(I)-catalyzed alkyne-azide cycloadditions (Click chemistry) to azides functionalized with various polymerizable substituents, or by partial reduction to a vinyl-substituted dye for vinyl free radical polymerization. Current and future syntheses and polymerization efforts are reported.

[1] White, T.J.; Broer, D.J. Nat. Mater. 2015, 14, 1087-1098.
[2] Yang, Y.; Hughes, P.; Aprahamian, I. J. Am. Chem. Soc. 2012, 134, 15221-15224.
[3] Yang, Y.; Hughes, P.; Aprahamian, I. J. Am. Chem. Soc. 2014, 136, 13190-13193.



From left to right: Marcus Brinks, Brandon Derstine, Sean Gitter, and Addison Duda. Photo courtesy Dr. Jason Gillmore.

Sonogashira Routes to Phenylenethynylenes for Photomechanical Polymeric Systems

Addison M. Duda

Mentors:
Dr. Jason Gillmore, *Chemistry*

Dr. Matthew Smith, *Engineering*

This research was supported by the Henry Dreyfus Teacher-Scholar Award and the Schaap Research Fellows Program.

Azo dyes are a class of organic compounds known for their ability to absorb UV-green wavelengths. This absorption causes reversible isomerization from trans- to cis-, which allows the azo dye to serve as the photoactive moiety in a photomechanical material if the dye is incorporated into a polymeric or liquid crystalline network.[1] The Gillmore and Smith research groups at Hope College seek to incorporate a relatively new class of red-shifted BF2-coordinated azo dyes[2,3] into such networks. In this poster we describe how this may be done by incorporating halides or ethynyl groups on the dye. Literature data and our own model studies indicate that Sonogashira coupling of this appropriately functionalized dye or a suitable precursor with a linker bearing the other (halo or ethynyl) substituent would allow preparation of a polymer in which the dye is incorporated main-chain, which is ideal for photomechanical materials. To be incorporated into a polymer in a useful way, a more soluble linker compound than those first used in our model studies is required. Preparation of multiple potential soluble linkers is underway. Once prepared these linkers will be used in further model studies and with the desired dyes to prepare the photomechanical polymer network of interest.

[1] White, T.J.; Broer, D.J. Nat. Mater. 2015, 14, 1087-1098.
[2] Yang, Y.; Hughes, P.; Aprahamian, I. J. Am. Chem. Soc. 2012, 134, 15221-15224.
[3] Yang, Y.; Hughes, P.; Aprahamian, I. J. Am. Chem. Soc. 2014, 136, 13190-13193.

Investigating the Role of xCT in Neuroregeneration

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This material is based upon work supported by the National Science Foundation under Grant Nos. 0843564, 1058981, 1039925, and 1263097 as well as the Sheldon & Marilyn Wettack Research Fellowship, Dow Foundation, Schaap Endowed Fund for Undergraduate Research, and the HHMI.

xCT, found in neuroprotective cells like astrocytes and microglia, is an important protein in the regulation of oxidative stress within neurons[1]. xCT controls production of glutathione, a critical reducing agent[2]. We hypothesize that because the neuroregenerative process is metabolically taxing and results in formation of reactive oxygen species, there is a vital need for antioxidants and, therefore, xCT. The study currently focuses on creation of genetic constructs incorporating a fluorescent protein, mCherry, and an xCT-EGFP fusion protein. These proteins will be inserted into zebrafish expression vectors operating under the hb9 and GFAP promoters using subcloning. This will allow us to visualize trafficking of xCT during the neuroregenerative process, which will be initiated using laser ablation. Initial images from a home-built confocal fluorescence microscope are presented, demonstrating the imaging ability of the instrument.

1 Jackman, Glia. 2010, 15, 1806.
2 McBean, Trends Pharmacol Sci. 2002, 7, 299.

Development of New Electrode Surfaces for Glucose Biosensors

Michael Giurini

Mentor:
Dr. Kenneth Brown,
Chemistry

Glucose Biosensors can be used to detect blood glucose levels in diabetics. These biosensors work through an electrode covered with a polymer film and an enzyme to provide sensitivity to glucose. Developing a paper-based electrode is a versatile and cost-effective alternative to conventional glucose test strips because they can be multi-use, multi-functional, and cheap to produce. Biosensors were formed on ceramic-plated electrodes to test the effectiveness of the enzyme on smaller electrode surfaces. Carbon Paste electrodes of varying compositions were tested in order to determine a viable electrode material.

Preparation and Characterization of a Highly Fluorinated Hydrophobic EDOT Film

Sydney Gross
Madelyn Orndorff
Macy Maraugha

Mentors:
Dr. Elizabeth Sanford, *Chemistry*

Dr. Kenneth Brown, *Chemistry*

Dr. Mary Elizabeth Anderson, *Chemistry*

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

Organic conducting polymers and redox polymers are important building blocks in the construction of electrochemical sensors and biosensors capable of detecting a broad range of analytes in a variety of environments. Using 3,4−ethylenedioxythiophene (EDOT) as the polymerizable moiety, we have prepared a variety of monomers to explore the surface and electronic characteristics of the resulting polymer films. We have designed monomers with both alkyl and aryl substituents containing a variety of functional groups and molecular shapes that have a wide range of expected properties. To explore how hydrophobic functionality will affect the PEDOT film, a monomer was prepared with a highly fluorinated straight chain alkyl substituent. The optimized synthesis of this highly fluorinated monomer and its characterization is described. The monomer was polymerized on an ITO electrode and the resulting film was characterized by scanning electron microscopy (SEM). Contact angle measurements showed the film to be highly hydrophobic.

Synthesis of Ortho-Substituted Benzamides Through Nickel Mediated Cross-Coupling

Ethan Heyboer
Rebecca Johnson

Mentor:
Dr. Jeffrey Johnson, *Chemistry*

This material is based upon work supported by the National Science Foundation under Grant Nos. 1148719 & 1764118, an award from the Henry Dreyfus Teacher-Scholar Award Program, and the Schaap Endowed Fund for Undergraduate Research.

This presentation provides an overview of the development of a nickel-mediated decarbonylative cross-coupling of phthalimides with boronic acids to form ortho-substituted benzamides, including exploration of the substrate scope and initial investigations into the mechanism. The otherwise efficient reaction is plagued by small amount of a reduction byproduct, which makes isolation of the desired product very challenging. A series of investigations into the source of this byproduct will also be presented.

CHEMISTRY

Poly(4-vinylpyridine)-N-oxide as a Polymer-Supported Oxygen Atom Transfer Reagent

Chloe Hutchison
Gretchen Fata
Anna Bauer
Nick Weigle

Mentor:
Dr. Christopher Turlington, *Chemistry*

This material is based upon work supported by the American Chemical Society Petroleum Research Fund under grant No. 58382-UNI3.

Pyridine-N-oxide is an oxygen atom transfer (OAT) reagent used as a stoichiometric oxidant in metal-catalyzed oxidation reactions. A polymer derivative of the N-oxide, poly(4-vinylpyridine-N-oxide), was discovered in the 1960s, but has not been investigated in OAT reactions. Could the insoluble poly(4-vinylpyridine-N-oxide), here called PVP-N-oxide, offer advantages over the molecular pyridine-N-oxide? PVP-N-oxide was synthesized and its reactivity compared to pyridine-N-oxide in the oxidation of phosphines and phosphites. Metal-catalyzed reactions were attempted with PVP-N-oxide. Recycling and reuse of the polymer backbone are described.

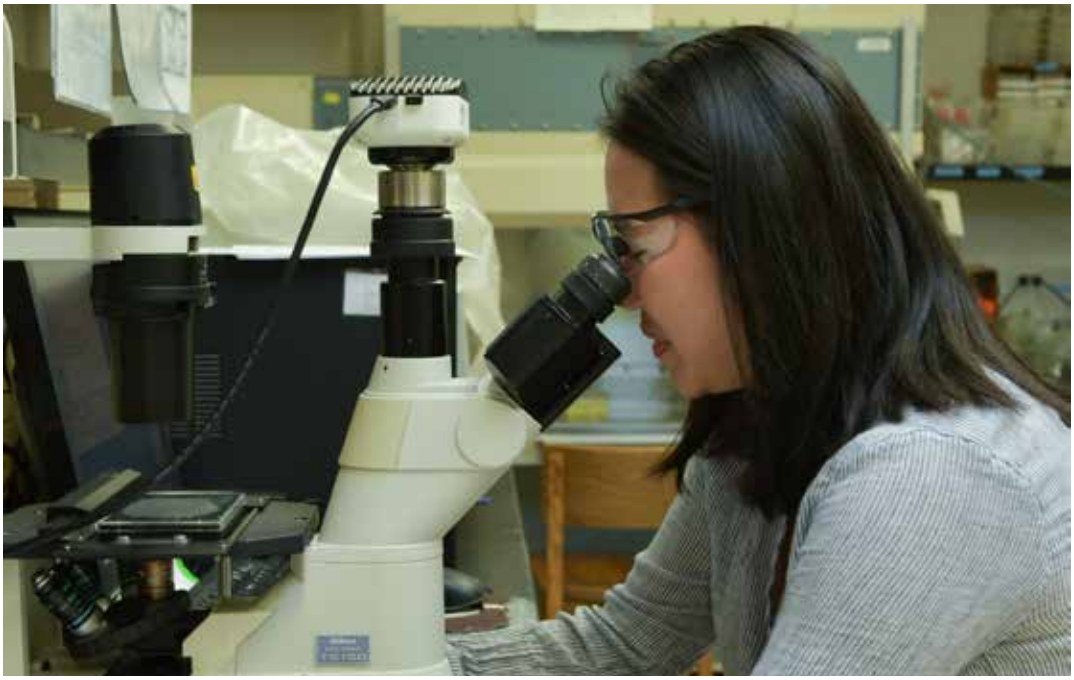

Photo courtesy Hope College Public Affairs and Marketing. Photo credit: Jon Lundstrom.

Solution-Phase Synthesis and Thermoelectric Characterization of n- and p-type Tetrahedrite Nanoparticles

Grace Kunkel
John Rogers
Andrew M. Ochs
Daniel P. Weller (MSU)
Daniel L. Stevens

Mentors:
Dr. Mary Elizabeth Anderson, *Chemistry*

Donald T. Morelli, *Chemistry (MSU)*

This work was supported by a Beckman Scholars Program award from the Arnold and Mabel Beckman Foundation, the Hope College Department of Chemistry and the Schaap Endowed Fund for Undergraduate Research.

Thermoelectric materials, which convert waste heat into electricity, are a potential avenue toward alleviating the current energy crisis.Tetrahedrite (Cu12Sb4S13) is a unique thermoelectric material composed of earth-abundant elements and conventionally produced by solid-state methods that typically require weeks at elevated temperatures (>600° C). We developed a bottom-up, modified polyol synthesis to produce high yields (2+ grams) of surfactant-free, nanostructured and phase-pure tetrahedrite materials with one hour of heating at 220° C. Nanoparticles (50-200 nm) were characterized by powder x-ray diffractometry, scanning electron microscopy and energy dispersive x-ray spectroscopy. Thermopower, electrical resistivity and thermal conductivity measurements were obtained to determine figure of merit (ZT) values, which describe the quality of thermoelectric performance. Our solution-phase synthesis outperforms the materials made by conventional methods. In creating thermoelectric devices, both n- and p-type legs must be used. However, thermal expansion mismatch issues can quickly arise, causing material degradation. This is attenuated by synthesizing tetrahedrite with each electrical behavior through the use of various dopants. Fe, Zn and Co dopants have been successfully incorporated on the copper-site. Fe-doped materials yielded the first reported observation of n-type behavior in tetrahedrite at low temperatures. Doping Mn and Ag on the copper-site, Bi and Te on the antimony-site and Se and Te on the sulfur-site is currently underway. Thermostability data will be taken as a function of dopant identity and concentration.

Investigating the Physical and Electrical Properties of Copper-Paddlewheel Surface-Anchored Metal-Organic Frameworks

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Ashley Trojniak
Alyssa Van Zanten
Alexander Osterbaan

Mentor:
Dr. Mary Elizabeth Anderson, *Chemistry*

This material is based upon work supported by the National Science Foundation under Grant No. 1508244, the Hope College Department of Chemistry, the Herbert H. and Grace A. Dow Foundation, and the Schaap Endowed Fund for Undergraduate Research.

Abstract not available online.

New Directions for Organocatalyzed Polymerization Reactions

Kjersti Oberle
Jared Lowe

Mentor:
Dr. Christopher Turlington, *Chemistry*

This material is based upon work supported by the American Chemical Society Petroleum Research Fund under grant No. 58382-UNI3.

Organic catalysts are ideal for synthesizing polymers that will be used in the body. Organic catalysts, however, have not been used either to control polymer chirality or to polymerize monomers that contain therapeutic transition metal complexes. Efforts in our lab to use organic catalysts to accomplish these goals are underway. Chiral NHCs are employed in an attempt to control chirality, and thiourea anions are used to polymerize metal-containing monomers.

Oxygen Atom Transfer to Molybdenum and Ruthenium Complexes

Sarah Olen
James Bird
Ryan Lash

Mentor:
Dr. Christopher Turlington, *Chemistry*

This material is based upon work supported by the American Chemical Society Petroleum Research Fund under grant No. 58382-UNI3.

This project seeks to transform nitriles into building blocks for pharmaceuticals and agricultural products. Nitriles are inexpensive, abundant chemical feedstocks that are produced from petroleum. Oxidation of nitriles is possible when they are coordinated to transition metals, but this reaction is not often observed or well understood. This lab is investigating and developing the nitrile oxidation reaction with ruthenium and molybdenum, in order to provide new avenues for preparation of chemical building blocks featuring carbon-nitrogen bonds. Organometallic nitrile complexes of ruthenium and molybdenum are in preparation and are being reacted with oxygen atom transfer reagents to study nitrile oxidation.

Morphological Differences in Electropolymerized EDOT Films

Madelyn R. Orndorff
Macy J. Maraugha

Mentor:s
Dr. Elizabeth Sanford, *Chemistry*

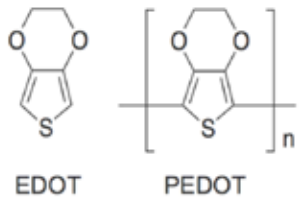
Dr. Kenneth Brown, *Chemistry*

Dr. Mary Elizabeth Anderson, *Chemistry*

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

Polyethylenedioxythiophene (PEDOT) can be formed from the electropolymerization of ethylene dioxythiophene (EDOT) to form films with good mechanical stability, and excellent electronic and optical properties for a variety of applications including electrochemical sensors (Figure 1). A study was designed to examine how the chemical and structural properties of a functionalized EDOT monomer affect the morphology of an electrochemically formed film. Five EDOT monomers were prepared for this study and then 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 effects of differing the number of polymerization cycles, the potential window for CV, and solvent on surface morphology were studied as well. Significant differences in film morphology were observed for all variables.

Figure 1: EDOT and PEDOT



CHEMISTRY

PyScan: Interfacing Laboratory Instruments with Python

Julian Payne
Peter Timperman

Mentor:
Dr. William Polik,
Chemistry

Laboratory instruments can be interfaced with and controlled from personal computers. Several programs to scan lasers and acquire data have been written by students in the Polik Lab. However, computer hardware and software change more rapidly (3-5 years) than instrument lifetime (20 years). Thus, programs must be replaced to run on modern computers and operating systems. This can be done to minimize dependence on specific hardware and software.

PyScan is a laser instrument interface program intended to replace the Polik Lab's current software. It allows the user to control the laser, setup a scan, acquire data, and store the data for subsequent analysis. PyScan is written in Python 3 in order to run on various computer platforms and access a variety of data acquisition products. This flexibility insulates it from future hardware and software changes.

Transition Metal Complexes and Their Effect on Amyloid-Beta Oligomerization

John Peterson

Mentors:
Dr. Amanda Eckermann,
Chemistry

Dr. Gerald Griffin,
Biology

This work was made possible by the generosity of the Wettack fund.

Soluble oligomers of amyloid-beta (Ab) are thought to be the cause of the neurodegeneration in Alzheimer's Disease, but the mechanism of Ab aggregation is poorly understood. The sequence of the peptide includes three histidine residues and a methionine residue (His 6, 13, 14, Met 35) that can coordinate to transition metal ions, as well as a hydrophobic region (residues 16-21). One proposed mechanism of oligomerization initiates by the association of the hydrophobic regions of two peptides, and is possibly influenced by the presence of transition metals. Therefore, we seek to probe the oligomerization mechanism using ruthenium cymene complexes with hydrophobic ligands that will (1) coordinate to the His residues and (2) interfere with the hydrophobic interactions. To this end, we have designed and synthesized ruthenium and cobalt complexes that bind to imidazole-type motifs and have hydrophobic ligands. In order to observe the effect of complex binding on the oligomerization of Ab, we take advantage of a relatively recent discovery that native Ab acts as an antimicrobial peptide. Exposure of Ab to one of our complexes ((cymene)RuCl2(L); L = isoquinoline) appears to depress the antimicrobial activity.

Isolation and Identification of Fungistatic Compounds from the Seeds of Pioneer Species

Eleda Plouch

Mentors:
Dr. Elizabeth Sanford, *Chemistry*

Dr. K. Greg Murray, *Biology*

This research was supported by the Hope College Departments of Chemistry and Biology, the Wettack Scholar Fund, and the Schaap Endowed Fund for Undergraduate Research.

Phytolacca americana, know commonly as pokeweed, is a pioneer species native to the northeastern United States. After a period of dormancy, pioneer species like *P. americana* grow rapidly during high light conditions, such as during canopy gaps caused by tree falls. To enable longevity in the seed bank, pioneer species have developed numerous chemical defenses to persist despite constant threats from the environment. This research seeks to identify and characterize the compounds in *P. americana* that may protect the seeds of this pioneer species from fungal attack while dormant in the soil. To isolate possible anti-fungal components of *P. americana*, methanol extracts of the crushed seeds were prepared, and the components separated using a cyclograph, preparative TLC, and HPLC. These compounds were identified via 1H NMR, 13C NMR, and MS. Their anti-fungal properties were characterized by poisoned-medium bioassays with pathogenic fungi on the separated and identified fractions.

Examination of the Reaction Mechanism of the Rhodium-Catalyzed Decarbonylation of Pyridyl Ketones

Erik Schoonover
Gregory Campbell

Mentor:
Dr. Jeffrey Johnson, *Chemistry*

This material is based upon work supported by the National Science Foundation under Grant Nos. 1148719 & 1764118, an award from the Henry Dreyfus Teacher-Scholar Award Program, and the Schaap Endowed Fund for Undergraduate Research.

An understanding of reaction intermediates and mechanistic pathways can provide information allowing the further diversification of a known transformation. Previous work has shown that pyridyl ketones undergo rhodium-catalyzed carbon-carbon bond activation and decarbonylation. With the goal of achieving alternative functionalization of the carbon-carbon bond, efforts are underway to examine the mechanism of this reaction. This presentation will provide an overview of the current understanding of this mechanism gleaned from analysis by NMR spectroscopy, in-situ IR spectroscopy, and competition reactions between various substituted pyridyl ketones.

The Next Generation of High Performance Computing Clusters Using Containerization

Zachary Snoek
Anna Prins

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, 1058981, and 1263097. 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 Computing and Information Technology at Hope College.

Hope College has two supercomputer clusters, curie and mu3c, that are regularly used to perform scientific calculations. Though the clusters work well overall, dealing with the dependencies inherent in an array of scientific computing software has created problems for both users and system administrators. To overcome this, we are exploring how to implement container virtualization into our clusters using Docker, an open-source container platform. We have created a test cluster and successfully run containerized Gaussian and MOPAC jobs through our job scheduler, Slurm. We have overcome security limitations inherent to Docker using a wrapper that we call Hocker, based originally on ideas from Socker (Azad, *2017 IC2E,* p. 279-285). We have created thorough documentation about the creation and operation of a virtualized cluster that promises to be more scalable and sustainable than previous designs.

A Hope College super computer. Photo credit: Dr. Brent Krueger

Tailoring the Material Properties of Surface-Anchored Metal-Organic Frameworks

Alyssa VanZanten
Ashley Trojniak
Macy Maraugha
Alex Osterbaan

Mentor:
Dr. Mary Elizabeth Anderson, *Chemistry*

This material is based upon work supported by the National Science Foundation under Grant No. 1508244, the Hope College Department of Chemistry, and the Schaap Endowed Fund for Undergraduate Research.

Abstract not available online.

COMPUTER SCIENCE

Graphics Processing Units (GPUs) and CUDA

Josiah Brouwer
Josiah Brett

Mentor:
Dr. Charles Cusack,
Computer Science

This work supported by the Herb Dershem Computer Science Summer Research Fund.

Computers almost always contain one or more central processing units (CPU), each of which processes information sequentially. While having multiple CPUs allow a computer to run several tasks in parallel, many computers also have a graphics processing unit (GPU) which contains hundreds to thousands of cores that allow it to execute many computations in parallel. In order to complete a larger task, GPUs run many subtasks concurrently. Each core performs the same instruction on different sets of data, making it useful for performing tasks such as calculating what each individual pixel displays on a screen. The purpose of this research was to learn how GPUs work, how to write CUDA programs to utilize GPUs, and to determine if GPUs could be used to increase the speed of algorithms used to determine the pebbling properties of graphs. In addition, we developed a class module on GPU computing with CUDA for the Advanced Algorithms class in Hope College's Computer Science department.

Vitalis

Phil Caris
Dennis Towns
Jori Gelbaugh

Mentors:
Dr. Ryan McFall,
Computer Science

Dr. Vicki Voskuil,
Nursing

Patricia Kragt,
Nursing

Vitalis is an electronic medical record (EMR) application developed for use by nursing students in sophomore level classes. It is designed to be a tool to help familiarize students with the terminology and concepts associated with EMR systems, and to serve as a stepping stone between the classroom and the hospital environment. Faculty set up patient scenarios for students to use to gain experience charting about patients, and then have the ability to review and comment upon each students' work. The main tools used in the development of Vitalis are the Angular2 Javascript framework with HTML5 and CSS3 for the front end, and Ruby on Rails for the backend database and REST API used to store students' and professors' data.

Bilancio: An Easy Way to Manage Your Money

Caleb Tallquist
Louis Kopp

Mentor:
Dr. Mike Jipping,
Computer Science

This project was funded by the Hope College Department of Computer Science.

In the summer of 2016, the Ready For Life program at Hope College requested an application that would allow students to be able to manage money and learn skills pertaining to budgets in both practical and simulated scenarios for their budgeting class. Three Hope Computer Science students developed Bilancio, a budgeting app designed for use on Apple devices, and the app was used frequently in the curriculum. Over the course of the next two years, an increasing number of students used Android phones, and while the program had access to iPads for those who did not have their own Apple devices, the number became almost unmanageable. As a result, the program once again requested the help of the Computer Science department to develop an Android version of Bilancio during the summer of 2018. Using tools such as Android Studio, Pivotal Tracker, and Git, we completed a version of Bilancio designed to run on Android devices, containing all of the same features present on the iPhone version so that teaching practices revolve around the concepts of budgeting and money management rather than the function of the app on each kind of device. As a result, users at all levels of technological skill can easily track their spending in a clear, organized fashion.

2018 Celebration of Undergradurate Research and Creative Activity. Photo courtesy Hope College Public Affairs and Marketing. Photo credit: Steven M. Herppich.

EEG Analysis of Physically and Electrically Activated Sensation

Michael Dennis
Barry Bait

Mentor:
Dr. Katharine Polasek,
Engineering

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

Phantom limb pain, a pain or discomfort in a missing limb, affects 80% of amputees. This pain may originate from incoherent signals in the amputated pathway, likely causing changes in the somatosensory cortex. We hypothesize that by applying a non-painful sensation in the amputated limb, phantom limb pain may be reduced or eliminated. The long-term goal of this project is to develop a non-invasive therapy that consists of an electrically activated tapping sensation in the missing limb to promote neuroplasticity and changes in the somatosensory cortex. In this phase we investigated the differences in cortical activity between sensations evoked through electrical activation of the median nerve and physical tapping on the hand.

An electroencephalogram (EEG) was used to measure cortical activation in the somatosensory cortex during artificial and actual touch. A 64 electrode EEG cap was placed on the scalp to measure cortical signals. Cortical responses were recorded under the following conditions: 1) Investigator tapped on each finger and the palm with a reflex hammer. 2) Electrical stimulation of the median nerve at the elbow was used to elicit a tapping-like sensation in the subject's hand. 3) Matched stimulation where the investigator tapped in the location where stimulation was felt. The trials were grouped based on tapping conditions, and each group was averaged together to remove non-event related portions of the cortical activation.

The data was analyzed by comparing normalized peak voltages of cortical activation by time and voltage, and by calculating the correlation coefficients between the different conditions. Analysis was done on peak voltages at approximately 20 and 60ms post stimulus to quantify the brain's detection of stimulus, and peaks around 100ms to quantify perception. It was found that stronger cortical activation was elicited contralateral (opposite side) to physical and electrically activated sensation in all cases. Signal correlation, and timing varied between subjects. More trials are needed to determine quantifiable differences between these two types of sensations.

Bio-Inspired Iterative Learning Techniques for More Effective Control of Civil Infrastructure

Camille Fogg

Mentor:
Dr. Courtney Peckens,
Engineering

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

Civil structures, such as buildings and bridges, are constantly at risk of failure due to extensive environmental loads caused by earthquakes or strong winds. In order to minimize this risk, the application of control systems for civil infrastructure stabilization has been proposed. However, implementation challenges including communication latencies, computation inundation at the actuation node, and data loss have been impeding large-scale deployment. In order to overcome many of these challenges, inspiration can be drawn from the signal processing techniques employed by the biological central nervous system. This work uses a bio-inspired wireless sensor node, capable of real-time frequency decomposition, to simplify computations at an actuating node, thus alleviating both communication and computation inundation and enabling real-time control. The simplistic control law becomes F=wN, where F is the control force to be applied, w is a weighting matrix that is specific to the structure, and N is the displacement data from the wireless sensor node. There is no empirical solution for deriving the optimal weighting matrix, w, and in this study numerous methods were explored in order to determine values for this matrix that produced the most effective control. These methods included particle swarm optimization, artificial neural networks, and optimal control theory. Through the use of performance metrics which compare the simulated structure's controlled and uncontrolled responses due to the applied disturbances, it was quantitatively found that the application of particle swarm optimization produced the preferred results.

Bio-Inspired Control of Civil Infrastructure

Rachel Foy

Mentor:
Dr. Courtney Peckens,
Engineering

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

Control systems have begun to be integrated into civil infrastructure, such as buildings and bridges, in an attempt to protect them from the damaging effects of large external loads, such as earthquakes and high winds. Although there have been some successful implementations of these systems, there still exists several flaws which prohibit their widespread adoption, such as high energy costs, lag-time and data-loss. As such, new, novel methods are needed to make such systems more effective and efficient. A bio-inspired wireless sensor has been developed that draws inspiration from the signal processing techniques used in the mammalian auditory system, which results in real-time frequency decomposition techniques, as well as extremely efficient data compression and transmission. Due to its up-front pre-processing capabilities, this sensor can be easily integrated into a streamlined control algorithm that requires minimal computational capacity, thus alleviating large lag-time in the system and resulting in more effective control. Previous results have shown promising results in simulation and this summer, efforts were made to validate this version of control theory in a physical system. Numerous hardware and software issues were addressed for the experiment and future research will further validate the control scenario.

ENGINEERING

Multi-Robot Communication and Coordination

Kyle Hydorn

Mentor:
Dr. Miguel Abrahantes, *Engineering*

Supported by the Hope College Department of Engineering.

The primary focus of this project was the implementation of a multi-robot system, comprised of three Yujin™ Kobuki turtlebots. Each turtlebot was initially controlled with a laptop, but was then upgraded to a Raspberry Pi™ single-board computer that runs Ubuntu Linux in accordance with ROS (Robot Operating System), which provides the capability of establishing a network connection among the three robots via Wifi. This network is the core aspect of the system and is crucial for communicating data among the robots in order to coordinate location and movement. Currently, each robot is programmed and configured to navigate via joystick controller, in addition to a USB web camera so that the driver can see from the robot's perspective, all while sitting at the desktop workstation. The primary goal of this research was to lay the groundwork for an autonomous multi-robot system that will be used to study, develop, and test distributed algorithms, written in python, to receive and process low level commands and execute high level tasks. This system could be applied to several real world scenarios that demand the teamwork of multiple robotic units, such as military surveillance and search teams looking for natural disaster survivors.

Engineering the Future Academy

Supported in part by the Michigan Space Grant Consortium NASA grant #NNX15AJ20H.

This project was an interdisciplinary endeavor between the Departments of Mathematics and Engineering. *See page 73 in the mathematics section of this book for full abstract.*

Photo courtesy Hope College Public Affairs and Marketing. Photo credit: Thomas Renner.

A Model of Selective Activation Using Surface Electrical Stimulation

Joseph Krocker

Mentor:
Dr. Katharine Polasek,
Engineering

This material is based upon work supported by the National Science Foundation under Grant No. 1805447 and Hope College Dean of Natural and Applied Sciences.

Developing an electrical interface that non-invasively interacts with the peripheral nervous system may be useful in treating phantom limb pain and other neurological problems. However, variations in electrode shape, placement, and stimulation pattern can greatly affect area of activation in the nerve. Therefore, a computer model of surface electrical stimulation was used to test stimulation parameters and an automated process was developed to identify parameters that produce selective activation of the median nerve.

A three-dimensional finite element model of the arm was used to predict voltages in the median nerve due to different stimulation parameters and electrode arrangements.These voltages were used to predict the firing of axons placed within a 10 fascicular median nerve.

A two by four electrode rectangular array was placed on the skin of the model just above the elbow. A genetic algorithm was implemented to find electrode relationships that would yield selective activation of different fascicles. This algorithm scaled the superimposed models of each of the eight electrodes to randomized values between 20 and 70 volts (anodic and cathodic). The percent of axons activated in each fascicle (out of 50-125 depending on size) was used to reject or save the electrode relationship. A relationship was considered promising if a fascicle had 40% or more axons activated compared to at least 8 of the other fascicles.

Ten promising electrode relationships have been identified, activating three of the ten fascicles selectively. After several more promising relationships are identified, small changes in the electrode voltages will be investigated to refine the ability to activate different portions of the nerve. In the future, these relationships will be tested on human subjects to validate the modeling predictions.

Wireless Sensor Networks for Long-Term Monitoring of Urban Noise

Cedric Porter
Taylor Rink

Mentor:
Dr. Courtney Peckens,
Engineering

This research was funded through the Natural and Applied Science Division Dean Start-up Fund.

Noise pollution in urban environments is becoming increasingly common and has the potential to negatively impact people's health and decrease overall productivity. In order to alleviate these effects, it is important to better quantify noise patterns and levels through data collection and analysis. Wireless sensor networks offer a low-cost and low-power solution for data collection and aggregation, in general. When applied to acoustic applications, these networks are capable of autonomously gathering and processing noise pollution levels in urban areas with a higher level of granularity than traditional handheld devices. In this study, a wireless sensing unit (WSU) was developed that possesses the same functionality as a handheld sound level meter. The WSU is comprised of an external peripheral board, a low-power micro-computer, and a wireless transceiver, making it capable of data acquisition, processing, and transmission. The data processing capabilities of the unit were compared to a handheld meter and showed less than a +/- 2dB difference in measurements. A network of four WSUs was deployed in a seven day pilot test. Each unit in the network transmitted its data directly to a coordinator repository, a Raspberry Pi single board computer, which can be queried remotely using 802.11n wireless LAN protocol, thus allowing for long-term data collection and management. Preliminary results indicate that it is possible to autonomously and continuously collect noise pollution data and future work will include more focused data analysis.

GEOLOGICAL & ENVIRONMENTAL SCIENCES

Using Remote Sensing to Evaluate Historic and Current Hydroecological Changes in a Great Lakes Interdunal Wetland/Slack

Alexandra Donaldson

Mentor:
Suzanne DeVries-Zimmerman,
Geological & Environmental Sciences

This research was funded by Michigan Space Grant Consortium NASA grant #NNX15AJ20H.

We used historic infrared USDA and 3-band IR drone images (2017, 2018) to examine ecological changes occurring in response to fluctuating lake levels in a secondary interdunal wetland or slack on Lake Michigan's eastern shore at Saugatuck Harbor Natural Area. Secondary slacks in Great Lakes coastal dunes are created where wind scours the sand to the water table within a dune. The studied slack is >1 ha in size with ridges and pools creating a diverse vegetation mosaic. Its water table is tied to that of Lake Michigan. The 2010 photo shows several pools (black) surrounded by bright red colors, indicating vigorously growing or wetland vegetation. In contrast, dune vegetation is light pink in color. Pools are not noted in the 2012 photo. Areas previously shown in red are now light red to pink, suggesting a decrease in plant vigor and a shift to dune/upland vegetation. This shift corresponds to a significant lake level drop from 2010 which dried the slack. Pools reappear in 2014 as lake levels rise from below average to average. The slack vegetation exhibits green, tan and pink to medium red colors, suggesting a mixture of plant vigor, density, and dune/upland and wetland vegetation in response to changing conditions. The 2016, 2017 photos show larger pool areas and dull–bright red colors dominating the slack, suggesting more vigorous or wetland plant growth in response to rising water levels. The pools greatly expand in 2018 while slack vegetation shows dull red, indicating vigorous or wetland plants. Vegetation quadrat sampling in 2016–2018 confirmed dominant wetland vegetation throughout the slack with different species creating the red color variations. Hence, these methods provide the means to evaluate past and to monitor current ecological changes due to fluctuating water levels.

GES student, Alexandra Donaldson (right) is assisted by fellow GES student, Jacob Stid, in performing vegetation quadrat sampling at Saugatuck Harbor Natural Area. Photo courtesy Suzanne DeVries-Zimmerman.

A Reconnaissance Survey of Metals in Untreated Drinking Water around the World

Benjamin Fry
Jonas Peterson
Jacob Stid

Mentors:
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Geological & Environmental Sciences

Dr. Aaron Best,
Biology

Dr. Michael Pikaart,
Chemistry

Randall Wade
Sarah Brokus
Day1: Watershed Program

As part of an ongoing global survey, our research group is investigating untreated drinking water sources for the presence of metal contamination. More than 120 sites have been sampled in over 20 countries for the presence of As, Ba, Cd, Cr, Cu, Mn, Ni, Pb, Sb, Se, and Zn. Field sampling was performed by trained NGO staff who used metal chelating polyurethane foam blocks to sequester metals from source water samples. Sample foams were returned to Hope College and were processed through an acid-wash procedure to recover trapped metals. Rinsates were analyzed by ICP-OES techniques. Preliminary analytical results from 45 sites show 47% of the drinking water sources contain metals above background controls. Metals detected were Ba, Cu, Cr, Mg, Mn, and Zn. Zn was the most commonly occurring and Cr the second-most occurring metal. Preliminary synthesis indicates drinking water sources elevated in Cr and Zn are located in predominantly volcanic terranes. Same-site data collected from hollow-membrane filters indicate that suspended particulate load concentrations are generally < 2 ppm at the sites with elevated Zn and Cr. Suspended load particulate matter was recovered from samples from some of the sites analyzed for dissolved metals. Semi-quantitative SEM-EDS analysis of these particulates shows some potential correlation between the presence of a Cr-bearing mineral phase and elevated dissolved Cr concentrations. As more foams from field drinking water sources around the world are returned for metal analysis, potential correlations to site land use, soil substrate, bedrock, and population density will be examined. So far, this project is a reconnaissance survey with small sampling density at any one site. Future work will focus on in-depth sampling of drinking water sources in targeted areas of high metal concentrations, revealed by this study.

Monitoring of Chemical and Physical Water Quality Parameters in the Macatawa Watershed

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Liam Kleinheksel
Brandon Bonilla
Carolyn Cooper
Eric Schumann
Chris Belica

Mentors:
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Day1: Watershed Program

This material is based upon work supported by the National Science Foundation under Grant No.1616737 and through a grant from the Herbert H. and Grace A. Dow Foundation.

Abstract not available online.

Day1: Watershed students collect water samples in the spring of 2019
Photo credit: Sarah Brokus

The Role of Water-Fluxed and Water-Undersaturated Melting in Garnetiferous Amphibolites across a Metamorphic Transect in the Eastern Segment of the Sveconorwegian Orogen, SW Sweden

Elizabeth Morehead
Cleveland Tarp
Max Huffman

Mentor:
Dr. Ed Hansen,
Geological & Environmental Sciences

Two end-member processes can contribute to partial melting in orogenic belts. Water-fluxed melting occurs when water enters a rock, lowering the solidus. Water-undersaturated (dehydration) melting is a peritectic reaction in which a hydrous mineral assemblage forms a melt and anhydrous solid phases. We evaluated the relative contributions of these two processes in the partially melted amphibolites in the Eastern Segment of the Sveconorwegian Orogen in Southwestern Sweden. We examined amphibolites along a 90 km transect. Concentrations of Ti in biotite and Ti, Na, and K in hornblende tend to increase westward, indicating an increase in metamorphic grade. Leucosome is dominated by plagioclase and quartz with grain sizes up to 10 times that of the amphibolite host. Analysis of outcrops surfaces indicate that proportions of leucosome vary from 0 to 25 percent by area. More variation in the proportion of leucosome occurs in the east than the west. Plagioclase is slightly more sodic (2 to 5 mole percent) in leucosome compared to amphibolite host in a third of the samples investigated and nearly identical in the remainder. Occasional biotite and hornblende megacrysts are associated with leucosome in the eastern portion of the transect. Orthopyroxene and garnet megacrysts appear 75 km from the eastern end of the traverse and clinopyroxene appears at the western end. Existing experimental data and thermodynamic models indicate that water-undersaturated melting of amphibolites should produce pyroxenes at lower pressure but pyroxene and garnet at higher pressure. The lack of pyroxene in the eastern portion of the traverse and the variation in leucosome proportions suggest that water-fluxed melting was the predominant processes, while water-undersaturated melting occurred in the hotter western portion.

GEOLOGICAL & ENVIRONMENTAL SCIENCES

A Reconnaissance of Microplastic Distribution in the Lake Macatawa Watershed

Amy Olgers
Chelsea Moore

Mentor:
Dr. Brian Bodenbender,
Geological & Environmental Sciences

This material is based upon work supported by the National Science Foundation under Grant No. 1153600 and by donors to the Ver Hey Geology Summer Research Fund at Hope College.

Abstract not available online.

A New Approach for Determining Size Distributions of Very Fine Particles in Aqueous Suspensions

Jonas Peterson
Jacob VanderRoest
Daniel Wade

Mentors:
Dr. Jonathan Peterson,
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Dr. Aaron Best,
Biology

Dr. Michael Pikaart,
Chemistry

Randall Wade
Sarah Brokus
Day1: Watershed Program

Total suspended solids (TSS) and settleable particles are important constituents in aqueous environmental samples, affecting water quality directly, or indirectly as substrates for contaminant transport. Particles are very-fine, with diameters in the sub-μm to nm scale. Particle size distribution is commonly characterized by dynamic light scattering (DLS), analytical disc centrifugation (ADC), or scanning electron microscopy (SEM). While a combination of these techniques may yield acceptable results, the instrumentation required is often inaccessible, or the analysis too costly for routine reconnaissance investigations. Our research group is working on a way to determine grain-size distributions by using the change in light absorbance/attenuation with time, as particles settle in aqueous samples. Different types of samples were investigated. These included single mineral suspensions of quartz, feldspar, kaolinite, hematite, and calcite, at TSS concentrations of about 100-1000 ppm. Other samples were from groundwater wells with settleable loads of 300-6000 ppm. The majority of samples analyzed were re-suspended material recovered from point-of use water filters which sampled rural drinking water sources from various global locations. Light attenuation was measured at 16 different λs between 360-880 nm. Particles were allowed to settle for 120-240 minutes, with spectroscopic measurements taken every 30 seconds. Measurement of light attenuation vs. time (settling curves) across multiple λs provided a basis for characterizing the particle size distribution within a sample. Size distributions were quantified by application of several published settling velocity equations to the spectrophotometric data. These equations range from relatively simple power functions to complex logarithmic and polynomial functions, and allow the semi-quantitative separation of particles into brackets of approximately 1μm – 750 nm, 750 -500 nm, 500-250 nm, 250-100 nm , and <100 nm diameter. The technique is currently being tested against NIST standards, SEM analysis of particles, and dynamic imaging particle analysis (DIPA) results.

Photo courtesy Hope College Public Affairs and Marketing.

GEOLOGICAL & ENVIRONMENTAL SCIENCES

Using Drone Acquired, High-Resolution, Multispectral Imaging to Predict and Monitor Coastal Dune Mobility: An Example from the Southeastern Shore of Lake Michigan

Jacob Stid
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Ian Gorgenson

Mentors:
Dr. Edward Hansen,
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Dr. Brian Yurk,
Mathematics

Dr. Paul Pearson,
Mathematics

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

Dune mobility can threaten human infrastructure but is essential to maintaining diverse ecological communities in coastal dunes. Only those patches on a dune with little or no vegetation will migrate. The size of these patches together with their shape, topographic position, and topographic orientation with respect to the direction of strong sand transporting winds affect the sensitivity of the dune surface to mobilization. Images acquired by drone flights over Saugatuck Harbor Natural Area will be used to analyze topography and extent of vegetation of the dune surfaces. The results will be used to create maps showing variations in the sensitivity to dune mobilization within the complex. The method will be tested by comparing drone images from successive years and by setting up systems of rods in test plots against which sand migration can be directly monitored. Monitoring will continue for at least two years.

A Global Reconnaissance Survey of Untreated Drinking Water Sources: Potential Relationships to Worldwide Metadata

Daniel Wade
Jacob VanderRoest
Cleveland Tarp
Jacob Stid
Jonas Peterson
Josiah Peterson

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Geological & Environmental Sciences

Dr. Aaron Best,
Biology

Dr. Michael Pikaart,
Chemistry

Randall Wade
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Abstract not available online.

MATHEMATICS

Classifying and Predicting US Mass Shooting Incidents

Tyler Gast
John McMorris

Mentor:
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Mathematics

This work was supported by the Matthew J. and Anne C. Wilson Foundation Faculty Development Fund, part of the Nyenhuis family of funds, and by Michigan Space Grant Consortium NASA grant #NNX15AJ20H.

Mass shootings are an unusually common occurrence in the United States and have become the subject of growing debate, especially since recent events such as the Vegas Shooting of 2017. Our aim is to better understand these atrocities, find any relevant commonalities between these events, and determine variables most relevant for characterizing these incidents. To that end, Principal Component Analysis, implemented on the software R, was used.

Engineering the Future Academy

Julia Hardy
Erica Slenk
Jenny Pedersen

Mentors:
Susan Ipri Brown,
Engineering

Dr. Eric Mann,
Mathematics

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

Hope College's 2018 Engineering the Future Academy provided 63 local area at-risk and underserved students the opportunity to explore engineering design in a hands-on, problem solving context as well as professional development for in-service (4) and pre-service (2) teachers. Designed as a learning experience for students and a research and mentorship opportunity for undergraduate STEM and STEM education majors, this year's efforts centered around two one-week 30 hour on-campus design challenges exploring alternative energy sources. This year's challenges were developed collaboratively with the STEM teachers at Holland Public Schools with the on emphasis building units of instruction that are transferable to the classroom in the upcoming school year. Supplies and equipment purchased for the camp activities were transferred to the schools at the end of the summer. Fees, transportation and meals were provided for students to facilitate their participation. Throughout the academic year, the Holland Public School STEM teachers continue to receive curriculum support and new materials through regular interaction with the program staff. Additionally, new curriculum and supplies were provided to support the school's Advanced STEM class for 8th graders.

Using Factor Analysis in Variable Selection and Clustering of US Mass Shooting Incidents

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Mentor:
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Mathematics

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

Estimated values of unobservable factors in Factor Analysis can be used for both variable selection as well as clustering of cases into groups. We implement Factor Analysis on a US mass shooting database with these two goals. The nature of the clusters suggested by Factor Analysis will be highlighted. Salient features from these shooting incidents, as well as intra-and inter-group characteristics, will also be discussed.

Photo courtesy Hope College Public Affairs and Marketing. Photo credit: Steven M. Herppich.

Relationship between Identified Delirium Symptoms and Falls Rates in a Non-ICU Setting

Noah Bertolone

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The majority of studies analyzing relationships between delirium and fall rates have been conducted in the intensive care unit (ICU). The purpose of this study was to examine the relationship between symptoms of delirium and fall rates in non-ICU patients and utilized Virginia Henderson's Need-Based Theory, because it focuses on the nurse's role in assessing and addressing patient needs. This correlational, retrospective, and non-experimental study utilized a chart review to gather data from four non-ICU units of a Midwest metropolitan hospital. Consecutive sampling created a sample of 129 cases involving patients who fell or required restraint use during hospitalization between January and June of 2018. Data were collected through chart audit by reviewing documentation of delirium symptoms within 12 hours prior to the fall or restraint implementation. Delirium symptoms were identified as alterations in level of consciousness (LOC), speech, mood, arousal level, and/or orientation. Data were analyzed using SPSS 23.0. There was no significant relationship between fall rates and alteration in orientation ($X2=1.459$, $p=0.152$) or LOC ($X2=2.609$, $p=0.075$). There was a significant relationship between fall rates and altered arousal level ($X2=13.310$, $p<0.001$), speech ($X2=6.196$, $p=0.010$), and mood ($X2=26.439$, $p<0.001$). There was also a significant relationship between number of alterations and fall rates ($t=5.041$, $df=127$, $p<0.001$) and between restraint use and an increased number of alterations. Limitations include small sample size, documentation inconsistencies, and lack of a standardized delirium assessment tool. Monitoring and assessment of patients with delirium symptoms in the non-ICU should be further investigated to maintain reduced fall rates.

Analysis of Operating Room Traffic in Orthopedic Surgical Cases versus Non-Orthopedic Surgical Cases

Emma Boerema

Mentor:s
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Operating rooms asepsis is essential to ensure a safe environment for the surgical patient. Operating room traffic and door swings is a possible source of contamination and could increase infection risks for the patient. The purpose of the observational study was to compare the mean frequency of door swings between orthopedic and non-orthopedic surgeries. Roy's Adaptation Model was applied to this study since the action of the healthcare provider effects the physical adaptation of the patient. This descriptive study compiled the direct observation of door openings during orthopedic and non-orthopedic surgical procedures, the number and type of providers who entered or exited the operating room, and reason for exit/entry. Data was analyzed for descriptive statistics and independent t-tests using SPSS©. The study took place at a Non-Profit Midwest Hospital's surgical unit. The results show that there is no significant difference between the frequency of door swings between orthopedic cases ($n=37$) and non-orthopedic cases ($n=34$). The independent t-test results indicate the lack of a significant finding. Length of case: $t(69) = 0.69$, $p= 0.49$. Frequency of door swings: $t(69) = 0.35$ $p=0.35$. There are several limitations to the study including the possibility for the Hawthorne affect, a small sample size and a convenient selection of surgical procedures. This data on operating room traffic will help nursing staff develop a quality improvement project to promote patient safety by reducing surgical site infections.

Theory of Planned Behavior: Examining Breastfeeding Intentions and Behaviors

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This work was supported by the International Society for Research in Human Milk and Lactation and by the Family Larsson-Rosenquist Foundation.

Breastfeeding is the gold standard for infant nutrition, providing benefits to both infants and mothers. According to the Theory of Planned Behavior (TPB), a mother's breastfeeding intention is directly related to the following antecedents: attitudes, subjective norms, and perceived behavioral control. The purpose of this descriptive, prospective study was to examine the relationship between antecedents and breastfeeding intentions and behavior at 60 days postpartum utilizing three online questionnaires administered prior to birth and at 10 and 60 days postpartum. The baseline questionnaire measured participants' attitudes, subjective norms, and perceived behavioral control toward breastfeeding intentions, while day 10 and day 60 questionnaires measured breastfeeding behaviors. Participants included 52 women residing in West Michigan who were English literate, 21+ years, at least 37 weeks pregnant, and intending to breastfeed. Data were analyzed using SPSS version 21. Participants were a mean age of 31 years, 96% (n=50) married, 80% (n=42) insured privately, and 78% (n=41) multipara. There was a significant positive correlation among maternal attitudes ($r(52)=.452$, $p<.05$) and perceived behavioral control ($r(52)=.330$, $p<.05$) and maternal intention to exclusively breastfeed at 3 months. Subjective norms and maternal intention to exclusively breastfeed at 3 months were not significantly correlated ($r(52)=.242$, $p=.09$). There was no significant association between maternal intention to exclusively breastfeed at 3 months and breastfeeding behavior at day 60 postpartum ($x2=2.70$, $p=.23$). Limitations included a small convenience sample of predominantly married, affluent, White women. Nursing interventions should foster positive breastfeeding attitudes and establish supportive measures to promote perceived behavioral control among breastfeeding mothers.

Evolution of Patient Dependent Fall Risk Factors in the Emergency Department

Caroline Finn

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Studies indicate a need for reducing patient falls by improved tools, assessment, and preventative measures in the emergency department (ED). The purpose of this quality improvement project was to evaluate the evolution of patient dependent fall factors in the ED. This project is established around Sr. Callista Roy's Adaptation Model, which utilizes nurse promotion of patient adaptation. As part of a Midwest Metropolitan hospital's project, data were collected retrospectively for 40 patients using the KINDER 1 Fall Risk Assessment Tool, the ED Patient Fall Story questionnaire, and chart review. The average age of patients who fell in the ED was 48.65 (21-85) years old. The most commonly noted fall risk variables were immobility (61.4%, n=27), altered mental status (50.0%, n=22), alcohol/drug intoxication (29.5%, n=13), and presentation to the ED due to a fall (25.0%, n=11). Of patients who fell in the ED, 65.9% (n=29) were identified as "fall risk," while 25.0% (n=11) were not. Of patients who fell, 34.1% (n=15) developed new fall risk factors after initial triage, prior to the fall. Administration of fall risk medications (73.3%, n=11) and altered mental status (33.3%, n=5) were the most common newly developed fall risk variables, with lorazepam (33.3%, n=5) most frequently administered. Fall prevention in the ED is strengthened through accurate initial assessment and utilization of reassessment. Limitations include self-reported data and convenience sampling of all patients who fell in a single ED, limiting generalizability. Accurate fall risk identification, assessment, and re-assessment are required to minimize fall occurrence in the ED.

Evaluating Evidence-Based Practice in a Local Wound Program

Kendra Grulke

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The bioburden, or population of bacteria present in a wound can profoundly impact its healing rate. Consequently, the management of chronic wounds and their respective bioburden requires extensive care from nursing and health-care resources. The purpose of this study is to evaluate the present wound practices of an outpatient wound clinic in a small, community hospital in Michigan and compare these findings to current research regarding evidence-based practice. Using a retrospective chart review from the wound program, data such as pathogen presence, indications for treatment including frequency of signs and symptoms present, wound culture technique, and empiric antibiotic use was collected. Databases searched for current research included PubMed and Micromedex using the following inclusion criteria: published within the last five years; English language; peer-reviewed; with keywords of "chronic wound," "biofilm," and "antibiotics." Fourteen articles and resources were found out of 650 results supporting different aspects of chronic wound management, i.e. prevalence of certain organisms, culturing techniques, and antibiotic risks. Pender's Health Promotion Model provided the framework for this study with its emphasis on self-management of health through supportive nursing care. Results found the local wound clinic's most commonly found pathogens and signs and symptoms of infection to be consistent with current research, along with a need for further emphasis confirming the use of the Levine technique for wound culture and presence of systemic signs and symptoms of infection. Limitations of this study included data collection from one site and a small sample size. The implications of this study could promote the wound care nurse's role of providing evidence-based care to patients, as well as facilitating further research on chronic wound management and antibiotic resistance.

Analysis of Surgical Personnel Traffic in the Operating Room

Sophia Jarzembowski

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Operating rooms (ORs) are one of the most aseptic environments in the hospital, but factors such as traffic caused by surgical personnel are associated with surgical site infections. This study proposes to evaluate the mean number of door swings per case among those trafficking the OR and reasons for entry and exit. This study will apply Florence Nightingale's Environmental Theory, as this theory focuses on factors within the environment that can affect the patient's outcome which is the main objective of this study. This observational study comes from log data (n= 71) of monitored scheduled surgical cases including the time, which door was used, direction of entry/exit, the personnel responsible, the reason for entry or exit of the OR, and number of doors swings total for each case at a non-profit Midwest hospital. Data analysis using descriptive statistics was conducted with SPSS. Limitations include the awareness of surgical personnel (Hawthorne effect), contradictions between data documentation, and technical limitations within the collection tools. The analysis of the data indicated a large percentage of OR traffic due to the role of the circulating RN (20%), surgical techs (17%), and OR assistants (10%). The greatest percentage of OR traffic was due to unknown reasons (33%). These results indicate the need to expand reasons for entry and exit in the observation tool. Further studies may reveal behaviors within the OR nurse population that may need to be altered in addition to ways nurses can encourage other surgical personnel to monitor their trafficking behaviors.

The Effects of Self-Reported Spiritual Importance on Patient Satisfaction With Chaplaincy Services

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Spiritual care has been found to be important to patients in the hospital setting. There is a lack of research regarding how self-reported spiritual importance in a patient's life can affect their level of satisfaction with the spiritual care they receive in the hospital setting. This study investigated how patients' self-reported spiritual importance affects their satisfaction with chaplaincy services within the hospital setting. Leininger's "Transcultural Nursing" theory was used as a foundation for this study because it recognizes the importance of aligning nursing care with the patient's beliefs, culture, and values, including their religious/spiritual beliefs. This was an exploratory descriptive study using a convenience sample. A data collection tool scored on a 5-point Likert scale developed by the researchers was used, along with qualitative data collection. Data was collected from 21 participants within a mid-size, community hospital in West Michigan. SPSS 22 was used to analyze the data. There was no significant relationship found between self-reported spiritual importance and level and satisfaction with the hospital chaplaincy services (Pearson correlation = 0.321, p-value = 0.156). Patients who received chaplaincy services were satisfied overall with their experiences in the hospital setting with a high mean score on the data collection tool (4.71 out of 5). Limitations include that convenience sample was gathered from one local hospital with little diversity. Results of this study helped to identify patient satisfaction with different aspects of spiritual care received from chaplains, and assisted in identifying patients that may benefit from a chaplaincy services referral by nurses.

Exploring the Physical Activity Behavior and Needs of Adolescent Girls: A Mixed-Methods Study

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This research was supported by the Holleman Nursing Student Research Fund.

Most adolescents do not meet recommended physical activity (PA) guidelines indicating 60 minutes of moderate-to-vigorous PA each day. Although PA has important health benefits, only 20% of girls meet the recommendations by the 9th grade. The purpose of this study was to evaluate the PA behavior and needs of adolescent girls using a qualitative and quantitative research approach.

Adolescent girls in eighth and ninth grade were recruited from a high school in West Michigan (N=33). Girls were excluded if they were involved in sports ≥ 3 days a week, had a health condition that compromised their PA, or could not read and write English. Each participant was given a Fitbit Flex 2 for one week which recorded daily steps, distance in miles, and active minutes. Four focus groups about PA and use of Fitbit trackers were completed. A Fitbit survey assessed the acceptability of the trackers. SPSS Statistics and ATLAS.ti were used to analyze the data.

An average of 7,759 steps and 3.66 miles were completed daily by the girls. Only 4 girls (12%) had a daily average above the recommended 10,000 steps. Favorite types of PA were soccer and biking. Top facilitators of PA were siblings and friends. Top barriers included technology and low motivation. Girls were interested in an all-female summer camp or afterschool program. Fitbit survey results showed 98% of girls would use a Fitbit on most days. Limitations include some missing Fitbit data and a small sample size.

Results were consistent with the literature that girls are not meeting recommended guidelines for PA. Fitbit trackers were well received by the girls and were suggested for use in future interventions. Findings from this study can be used by nurse researchers to design a PA intervention to meet the needs of adolescent girls.

Mother's Milk for Michigan Infants: Exploring the Personal, Social, and Biological Factors of Maternal Milk Supply

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This work was supported by the International Society for Research in Human Milk and Lactation and by the Family Larsson-Rosenquist Foundation.

Breastfeeding reduces infant mortality rates, metabolic and cardiovascular risk, and allergic symptoms of asthma and eczema. The longer the duration of breastfeeding, the greater the protective effect against maternal breast and ovarian cancer, stroke, type 2 diabetes, and risk of postpartum depression. The psychosocial, economic, and environmental effects of breastfeeding surpass generational influence within families to impact local communities. Many mothers prematurely discontinue breastfeeding due to a perceived insufficient milk supply (PIMS). The purpose of this study is to explore the use of maternal DNA and human milk (HM) biomarkers as a means to validate the PIMS Questionnaire. This study utilizes a longitudinal descriptive design, applying a modified Theory of Planned Behavior to investigate the personal, social, behavioral, physiological, and biological influences with 100 mothers intending to breastfeed in West Michigan. Participants are enrolled after 30 weeks gestation and asked to complete three surveys (pre-birth, 10 and 60 days post-birth) and to provide a saliva (DNA) and a milk sample (30mL, day 10 post-birth). Data will be analyzed using descriptive statistics, correlations, linear and logistic regression, and Structural Equation Modeling. Enrollment is closed with 100 participants and 96 saliva and 94 HM samples collected. Results and conclusions are pending analysis of DNA and HM samples. The attrition rate for enrollees was 4% at day 10 (n=4) and 13.3% (n=12/90) day 60 post-birth. Increased knowledge related to the biological aspects of breastfeeding may be used to provide a foundation for personalized lactation interventions based on individual genetic variations and human milk biomarkers.

Students are working on the Mother's Milk for Michigan Infants project. Photo courtesy Hope College Public Affairs and Marketing. Photo credit: Jon Lundstrom.

PHYSICS

Developing a General Spin Dependent Compton Scattering Cross-Section in Strong Magnetic Fields

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Mentor:
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Physics

This research is made possible by the generous support of the Hope College Department of Physics and the Hope College Dean for Natural and Applied Sciences.

Various X-ray space telescopes have detected steady soft X-ray emission originating from highly magnetized neutron stars known as magnetars. Within the magnetospheres of these stars, accelerated electrons interact with X-ray thermal photons through Compton scattering, a quantum electrodynamic process where the X-ray photons are boosted to higher energies. This is believed to be the source of the production of the high-energy tails in observed X-ray spectra from magnetars. Through the implementation of Sokolov & Ternov spin states, there exist analytical expressions for the spin-dependent lifetimes of excited states of electrons/positrons in strong magnetic fields near the surface of magnetars. These lifetimes are required for determining the spin-dependent Compton scattering cross section. We propose the development of compact analytic expressions for the spin-dependent Compton cross section in strong magnetic fields that will eventually be used in Monte Carlo simulations of magnetars' X-ray emission. With these expressions, we will be able to graphically analyze the specific effects of initial and final spin states as well as the role that polarization plays in photon intensities. This will allow for more accurate and efficient modeling of magnetars using Monte Carlo techniques and may prove useful in understanding distinct features between highly magnetized pulsars and conventional gamma-ray pulsars.

Comparing the Intercalation of Na, Mg, and Al in Prussian Blue Analogues

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Mentor:
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Physics

This material is based upon work supported by the National Science Foundation under Grant Nos. 0959282 and 1608327.

Recently Prussian Blue Analogues (PBAs) have become a growing area of study because of their charge storage capacity and their potential for use as a battery material. One of the most commonly used batteries is a lithium ion battery, but lithium is not as Earth abundant as sodium, magnesium, and aluminum. The purpose of this study was to substitute each of these three elements as the intercalating cation in the formation of PBAs. Intercalation is the movement of ions in and out of crystalline structures. Nickel was electrodeposited on a surface, and the PBA was then created on top of the thin layer by using cyclic voltammetry (CV) experiments. CV scans were carried out at several different scan rates to characterize the PBA produced. The reaction potential, the variation of the current with CV scan rate, and the total charge storage of each cation were compared. Preliminary results show that the Na and Al reactions occur at faster rates than the Mg reactions. Mg has been shown to have the largest storage capacity of the three cations. The reaction potential of Al was shifted about 200 mV compared to Mg and Na, which shared similar reaction potentials.

Determining the Beta-decay Intensity Function for Unstable Nuclei

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This material is based upon work supported by the National Science Foundation under Grant Nos. 1613188 and 1153600.

Beta decays of 103,104mNb were observed with the Summing NaI(Tl) (SuN) detector at the National Superconducting Cyclotron Laboratory. The beta-decay feeding intensity distribution Iβ(E) for each isotope was extracted by measuring gamma rays in coincidence with an emitted electron. Energy levels in the energy level continuum of the daughter nuclei were populated. The sums of all the gamma rays resulting from the de-excitation cascades were measured and modeled so that the experimental calculations would be free from the Pandemonium effect. The Iβ(E) was extracted via the Total Absorption Spectroscopy technique. The Iβ(E) for each nucleus was compared to predictions made by the Quasi Random Phase Approximation (QRPA) model. The goals included providing experimental data for nuclei found in the r process which could give insight into the reliability of QRPA and lead to a more dependable prediction of the formation of heavier nuclei birthed from supernovas or neutron star mergers. In addition, the extracted beta-decay feeding intensity distributions will lead to a better understanding of nuclear structure. Finally, experimental data for 104mNb is also of interest to antineutrino studies of nuclear reactors.

Comparing Electrochemical Analysis and Particle Induced X-Ray Emission Measurements of Prussian Blue Analogue Deposits

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Physics

This material is based upon work supported by the National Science Foundation under Grant Nos. 1608327, 0959282, & 0319523.

Prussian Blue Analogues (PBAs) have become a popular area of study due to their low cost and ability to store charge. Producing Nickel Hexacyanoferrate (a PBA) can be time consuming and expensive. In order to reduce time and streamline the production, one can use electrochemistry to plate a PBA film onto a metallic surface. Although this provides a more efficient and faster method for production, one major disadvantage is that the amount of PBA formed by this process is not precisely known. The purpose of this research is to develop a method to compare this electrochemical process of creation with other methods which allow one to know the amount of PBA formed.

The Nickel Hexacyanoferrate (a PBA) was analyzed with Particle Induced X-ray Emission (PIXE) to determine the amount of Fe and Ni deposited. These values were then compared to the amounts determined during electrochemical production. The measurements of the amount of PBA show that electrochemical calculations generally report a greater value than the PIXE values measured. Additional catalytic reactions due to the presence of the PBA may explain this discrepancy. Chronoamperometry measurements may enable this catalytic reaction to be extracted and be accounted for in the characterization of the PBA electrochemically.

PHYSICS

Study of Charge Transfer Quantities of Prussian Blue Analogues Using Electrochemical Impedance Spectroscopy

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Mentor:
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Physics

This material is based upon work supported by the National Science Foundation under Grant Nos. 0959282 and 1608327.

Prussian blue analogues (PBAs) have been more frequently studied as of late due to their ability to store and transfer charge as well as their use of more earth abundant metals. This study was concerned with extracting quantities related to the charge transfer of PBAs in characterization solution. This was done using the methods of Electrochemical Impedance Spectroscopy (EIS). AC current was run through the PBAs in characterization solution and the best circuit model (modified Randles circuit) was fit to the data. The parameters from the circuit elements involved in the transfer and storing of charge were extracted and analyzed. These elements included the charge transfer resistance and the Constant Phase Element (CPE) in series with the charge transfer resistance. The charge transfer resistance shows a broad minimum near the potential of the charge storage reaction. The Warburg coefficient, which is associated with the diffusion of ions in the PBA, was determined through mathematical relationship with the CPE parameters and the charge transfer resistance. The Warburg coefficient also displays a broad minimum near the potential of the charge storage reaction.

Generating Depth Profiles of Semiconductors Using Rutherford Backscattering Spectroscopy

Zachary Kellner

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This work was supported by funds provided by the Frissel Physics Research Fund, the Hope College Dean of Natural and Applied Sciences, and the Michigan Space Grant Consortium NASA grant #NNX15AJ20H.

Many developing thin film technologies require an understanding of the composition of the films. Nanometer scale depth profiles of the elemental composition of thin film samples are done non-destructively with Rutherford Backscattering Spectroscopy (RBS). The energies of helium ions are measured after backscattering from the target sample. These energies are analyzed using SIMNRA+, to fit a simulation of backscattered energies based on energy dispersive X-ray analysis of the target's composition. This simulation of the target is divided into multiple layers with the scattering of each layer adjusted by the stopping power of the overlying layers. An iterative process was used to fit this simulation to the data. First, each layer was adjusted individually to produce a fit; this can lead to a jagged, unphysical depth profile. A polynomial smoothing function was then used to eliminate this jaggedness between layers. This smoothed profile was then readjusted with a second layer-by-layer fit, which produced a much less jagged and more physical depth profile, with a negligible increase in uncertainty as measured by the standard deviation of the residuals.

+M. Mayer, SIMNRA User's Guide, Report IPP 9/113 (Max Planck Institut für Plasmaphysik, Garching, 1997.)

Effects of Columnar Defects on Microwave Nonlinearity in a Superconducting YBCO Resonator

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Mentor:
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This material is based upon work supported by the National Science Foundation under Grant No. 1505617.

Second and third order intermodulation (IM) signals in two superconducting microwave devices are measured before, during, and after the application of an approximately 50G static magnetic field. Each device under test is a roughly identical thin film YBa2Cu3O7−δ (YBCO) hairpin microwave resonator with a resonant frequency of approximately 840MHz. The first sample contains columnar defects orthogonal to the transmission line on its magnetic end. The second (control) sample contains no engineered defects. The defects were produced by irradiation of the sample with a beam of 250 MeV Au ions and serve as pinning centers for trapped magnetic flux. Flux pinning is a significant component of microwave nonlinearity in superconducting devices, which links pinning to the strength of produced IM. Second order IM in the control sample exhibits three distinct temperature dependent relaxation processes: an "ultrafast" exponential decay of unknown origin with a time constant on the order of 10-1 seconds, a fast exponential decay due to remanent demagnetization with a time constant on the order of 101 seconds, and a slow logarithmic relaxation due to Bean-Livingston surface barrier penetration with a duration on the order of 102 seconds. The irradiated sample does not exhibit the fast process. The influence of magnetic fluxons on second order IM is compared with the influence on third order IM, and the contributions of the columnar defects to each influence are examined.

Implementing the FIDO Model in a Pulsar Population Synthesis

Madeleine Rabitoy

Mentor:
Dr. Peter Gonthier,
Physics

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

Recent advances by our NASA Goddard colleagues in pulsar modeling utilize a new model known as Force-free Inside, Dissipative Outside (FIDO) to model the electrodynamics in the magnetospheres of pulsars, in which the magnetosphere within the light cylinder has infinite conductivity σ inside and finite conductivity σ outside. This more realistic model has the potential to describe the electric field distribution in pulsar magnetospheres more accurately than previous models, such as the pair-starved, polar cap and slot gap models, by assuming the dissipative regions of the magnetic field exist only outside the cylinder. The population synthesis code will seed the galaxy with neutron stars evolving them from their birth to the present time within the galactic potential and spinning them down to their present-day period and period derivative as a result of the magnetic field at birth. The Monte Carlo code will provide pulsars with particular set of characteristics such as period, magnetic field, viewing geometry - inclination angle α and viewing angle ζ with respect to the rotational axis, with the conductivity σ and γ-ray luminosity determined by the predicted trends of the FIDO model. In order to obtain the γ-flux, the phase averaged profile is obtained from the FIDO sky maps, requiring a standard method of a 5D interpolation computer routine. My research took the first step towards the implementation the FIDO model into our population synthesis code by using the sky maps of the gamma-ray intensity in the sky as seen from a viewing geometry from simulation of the high-energy emission of a particular neutron star. I implemented a standard 5D interpolation method to create arbitrary maps from arbitrary simulation data with values of α and ζ, the pulsar period, the period derivative, the assumed conductivity σ outside the pulsar light cylinder, and polar surface magnetic B.

PHYSICS

Ion beam Analysis for Silicon Carbide Crystals and Battery Materials

Forest Rulison

Mentors:
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Dr. Paul DeYoung, *Physics*

This research was made possible by the generous support of the Hope College Department of Physics and the Hope College Bibart Research Fund and is based upon work supported by the National Science Foundation under Grant Nos. 1608327, 0959282, and 0319523.

In this research, particle beam analysis was used to analyze two distinct materials: thin nickel films for the production of battery materials, and silicon carbide crystals containing vacancies for quantum storage application. Our research sought to improve already promising battery materials, Prussian Blue Analogues (PBAs). Depositing nickel on gold/silicon wafers using a Teflon cell has been a standard technique in our lab. However, this method tends to create PBAs that lack the required level of uniformity and reproducibility. We focused on a more robust technique with the aim of providing a superior method of creating PBAs. To create these improved PBAs, films of nickel were deposited on indium tin oxide (ITO)/quartz substrates. The goals of this investigation were to find what nickel quantity would best adhere to the substrate with least degradation over time, to analyze the surface characteristics at each quantity, and to determine which quantity was deposited most evenly. The films were analyzed with Particle Induced X-ray Emission (PIXE) to accurately establish the amount of nickel deposited on the ITO. Using a scanning electron microscope, the surfaces of the films were observed for their structural features. The second material our lab worked with, silicon carbide with induced vacancies, may have the ability to store quantum information within these vacancies. One method of creating vacancies is to irradiate the crystals with ion beams. In collaboration with Dr. Balili from Calvin College, we irradiated silicon carbide crystals using a variety of beam species, beam energies, and fluences while collecting spectral data. These samples were studied by Dr. Balili to understand and quantify their quantum storage abilities.

Determining the β Decay Strength Function of 91Rb

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Jason Gombas

Mentor:
Dr. Paul DeYoung, *Physics*

This material is based upon work supported by the National Science Foundation under Grant No. 1613188.

The r-process predicts the formation of elements heavier than iron and occurs in neutron star mergers and supernovae. The β decay strength function reveals nuclear structure properties necessary to improve r-process models. Measurements of the 91Rb strength function, a nucleus involved in the r process, were made at the National Superconducting Cyclotron Laboratory (NSCL) this past July (2018). The 91Rb were made with the A1900 fragment recoil separator, then stopped in a long gas cell, and finally implanted in a mylar tape. Spectra and multiplicity of γ rays from the daughter, 91Sr, coincident with β particles from the decay of implanted 91Rb give one the information needed to determine the β decay strength function. Electrons produced by the β decay were measured in a plastic detector constructed at Hope College and γ rays were detected in the Summing NaI (SuN) detector. Coincidences between electrons and γ rays were needed to identify the energy level in the 91Sr daughter nucleus to which the parent 91Rb decayed and to quantify the probability of that decay path. β particles from the decay of 91Rb are difficult to distinguish from background events due to the buildup of long-lived daughter particles that subsequently also β decay. A tape system extending into the beam pipe through SuN is needed to move radioactive daughter particles away from the detector. Thus, a conventional Si surface barrier β detector could not be employed because of minimal space inside the beam pipe. The needed β detector was fabricated to fit inside the small beam pipe and around the tape system. The 20 cm long, barrel-shaped detector was constructed out of scintillating plastic with wave-shifting fiber optic cables on the exterior leading to photomultiplier tubes outside the SuN detector. Preliminary results are shown.

The Effect of Potassium Hexacyanoferrate (III) Concentration on Prussian Blue Analogue Charge Storage

Kamaron Wilcox

Mentor:
Dr. Jennifer Hampton,
Physics

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The vast array of characteristics encompassed by Prussian Blue Analogues (PBAs) make PBAs intriguing to many researchers, especially because of their immense potential for commercial use as batteries. Their low cost, easy creation, and efficient charge storage make for great battery material; however, many of the properties of PBAs have yet to be explored before society potentially can implement them in commercial use. This research strives to understand how the concentration of the modification solution consisting of K3Fe(CN)6 and NaNO3 affects the quantity of PBA formed and the amount of charge it can hold. This research used controlled potential electrolysis with a nickel deposition solution in order to form a nickel precipitate of a predefined volume on top of a gold substrate. Dipping the nickel deposits in the modification solution for 60 seconds produced the surface bound PBAs. Cyclic voltammetry then allowed for the characterization of the PBA films using different scan rates in order to study how much charge the films could store. When viewing the current versus potential graphs generated by cyclic voltammetry, a tilt in the graph appears; a background line of a slope equal to that of an approximation of the early forward slope of the graph aptly reflects the apparent tilting. Subtracting this trend from the forward current and integrating with respect to potential allows for the calculation of the total charge stored by the PBA. When analyzing preliminary data, a logarithmic trend appears to emerge between the charge stored and the K3Fe(CN)6 concentration.

Local Whole-Device Scanning of Distortion in Superconducting Microwave Resonators

Anna Wormmeester

Mentor:
Dr. Stephen Remillard,
Physics

This material is based upon work supported by the National Science Foundation under Grant No. 1505617.

Nonlinearity within a superconducting microwave device was investigated. Through the modifications of the raster probe as well as narrowing down a data taking technique, device physics was able to be studied without global averaging. A finer probe was created with 0.020 coaxial cable, which enabled precise measurements to pinpoint the location of the nonlinearity phenomenon. With improved processes for data taking, synchronous measurements of even and odd order intermodulation distortion were accomplished. Mapping of these superconducting devices was also accomplished, which helped develop models for the distinct processes of even and odd order distortion. Altogether the new probe and data taking process, and the mapping of the superconducting devices allowed for local intermodulation to be distinguished from nonlocal intermodulation.

COMMUNICATION

Sheryl Sandberg: A Look at Women in the C-Suite

Leah Asen

Mentor:
Dr. Marissa Doshi,
Communication

This study set out to understand the ways that society discursively constructs female leaders in the workforce. Although women currently make up a little under half the workforce, very few women are at top-level positions in hierarchical businesses. This project used semiotic analysis, discourse analysis, and intersectional analysis to deconstruct texts centering Sheryl Sandberg. By deconstructing multiple texts, this study uncovers explicit and implicit messages that persist in the conversation about women in the workplace. This study found that while women are welcome in the workplace today there are still deep-rooted cultural oppressions at work that must be addressed and even affect the career and experiences of women in powerful leadership positions.

A Cultural Analysis of Twenty One Pilots

Annah Duffey

Mentor:
Dr. Marissa Doshi,
Communication

Twenty One Pilots, a popular band in the United States, has become a subject of intrigue in popular culture, since it challenges lyrical and musical themes through genre variation and themes of internal complexities requiring intricate listening among consumers. Through close analysis of photos, songs, music videos, and media interviews, this three-part paper and website project sought to uncover messages the band has promoted and perhaps, unintentionally advertised to its listeners. Semiotic analysis showed that the band positions itself as unusual by placing popular symbols within alternative symbol systems. Discourse analysis of the band's song "Neon Gravestones" showed that the band explores suicide and depression openly yet cautiously, in contrast with the misrepresentation or absence of discussion of these issues in other mainstream media. Identity deconstruction, using an intersectional approach, revealed that despite Twenty One Pilots' calls for inclusivity, they have incorrectly generalized their audience and glossed over their own positionality, and thus, contradicted their stated messages. The band would do well to acknowledge the social inequalities that exist based upon identities like class and race, and listeners would benefit from awareness about the silences within Twenty One Pilots' music.

The Complex Role of the Church in South Africa in the Justification of Apartheid, Racial Reconciliation, and the Anti-Apartheid Struggle

Jenny Lussenhop

Mentors:
Dr. Deirdre Johnston, *Communication*

Dr. Roger Nemeth, *Sociology*

This project was supported by grant funding from the Oral History in the Liberal Arts Grant, Hope College Mellon Grand Challenge Summer Research Grant, and New Directions in Scholarship Grant from Great Lakes College Association, made possible by a grant from the Andrew W. Mellon Foundation.

The purpose of this study is to better understand the contradictory role of the church in South Africa in both the infliction of apartheid trauma, and its use in healing from trauma. Prior research understood religion to be a common coping mechanism for people in the transformative process of healing from trauma (Tedeschi and Calhoun,1995). Black theology has been used as a way to think about Christianity within the context of the colonization and subjugation of black Christians, while also in the context of liberation (Boesak, 2005). This research pairs the two by questioning how the use of religion in the healing from trauma would change when the religion is somewhat responsible for the trauma. In South Africa, the Afrikaner Dutch Reformed Church, among others, was a platform for justifying apartheid. This study builds upon research calling upon the church in South Africa to assume greater leadership in healing racial divides (Pillay, 2017). In June 2018, 72 oral history interviews were conducted in Gauteng and the Western Cape regions of South Africa, to explore intergenerational differences in the reflection and experience of Apartheid. Participants were asked to tell their Apartheid and Post-Apartheid stories, and the narrative transcripts will be analyzed using NVIVO to explore demographic predictors of post-apartheid evaluations. Participants represented four generations and three racial groups. The four generations are the 'Born Frees', the 'Rainbows', the 'Soweto Uprisings', and the 'Sharpevilles,' and the three racial groups are Black, Afrikaner, and Colored (the name for mixed-race in South Africa). Participants were recruited through community organizations and local neighborhoods of which long-term relationships have been established and continue to develop. This research explored the separation that was endorsed and justified by the Dutch Reformed Church in South Africa, the willful ignorance from white South Africans, and the hope that Christianity could help to combat the hatred the Christian Church so often endorses.

Jennifer Lussenhop conducting an interview in South Africa. Photo courtesy Dr. Deirdre Johnston.

Transgenerational Trauma

Itzayana Zuniga

Mentors:
Dr. Deirdre Johnston,
Communication

This project was supported by grant funding from the Oral History in the Liberal Arts Grant, Hope College Mellon Grand Challenge Summer Research Grant, and New Directions in Scholarship Grant from Great Lakes College Association, made possible by a grant from the Andrew W. Mellon Foundation.

Transgenerational trauma is the transmission of suffering through multiple generations, where younger generations experience trauma as if it were their own. In 1998, Rachel Yehuda, a leading researcher studying the effects of generational trauma in the children of Holocaust survivors, found a multigenerational pattern of shared suffering and trauma. From her research, she gathered that "children and grandchildren of Holocaust survivors frequently noticed and tracked symptoms of generalized anxiety and depression" (Levine 163). In this study, it will be determined whether or not the born-free generation of post-Apartheid South Africa suffer from transgenerational trauma passed on through their grandparents and parents who lived in the Apartheid era. Based on oral history interviews conducted in South Africa during the summer of 2018, this study will focus on the analysis of 8 in-depth interviews of South African youth ages 18-25 who have socially marginalized racial/ethnic identities. Using NVIVO qualitative analysis software, the interviews will be coded for themes such as well-being, emotional flourishing, etc. The interviews will also be coded for emotional and psychological trauma symptoms such as stress, anxiety, and depression.If the study finds that transgenerational trauma is experienced and self-identified by the born-free generation of South Africa, additional research questions will include an exploration of demographic and social support predictors of transgenerational trauma.

The Effects of Educational Attainment on U.S. Welfare Duration

Andy Atkinson

Mentor:
Dr. Steven McMullen,
Economics & Business

This research will explain the effect of educational attainment on the duration of welfare while controlling for numerous demographic characteristics and market effects associated with the length of welfare spells. Specifically, this study explores those who received payments from the TANF (Temporary Assistance for Needy Families) program from 2008-2018. The empirical method is a multivariate regression technique used on a panel dataset from the Current Population Survey (CPS) that will estimate the impact of schooling on welfare duration and the demographic characteristics and economic conditions related to different durations. Results from this study will provide insight into whether new schooling or other incentivizing policies could decrease reliance on the TANF program while also optimizing funding in order for it to readily available to struggling families.

Returns to Education: An Investigation into the Role of Gender in Post-Graduation Salary

Heather Bonga

Mentor:
Dr. Steven McMullen,
Economics & Business

Today women are attending higher education at levels greater than before, raising the question: How does the payoff to education for women compare to the payoff for men? The data set used to investigate this question comes from the American Community Survey, and includes: completion rates at different levels of education, specifics on majors, gender, years out of school, and post-graduation pay. This study will estimate the differences in payoff to education using a multivariate regression approach.

The Effect of a Changing Marriage Age on Marriage Continuity

Sarah Gargan

Mentors:
Dr. Steven McMullen,
Economics & Business

Marriage stability has a wide range of determinants, such as education, marital history, and demographic characteristics. Age at marriage, however, has repeatedly been cited as one of the most important influences. Since the 1950s, divorce rates and the mean age at marriage for both men and women have seen a great deal of change. Past studies suggest that an early age at marriage is associated with a higher risk of divorce. Studies also propose that this relationship only holds up to a certain point. Changes to marriage age and divorce rates can have unforeseen interactions with cohabitation, fertility, educational attainment, and labor force participation. This research examines the significance of the relationship between the changing age at marriage and the changing rates of divorce. The data come from the American Community Survey from 2008 to 2017. A multivariate regression approach is implemented to estimate the probability of divorce within the past year for a given age at marriage.

ECONOMICS & BUSINESS

The Impact of Immigration on Wages in the United States

Quincey Glupker

Mentor:
Dr. Steven McMullen,
Economics & Business

This study analyzes the effect of immigration on the wages of native workers and resident immigrants. Immigration is currently a highly contested and politicized debate in the U.S. This research examines the flows immigration throughout time as well as to certain regions in the United States to determine if the wages of low-skilled workers drop when there is an increase in low-skill immigration. Data on the education, skill level, employment, demographics, and the geographic region comes from the American Community Survey gathered by the Census Bureau. A multivariate regression approach will be used to estimate the effect of immigration on wages.

Exploring the Impact of Long Work Hours on Physical Health Outcomes

Kellen Gove

Mentor:
Dr. Steven McMullen,
Economics & Business

Working hours are on the rise in the United States, leaving policy makers and workers alike wondering about the effect working more has on their health. Moreover, as obesity levels in the country rise, the media continues to point to increasing working hours (and the associated sedentary lifestyle) as a main culprit. This research investigates the impact of working hours on the physical health of individuals. Panel data is taken from the National Health Interview Survey and is analyzed with a multivariate regression model to estimate the impact of working hours on BMI and self-reported health scores. Individual unobserved differences and reverse causality are accounted for with individual fixed effects and an instrumental variable approach.

The Effect of Maryland's Minimum Wage Hike on Employment: A Synthetic Control Analysis

Thomas Kouwe

Mentor:
Dr. Steven McMullen,
Economics & Business

Using data from the Current Population Survey, this paper estimates the effect of a hike in the Maryland minimum wage on employment in the state. After being equal to the federal minimum wage for six years, the Maryland minimum was raised by a dollar to $8.25 per hour in 2015. By using synthetic control analysis, this paper identifies an appropriate comparison sample from other states in order to estimate the causal effect. This research attempts to determine what effect, if any, this had on both Maryland's low skilled workers as well as the workforce as a whole.

Delineating Higher Education Faculty Stress: Examining the Role of Resources on Stressor-Strain Relationships from Teaching, Research, and Service

Reece Lindemann
Caleb Hoekstra

Mentor:
Dr. Marcus Fila,
Economics & Business

Work stress in college and university professors has been rising over recent decades; despite academia being conceived as a low stress occupation, sought after by those who espouse the life of the mind. Rising stress is largely due to increasing teaching commitments, greater publication and grant sourcing pressure, and broadening service duties (Kinman, 2001). Faculty work life is also wrought with role conflict (and therefore, stress) between teaching, research, and service (Hendel & Horn, 2008). In accordance with the stressor-strain model (Jex, 2002), we examine stress relationships between teaching, research, and service, and psychological strains of anxiety, emotional exhaustion, and depressive symptoms. Following this, we apply theory from the job demands-control (-support) (JDC(S)) model (Karasek and Theorell, 1990) to examine how resources of control over work, and support from chairs and supervisors might mitigate these relationships. In a sample of 281 full-time US and UK-based faculty, we found that teaching, research, and service stress are positively related to anxiety, emotional exhaustion, and depressive symptoms. Several two-way interactions were found, revealing two distinct patterns of moderation between the three activity groups, and the three psychological strains. First, for those reporting low levels of the resource (e.g., control, chair/supervisor support, or coworker support), strain remained constant regardless of level of stress; but for those reporting high resource levels, strain was lower with low stress, but equaled that of those with low resources when stress levels were higher research stress. In the second pattern, participants generally reported the same level of strain when stress was low regardless of their resource level, but those reporting low resource levels experience higher levels of strain when stress was high. In all, research stress and emotional exhaustion had the most interactive effects. Several triple-order interactions were also found.

The Impact of Unemployment on Wage Rates

Olivia McCalla

Mentor:
Dr. Steven McMullen,
Economics & Business

This research investigates the effect that unemployment has on wage rates by state. Low unemployment rates are a sign of good economic health and a tight labor market. A change in unemployment can, through supply and demand of labor, signal growing bargaining power for workers and decreasing power for employees. State-level data on employment status, wage rates, minimum wage rates, inflation and prices, and the state of the economy from (data sources) will be used to evaluate the research question. This research will use a multivariate regression approach to estimate the effect of unemployment on wages. To control for unobserved differences between states state fixed effects will be used in the regression.

ECONOMICS & BUSINESS

The Effect of Air Quality on US Labor Market Participation

Grant Taylor Miller

Mentor:
Dr. Steven McMullen,
Economics & Business

The adverse effects of deteriorating air quality on both human health and labor markets have become well-documented in epidemiological and economic literature. Health-conscious policymakers are presented with the challenge of implementing environmental regulations without causing substantial economic disturbance to industry employment, productivity, and wages. However, the social benefits of better health outcomes may correspond with economic benefits that outweigh the costs. Using data from the Current Population Survey and the Environmental Protection Agency's Air Quality Index, this paper uses a multivariate fixed effects regression approach to estimate the relationship between air quality and various measures of labor market participation across 101 metropolitan areas in the United States between 1994–2017. Understanding the reflection of health outcomes in labor market participation may assist the quantification of economic benefits and contribute to a cost-benefit analysis of regulation policy. Empirical analysis suggests that variation in air quality has a negligible impact on US labor markets.

The Effects of Health Insurance on Alcohol Consumption: Analyzing the Existence of Moral Hazard

Sarah Mozdren

Mentor:
Dr. Steven McMullen,
Economics & Business

A major consequence of risk-sharing in the insurance industry is the possibility of moral hazard, where health insurance coverage may incentivize risky behaviors. This study attempts to explain whether one type of moral hazard exists by estimating the effect of health insurance coverage on alcohol consumption. Previous studies estimating the relationship between individuals' different health insurance coverages and their alcohol consumption have shown mixed results. I use data on insurance coverage and demographics from the American Community Survey (ACS). Data that measures alcohol sales by state and year from 1970 through 2016 is drawn from the National Alcohol Beverage Control Association which collected data from the Alcohol Epidemiological Data System (AEDS). To analyze how individuals' health insurance decisions impacts alcohol consumption, I use multivariate regressions to estimate alcohol sales while controlling for demographics, other drug usage, crime rates, and time periods of government policies.

Investigating the Role of Gender in Job Satisfaction

Leah Overbeek

Mentor:
Dr. Steven McMullen,
Economics & Business

Despite earning a lower average salary than men, women report higher levels of job satisfaction. Moreover, job satisfaction has become a subject of growing interest among employers, justified by the fact that job satisfaction is correlated with productivity, decreased absenteeism, and lower employee turnover. Utilizing data from the 2013 National Survey of College Graduates, this paper analyzes the determinants of job satisfaction for male and female college graduates to explore the gender-job satisfaction paradox. This paper uses a multivariate regression model to estimate the gender differential based on a variety of measures of job satisfaction.

The Effects of Minimum Wage Laws on SNAP Enrollment in the United States

Christian Rhoades

Mentor:
Dr. Steven McMullen,
Economics & Business

This research will estimate the impact of minimum wage increases on SNAP enrollment and benefits per household. Using CPS and Department of Labor data on state level SNAP participation, I employ a multivariate regression difference-in-difference approach to estimate the impact of minimum wage laws on the number of family and individual SNAP beneficiaries, as well as average benefit per recipient. State and year fixed effects will be included as controls. This study will help evaluate the effectiveness of government assistance on alleviating poverty, as well as explore the potential interactions between wage regulation and welfare programs.

The Impact of Immigration on Wages: An Empirical Analysis Controlling for Skill-Level

Nicholas Schanhals

Mentor:
Dr. Steven McMullen,
Economics & Business

Using panel data from the American Community Survey, this paper highlights the broad effects of immigration on wages. The labor supply and demand model suggests that an increase in the labor supply (in this case immigration) will cause a negative shock to the average wage. This motivates a popular argument against immigration in political debates. Particularly in the past ten years, the empirical literature, however, suggests a small shock or perhaps no shock at all to wages. This research uses a multivariate regression approach, using data on education to account for varying skill levels among the workforce to estimate the effect of new immigrants upon the wages of earlier cohorts of immigrants and native-workers. Taking data from cities of close proximity and setting demographic parameters of age and sex account for a spillover problem in the regression.

Diversification of Wealth and Wealth Management across Socioeconomic Status

Mason Schut

Mentors:
Dr. Steven McMullen,
Economics

Income diversification is a practice that is popular in order to both mitigate risk and increase income. This practice is usually limited to those who have considerable capital. Income risk, however, is a problem for those across the income distribution. This raises the question focused on in this paper: How does income diversification vary based on socioeconomic status? With data from the Current Population Survey, this paper estimates the effect that socioeconomic status has on the wealth management and income diversification of an individual.

ECONOMICS & BUSINESS

Neighborhood Effects on the Educational Attainment of First-Generation Immigrants

Gordon VanWieren III

Mentor:
Dr. Steven McMullen,
Economics & Business

The educational attainment a first-generation immigrant receives and the community that they live in may affect their economic prospects. This analysis investigates "neighborhood effects," specifically, the role that the ethnic density within an American county has on the schooling of first-generation immigrants. Using a condensed theoretical model in conjunction with demographic data from the American Community Survey (ACS), this research uses multivariate regression techniques to estimate the effect of neighborhood effects on first-generation immigrant educational attainment.

The Impact of Income Differentials on the Decision to Immigrate

Yizhe Zhang

Mentor:
Dr. Steven McMullen,
Economics & Business

Every year, more than a million immigrants from all over the world become lawful permanent residents of US. Those immigrants account for one-third of a percentage point of the US population each year. These immigrants have major effect on the US labor market. This paper estimates the effect of per capita income differences between the U.S. and the countries of origin on immigration decisions. The data employed by this study comes from the American Community Survey, which includes birthplace, year of immigration, education, as well as labor force data. The study employs a multi-variable regression analysis to estimate the effect of per capita income on immigration decisions.

CASA Enrichment Program 2018

Elisabeth Cole

Mentors:
Dr. Jane Finn,
Education

Dr. Vicki-Lynn Holmes,
Mathematics and Education

Children's After School Achievement (CASA) is located on the Hope College campus, and it serves at-risk students in the community during an after-school enrichment program. Collaborating with special education teacher candidates, the CASA elementary children were assessed using the Brigance Comprehensive Inventory of Basic Skills subtests in WR (word recognition), OR (oral reading), and RC (reading comprehension) for the Fall of 2018. These same assessments were given to the identical CASA students by the same teacher candidates in the Spring of 2018. The purpose of this study was to examining the results from t-tests and an ANOVA (significant .05) to gauge whether the CASA reading interventions improved CASA students' reading skills.

Communication Participation: Let's Have a Party!

Reganne Diener
Jessica McAlpine
Nicole Radgens

Mentors:
Dr. Jane Finn,
Education

Dr. Vicki-Lynn Holmes,
Mathematics and Education

Post-secondary school outcomes have been dismal for individuals with exceptionalities. Because of these poor outcomes, the federal law entitled the Individuals with Disabilities Education Act put into place services to help these individuals develop vocational skills, independent living proficiency, and increased community participation. The purpose of this study was to identify if the Council for Exceptional Children's (CEC) Halloween Party helped individuals with disabilities increase their level of social engagement and community participation. We also identified if engagement in activities by Hope College students increased the desirability of the activity. Both the residents from the group homes and the Hope College students in attendance were given a survey asking about which events they were engaged in during the party and which events they enjoyed the most. When the surveys were completed, the data was analyzed to discover the individuals with disabilities' and Hope College students' levels of engagement, and the activities that were listed as most enjoyed by the individuals with disabilities. The results indicated that the majority of individuals with disabilities experienced high levels of engagement and community participation throughout the party and the most enjoyed activities correlated to the activities where Hope College students were the most engaged. It appears that the Hope College CEC Halloween Party helps individuals with disabilities increase their community engagement and participation skills

How Pre-Service and In-Service Teachers' Philosophies Affect Their Perceived Value of STREAM School

Abby Couwenhoven
Montserrat Dorantes
Shelby Bowers

Mentor:
Dr. Stephen Scogin,
Biology and Education

This work supported by the John R. Soeter Faculty Development Fund and the Howard R. and Margaret E. Sluyter Faculty Development Fund, part of the Nyenhuis family of funds; and by the Dow Scholars Program.

Project-based learning (PBL) is a student-centered educational experience that focuses on active learning through investigations of challenging and complex questions. PBL is showcased in a rural middle school where seventh- and eighth-grade students integrate the natural world into their learning experiences. The program, called STREAM School (science, technology, reading, engineering, arts, mathematics), began in 2014. In this study, in-service teachers from STREAM were interviewed about their experiences in the program. Furthermore, 13 pre-service teachers (PSTs) from Hope College were interviewed about their time in the STREAM setting during clinical experiences from 2015-2018. All interviews were transcribed verbatim and analyzed using grounded theory methodology. Central categories were identified, and factors that both detracted from and contributed to positive experiences from both groups were crafted into a conceptual framework. Several thematic threads were uncovered, such as PSTs questioning the value of the program, perceiving less cognitive learning, and believing students were given too much freedom within the classroom structure. In an effort to explain these findings, researchers investigated the differences in educational philosophies between STREAM teachers and PSTs as found in *Curriculum Theory: Conflicting Visions and Enduring Concerns* by Michael Stephen Schiro. According to this framework, PSTs tended to have a more *Scholar Academic* philosophy which led to them questioning the value of the program and wanting more cognitive learning and structure. To the contrary, STREAM teachers typically had a more *Learner-Centered* philosophy and were more focused on developing the whole child by focusing on both cognitive and non-cognitive skills. These differences in educational philosophies led to critical disconnects between the two groups of teachers in regard to the overall value of the program. By understanding the sources of this disconnect, researchers can offer suggestions for teacher preparation programs to help bridge the gap between differing philosophies and teaching styles to create a more cohesive pedagogy that will further benefit students.

The Value of Outdoor-Based Programs on Students' Growth: Does PBL-Based Learning Actively Enhance Students' Soft Skills?

Reese Yount

Mentor:
Dr. Stephen Scogin
Biology and Education

STREAM (science, technology, reading, engineering, art, and math) School is a program within a West Michigan public middle school in which students engage in a PBL-based curriculum in a variety of outdoor settings. The program is designed to focus more on developing students' critical thinking skills and enhance a variety of soft skills. Soft skill development goals include greater communication, more self-efficacy, and better problem-solving capabilities. In this study, the parents of the STREAM students in 6th (n = 15), 7th (n = 9), and 8th grades (n = 7) responded to online qualitative surveys. These questions invited parents to express their views about the program including if and how the program affected their child's attitude and growth. These interviews were transcribed verbatim and served as the primary data used in the study. Interviews were loaded into the qualitative software NVivo, and researchers used grounded theory to code the parents' responses into common themes and categories. Some of the popular categories included *Program Attractors, Student Growth,* and *Response.* Once coded, the data were collapsed down using Strauss and Corbin's (1990) paradigm model with the central phenomenon being a positive change in the students' attitudes toward school. Most parents were convinced that their child's attitude toward school improved. According to parents, the reasons their child's attitude changed was in part due to the flexible learning space, creative teaching methods, and authenticity of the content. As a result of this improved attitude, the students exhibited growth in a wide range of soft skills from better problem-solving skills to greater global awareness. Researchers believe that the results of this study can be used to help teachers tailor existing educational programs to engage their students at a higher level and promote deeper learning.

Photo courtesy Hope College Public Affairs and Marketing.

KINESIOLOGY

The Effect of the VKTRY Insoles on Vertical Jump and Broad Jump

Eliza Beird
Hilary Curry
Jason Beckman
Jack Sojka

Mentor:
Dr. Maureen Dunn,
Kinesiology

Funding for this project was provided by the Department of Kinesiology.

VKTRY insoles are a carbon-fiber shoe insert designed to improve athletic performance and prevent injury by using the transformation of potential energy to elastic energy. Previous research has suggested that the VKTRY carbon fiber insoles have increased jump performance and decreased sprint time by reducing the energy absorbed throughout the metatarsophalangeal joints. However, there is only one study that has researched this particular set of carbon fiber inserts in athletic tasks. The purpose of this study is to investigate the claims made by VKTRY by comparing the effect that the inserts have on jump height through vertical jump and jump distance through broad jump to a control and placebo (spring steel) set of insoles. Twenty to 35 former and current college-aged athletes will be assessed for vertical jump and broad jump. Two vertical jump tests (static and one-step) will be completed using a Vertec Vertical Jump Tester, while the broad jump tests will be assessed using measuring tape. Each participant will be brought in on three different counterbalanced occasions to perform one of the 3 tests on each visit. All of the testing will be completed in the Devos Fieldhouse weight room or gym at Hope College. Participants will be asked to refrain from practicing high intensity or maximal lower body workouts two days before each testing period. It is hypothesized that the VKTRY carbon fiber insoles will improve vertical jump height along with broad jump distance compared to the control and placebo conditions. Significant results may validate or disprove the findings and statements made by VKTRY as well as allow athletes to utilize these inserts to advance their athletic ability. This study is ongoing, and the results will be available during the poster celebration.

Complications of Arthrofibrosis in an ACL Repair and Rehabilitation

Zebulon Broersma

Mentors:
Dr. Kirk Brumels,
Kinesiology

Katharine Rose,
Kinesiology

The purpose of this study is to review the injury pathology, surgeries, and complications with scar-tissue during rehabilitation after an ACL tear in a 18-22-year-old patient. Discussion of injury mechanisms, healing process and development of arthrofibrosis will be undertaken to help the reader better understand this possible negative outcome following injury/surgery. An in-depth analysis of the interventions, both invasive and non-invasive that facilitate return function, as well as rehabilitation processes and obstacles that can contribute to worsening or recovery from this condition will also be explored. Finally, a summary of key learning points from the entire case will be made to promote improved understanding and subsequent recovery in future cases.

The Impact of Fluid Ingestion on Intermittent Cycling in Male Lacrosse Athletes in a Hot Environment

Grace Ditzenberger
Thomas Sprys-Tellner
Betsy Craig
Brooke Hedglen
Nick Brohl

Mentor:
Dr. Maureen Dunn
Kinesiology

Prolonged exercise in the heat leads to a decrease in athletic performance due to an increase in core body temperature. Two types of fluid ingestion, cold water and ice slurry, have demonstrated an ability to combat the impact of heat stress during endurance activities, yet fluid ingestion has not been examined during intermittent activities like team sport. This study investigated whether 6.0 g/kg (pre) and 2.0 g/kg (per) of cold water or ice slurry ingestion would improve cycling power and distance traveled during repeated bouts of sprint cycling in the heat. Participants (n=8) cycled for 10 minutes at an RPE of 10, followed by 4 five-minute bouts interspersed with 3 minutes of passive rest. Bouts consisted of a 10s maximum effort sprint at the top of each minute followed by cycling at an RPE of 15 for the remaining 50s. It was hypothesized that ice slurry ingestion would result in lower core temperature and greater power output and distance traveled compared to ice water. Fluid was ingested 25 min prior to exercise (6.0 g/kg), and during each 3 min rest period (2.0 g/kg). Following 2 bouts of cycling at 89.94±4.0°F with 14.13±5.6% humidity, the difference of mean core temperature between the ice water trial (100.032°F±0.27°F) and ice slurry trial (100.301°F±0.26°F) did not reach significance (p=0.590). Furthermore, no significant difference was found between distance traveled (14.013± 4.8 vs. 13.013±0.1km, p=0.421) and peak power (266.105±17.1 vs. 278.752±16.7 W, p=0.739) in ice water or ice slurry, respectively. Results suggest that there is no difference in peak power, distance traveled, or core body temperature when comparing the effects of ice water and ice slurry ingestion during repeated bouts of moderate to high intensity cycling in collegiate Lacrosse players. Further research is necessary to examine ways to improve team sport performance in the heat.

The Effect of Peppermint Essential Oil on VO2 max and Ventilatory Threshold in Active College Students

Lauren DeYoung
Allison Mann
Houston Bedford
Jared Stygstra

Mentor:
Dr. Brian Rider
Kinesiology

Essential oils are plant-derived oils that contain chemical compounds that may have beneficial health effects. Previous research has found that the oral consumption of peppermint essential oil has resulted in improvements some fitness metrics such as lung function and oxygen consumption (VO2). However, no studies have examined how inhalation of peppermint oil impacts these same variables and thus it is unclear if similar effects are consistent across ingestion pathways (oral vs. nasal). Therefore, the purpose of this study was to determine the effect of the inhalation of peppermint oil on VO2 max and ventilatory threshold during an exhaustive exercise test in physically active college students. Hope College students were recruited to participate in this study, which consisted of three hour-long trials, each separated by seven to ten days. The first visit consisted of a familiarization VO2 max treadmill test, where participants were instructed to run until exertional fatigue. The second and third visit consisted of the same VO2 max treadmill test, however, prior to the test, participants applied either peppermint or a control (orange citrus) essential oil underneath their nose and calmly inhaled for five minutes from a seated position. Significant results would suggest that peppermint essential oil could be utilized as a safe and legal aid in improving VO2max and ventilatory threshold, thereby aiding exercise performance. This study is ongoing, and future results will be presented during the poster celebration.

KINESIOLOGY

Examining the Impact of Facial Expressions on Running Economy

Thomas Sprys-Tellner
Brooke Hedglen
Grace Ditzenberger

Mentor:
Dr. Brian Rider,
Kinesiology

The research was supported by the Donald W. Cordes Faculty Development Fund and the Yntema Family Faculty Development Fund, part of the Nyenhuis family of funds.

Running economy (RE) is an important performance metric for runners. It is determined by comparing the oxygen cost of steady state exercise at given running speeds across individuals. A recent study examined the impact that facial expressions had on RE compared to more traditional cognitive relaxation techniques. Smiling while running resulted in a 2.8% improvement in RE among a group of recreational adult runners. The purpose of this study was to determine whether facial expression would impact RE in a group of aerobically trained collegiate athletes. Twenty-four Division III collegiate athletes (females n=14) completed four 6-minute running blocks at 70% of VO_2max. The order of bouts was determined using a balanced Latin square design with each participant serving as his/her own control. Participants completed running blocks while smiling (Smile), frowning (Frown), relaxing their hands and upper bodies (Relax), and running as they "normally" would (Control). Cardiorespiratory responses were recorded continuously and participants reported perceived effort (RPE), affective valence (FS), and arousal (FAS) after each condition. Blood lactate was measured at the end of each block. Repeated measures analysis of variance was run on all primary variables with a significance level set a priori at 0.05. There were no significant differences in RE between conditions (Smile 33.72±4.4, Frown 34.15±4.08, Relax 34.17±4.12, Control 34.16±3.91 ml/kg/min, $p > 0.05$). Additionally, unlike previous research, there were no significant differences in RPE during smiling and frowning conditions (11.71±2.56 vs. 11.82±1.97, $p = 0.71$). Among a group of aerobically trained collegiate athletes running at 70% VO_2max, smiling does not improve RE. However, future research should be conducted in order to discern what meaningful effect facial expression could have on psycho-physiological markers across a more diverse population.

Diagnosis, Treatment, and Rehabilitation of Meniscal Tears

Jenna Essenburg

Mentors:
Dr. Kirk Brumels,
Kinesiology

Katharine Rose,
Kinesiology

The purpose of this case study is to review the injury, surgery, and rehabilitation of a lateral meniscus injury of a Hope College Football player. The case will review the prevalence of the injury, the types of the injury as well as the surgical or non-surgical corrections, the anatomy of the affected area, the surgical procedure to correct the injury, and an overview of the rehabilitation of the injury. The injury occured with a typical mechanism and the athlete had no prior knee injury history. The athlete sustained a lateral meniscus tear during a football play, a diagnosis confirmed through an MRI afterwards. The athlete underwent a surgical repair of the meniscus rather than a meniscectomy. The rehabilitation the athlete followed was based on one the protocol given to him by his surgeon. The overall rehabilitation goals consisted of regaining ROM, global strengthening, and functional activities to return to play. Once rehabilitation is complete, the athlete should be able to return to play without major complications.

The Effect of Caffeine on Delayed Onset Muscle Soreness and Vertical Jump in Collegiate Female Volleyball Players

Beth Fransted
Vanessa Reynhout
Adam Hudson

Mentor:
Dr. Brian Rider
Kinesiology

Caffeine is an ergogenic aid, used by athletes to enhance endurance and strength performance when consumed before and after exercise. Currently, there has been a relative lack of research on the potential benefits of caffeine during recovery from exercise. Recent studies have found that supplementing with large doses of caffeine after exercise may help attenuate delayed onset muscle soreness (DOMS) by decreasing perceived muscle soreness and increasing muscle function in the days after an exhaustive exercise bout. However, large doses of caffeine have been associated with symptoms such as irritableness, irregular heart beat, and headaches. Therefore, the purpose of this study was to examine the effects of a smaller dose of caffeine on recovery and performance following an exhaustive exercise bout. Ten athletes from the Hope College women's volleyball team were recruited to undergo an exhaustive air-squat protocol to elicit DOMS. The participants returned 24 and 48-hours later and consumed either caffeinated or decaffeinated coffee before assessing their perceived muscle soreness and vertical jump performance. The protocol was then repeated the following week, but conditions were reversed. It was hypothesized that the caffeinated coffee would decrease perceived muscle soreness and increase vertical jump performance as compared to decaffeinated coffee. Hope College Women's Volleyball players were selected for this study because they are often subjected to multiple days of practice and workouts with limited rest in between. This study was designed to imitate the specific motion skills of a volleyball athlete. Vertical jump is an important measure of explosive strength that is necessary during an intense game, but DOMS may cause a decrease in muscle function. Significant results would allow for coffee to be recommended as an effective agent in recovery in this population. This study is ongoing, and results will be available during the poster celebration.

Examining Changes in Sleep Habits, Physiological Variables, and Physical Activity Behaviors in Division III Female Soccer Players during a Competitive Season

Austin Hemenway
Sophie Kleinheksel

Mentors:
Dr. Brian Rider
Kinesiology

Dr. Leigh Sears
Kinesiology

Coaches monitor the volume and intensity of their athletes' activity during practices and games. Tracking players' daily physical activity (PA) and sleep is more challenging and yet these metrics are critically important as they can have a direct impact on the athletes' performance and recovery. Advances in wearable technology have made the monitoring of athletes outside of structured team activities possible. Therefore, the purpose of this study was to examine the daily PA and sleep habits of a Division III women's soccer team over the course of a season. Thirty members of the Hope College women's soccer team participated in this study. Each participant was outfitted with a wrist-worn Polar A370 activity monitor at three separate weeks during the season. This device records steps per day and also minutes of sleep. Participants were instructed to continually wear the devices throughout the week. The weeks occured at the beginning (wk1), middle (wk2), and end (wk3) of the regular season. Complete data sets were available on 15 athletes. During the course of the season daily PA decreased from wk1 (17055 ± 4326 steps) to wk2 (15933 ± 419 steps) to wk3 (15231 ± 622 steps) with a significant difference in steps occurring between wk1 and wk3 ($p=0.019$). Sleep duration also changed over time, wk1 (456 ± 11 min) to wk2 (427 ± 12 min) to wk 3 (444 ± 9 min) however these changes in sleep duration across weeks were not significant ($p>0.05$). These findings provide insight into how the daily PA levels and sleep habits of collegiate soccer athletes fluctuate during the course of a season. Future studies should examine utilizing this data in real-time, during the season, to assist in managing the athletes' workload.

KINESIOLOGY

Conservative Treatment of an L5/S1 Herniated Disc in an Electrical Lineman: A Case Study

Paige Kaufman

Mentors:
Dr. Kirk Brumels,
Kinesiology

Katharine Rose,
Kinesiology

The purpose of this case study is to review the injury, orthopaedic consultation, and conservative decisions and treatment of an L5 herniated disc in a healthy 25 year old male. This case reviews the injury and anatomy of the affected area, and the procedures used to treat the injury. Specifics of the rehabilitation process will also be covered. Progress and outcomes will be stated and compared to the national norm, as will as a comparison of conservative and invasive procedures in terms of outcomes, side effects, and potential costs.

Little Time, Big Impact: A Concussion Case

Chandler Kirinovic

Mentors:
Dr. Kirk Brumels,
Kinesiology

Katharine Rose,
Kinesiology

Tim Koberna,
Kinesiology

Annie Carrigan,
Kinesiology

The purpose of this project is to review a concussion case of a Hope College basketball athlete, introduce a clinical trial of preventative concussion equipment, and emphasize the importance of following concussion protocol from an athletic training perspective. This case is unique in that the athlete experienced three concussive episodes over the course of three months. The history of the athlete will be reviewed, as well as a comparison of mechanisms, symptoms, and duration for each concussive episode. The differences of the third concussive episode and referral process will be discussed in detail. A study involving the clinical trial assessing the use of the Q-Collar to externally compress the jugular vein upon impact will be presented. In addition, the legal obligations of an athletic trainer who supervises concussions will also be provided and assessed.

Validation of the PolarV800 Watch VO2 Max Prediction

Kristen Marsman
Elyse Smalley
Mackenzie Greendyke
Elisabeth Craig
Grace Ditzenberger

Mentors:
Dr. Kevin Cole, *Kinesiology*

Dr. Maureen Dunn, *Kinesiology*

Dr. Brian Rider, *Kinesiology*

Funding for this project was provided by the Hope College Department of Kinesiology.

VO2 max testing is physically demanding, costly and time consuming. Technology is rapidly advancing and granting individuals easier access to their health information including heart rate, daily activity level, sleep patterns and most recently: VO2 max predictions. The Polar V800 watch claims to accurately predict an individual's VO2 max based on demographics, heart rate and training level. The purpose of this study was to validate the Polar V800 watch on its fitness assessment of predicting VO2 max when compared to a VO2 max test and a Queen's College Submaximal Step Test. Over a three-week period, participants completed three sessions one week apart consisting of a familiarization session, a Queens College Step Test, and a VO2 max treadmill test (n=19). It was hypothesized that the Polar V800 watch would not produce valid estimates when compared to the submaximal and maximal exercise tests. The Polar V800 watch accurately predicted VO2 max in relation to the value produced by the submaximal test (submaximal: 46.57 + 12.68 ml/kg/min, mean predicted: 51.25 + 10.78 ml/kg/min, r=0.714). In addition, the Polar V800 watch was able to accurately predict the VO2 max value when compared to the VO2 max test (maximal: 46.62 + 7.09 ml/kg/min, mean predicted: 51.25 + 10.78 ml/kg/min, r=0.829). Prior to this study, there was no concrete evidence demonstrating that the Polar V800 watch is able to produce valid predictions of an individual's VO2 max. These study results indicate the accuracy of the predictive VO2 max measurement using the Polar V800 watch is acceptable.

Validity of the Wahoo Tickr Fit Heart Rate Monitor

Kaylee Arendt
Evan Augustine
Angela Mascari
Savannah Tallman

Mentors:
Dr. Kevin Cole, *Kinesiology*

Dr. Maureen Dunn, *Kinesiology*

There are many different styles of heart rate monitors used for exercise or health. Previous research has tested and validated many of these devices. However, very little research has been performed on the accuracy of the optical Wahoo Tickr Fit heart rate monitor, that is worn on the forearm. Therefore, the purpose of this study was to validate the Wahoo Tickr Fit heart rate monitor by comparing its functionality during exercise simultaneously to an ECG monitor. Testing involved placing two monitors on the anterior and posterior positions of each of the participant's forearms during a Bruce treadmill test. Additionally, the participant squeezed a ball during exercise in a predetermined randomized hand, to assess if this additional forearm muscle involvement would affect the heart rate reading. The heart rates of each band were recorded and compared to the ECG recording of the participant. It was hypothesized that the Wahoo Tickr Fit Heart Rate Monitor would show significantly similar results compared to the ECG monitor. Significant results would allow the Wahoo Tickr Fit heart rate monitor to be a validated device for everyday exercise/health related heart rate monitoring. This study is ongoing, and results will be available during the poster celebration.

KINESIOLOGY

The Effect of a Maltodextrin Mouth Rinse Solution on 5k Treadmill Time Trials in Endurance Trained Collegiate Athletes

Sarah Neumar
Lillianne Vogt
Allie Thiel
Christopher Kelly
Brandan Campbell

Mentor:
Dr. Maureen Dunn,
Kinesiology

Carbohydrate (CHO) mouth rinsing has been shown to provide ergogenic effects during endurance exercise. The aim of the present study was to determine the effect that mouth rinsing 25 ml of a 6.4% maltodextrin CHO solution for 10 seconds, before and after the warm up and at mile 1 and 2 of the trial, has on completion time of a 5K treadmill time trial and RPE scores in collegiate athletes, compared to a placebo (PLA) solution. It was hypothesized that mouth rinsing a 6.4% CHO solution for 10 seconds would decrease time to completion. Eight endurance-trained collegiate athletes participated in two 5K time trials by running on a treadmill and swishing with a CHO solution on one occasion and a PLA solution on the other. Results indicated that the CHO solution did not significantly decrease time to completion of a 5K (CHO: 19.63 ± 1.29 min, PLA: 19.74 ± 1.18 min, $p = 0.362$). Additionally, the results indicated no significant differences between the CHO solution and PLA solution in reported mean rate of perceived exertion (CHO: 15.71 ± .662, PLA: 15.96 ± .634, $p = 0.649$), mean heart rate (CHO: 186 ± 3.13 bpm, PLA: 181.08 ± 2.17 bpm, $p = .199$), and mean mileage split times (CHO: 15.71 ± .662, PLA: 15.96 ± .634, $p = .649$). In conclusion, the present study provided evidence that mouth rinsing a 6.4% CHO solution does not decrease time to completion of a 5K time trial in endurance-trained collegiate athletes. Further research is warranted in order to test the practical significance of a CHO mouth rinse on 5K running performance.

Deterioration Rate of Running Shoe Function over First 200 Miles of Wear

Kelly Peregrine

Mentors:
Dr. Mark Northuis,
Kinesiology

Stein Slette,
Kinesiology

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

The purpose of this study was to identify the deterioration rate of sole thickness, force absorption, torsional stiffness, and tread density of various running shoe makes and models during the first 200 miles of in vivo use. The shoes of 16 participants were assessed when new and in 50-mile increments. Statistically significant decreases in heel and forefoot sole thickness, heel-to-forefoot drop, force absorption in the heel and forefoot, and torsional stiffness were reported at each of the 50-mile increments. There was no significant change in the tread density during the 200 miles. This study indicates that runners should consider replacing their training shoes sooner than the 300 to 500 mile standard.

Delayed Onset Muscle Soreness Following Acute Resistance Training in Occluded vs. Non-Occluded Limbs

Timothy Pletcher
Stephen Rivas
Colten Stuive

Mentor:
Dr. Kevin Cole,
Kinesiology

The purpose of this study is to determine if there is a significant difference in delayed onset muscle soreness in an occluded (low-intensity) and non-occluded (high-intensity) arm after an acute bout of arm resistance training exercise. Non-athlete, collegiate students who have not participated in a structured resistance training program within the last 3 months were selected. Participants underwent a familiarization protocol for the exercises and occlusion bands. The participants' right and left arms were randomized to arm occlusion resistance training at 30% 1RM or non-occlusion resistance training at 70% 1RM. The occluded arm completed 5 sets of cable bicep curls and tricep extensions with the repetition scheme of 30-15-15-15-15, while the non-occluded arm also completed 5 sets of cable bicep curls and tricep extensions with all sets completing 8 repetitions. Weight was lowered if participants could not complete the set. Delayed-Onset muscle soreness was measured at 24, 48, and 72 hours post exercise. Rate of perceived exertion was assessed every set for each arm. A comfortability questionnaire of the occlusion bands was completed at the end of the exercise protocol. Results will be recorded at a future date.

Examining the Accuracy of the Polar OH1 Monitor

Colten Stuive
Betsy Craig
Eliza Beird
Caroline Serkaian

Mentor:
Dr. Brian Rider,
Kinesiology

The purpose of this study was to determine the accuracy of the Polar® OH1 HR monitor during periods of rest, walking, running, and active/passive recovery from exercise. Twenty collegiate athletes (females n=12, males n=8) wore an OH1 monitor and a previously validated chest HR monitor (Polar RS400) that served as the criterion measurement across a range of resting and walking/running intensities. First, subjects rested in a supine, seated, and standing position. Next, each subject walked on a treadmill at 1 mile per hour (mph). Speed was increased by 1 mph every two minutes until volitional fatigue. Then, subjects walked at 3 mph followed by a seated recovery stage. HR was recorded every 30 seconds from both devices. Total mean difference in HR readings, percent accuracy, and Intraclass Correlation Coefficients (ICC) analysis established the level of agreement between devices. Bland-Altman plots and a regression were also used to determine agreement and variance between devices. The OH1 demonstrated a strong correlation with the RS400 ($r2 = 0.98$) across the protocol. The RM ANOVA indicated an overall significant difference between the RS400 and the OH1 (mean=112.8 vs. 112.47 bpm, p=.034). An ICC of 0.99 (OH1 vs RS400) indicated a strong level of agreement between devices. The OH1 was fairly accurate with 85% of all HR measurements being within 5 beats of the RS400. Those who use the OH1 can have confidence in the accuracy of the device. Future research should examine a more diverse cohort of individuals to determine the OH1's accuracy across skin tones. Additionally, device accuracy during different modes of exercise should also be examined.

KINESIOLOGY

The Rehabilitation of a Nonoperative SLAP Tear

Leela Thomas Parrish

Mentors:
Dr. Kirk Brumels,
Kinesiology

Katharine Rose,
Kinesiology

The purpose of this project is to review the injury, treatment option, and rehabilitation of a superior labral tear from anterior to posterior in the left shoulder of a Hope College Football player. It will review the prevalence of the injury, the anatomy affected, and the procedures commonly used to correct the injury. The athlete's specific rehabilitation will be covered, as well as the standard rehab procedure. The patient's outcomes will be compared to national non operative outcomes for collegiate athletes and national surgical outcomes. The injury caused prolonged shoulder pain, resulting in further injury to the acromioclavicular joint. As a result, the athlete experienced irritation and pain with horizontal adduction, flexion beyond 90˚, and weight lifting with weight directly on the shoulder. The athlete chose not to have the recommended surgical intervention, a labral repair. Conservative measures were taken to ensure the athlete could participate in the 2019 football season. Rehabilitation consisted of global scapular stabilization and strengthening exercises, similar to a post dislocation protocol. The normal surgical procedure and rehab will also be discussed in this study as it pertains to the normal injury progression. With rehabilitation completed the patient will need to continue a maintenance program up to and throughout the season until a surgical repair can be obtained.

Anterior Ankle Impingement in a Collegiate Football Player

Melanie Weesies

Mentors:
Dr. Kirk Brumels,
Kinesiology

Katharine Rose,
Kinesiology

The purpose of this case study is to examine the injury, surgery, and rehabilitation in a DIII collegiate football player who suffered from anterior ankle impingement (AAI). AAI is a pathology that occurs when the bony or soft tissues are compressed during maximal ankle dorsiflexion. This case study reviews the general epidemiology, anatomy, and corrective procedures associated with this injury, and it will outline the specific rehabilitation process from surgery to return to normal sport activity for this athlete who suffered from AAI caused by the presence of anterior osteophytes located on the talus and tibia.

Is There a "Resource Curse" and What does Africa Reveal about Its Existence and Impact on Political and Economic Stability and Development?

Claire Bates

Mentor:
Dr. Virgina Beard,
Political Science

Is there a "resource curse" and what does Africa reveal about its existence and impact on political and economic stability and development? The term "resource curse" reflects the paradox of many countries in Africa that share in the continent's extremely abundant presence of resources, but also struggle with conflict and unstable markets. Such countries have a difficult time making positive economic gains from their oil or minerals. This curse diminishes the global economic credibility of the African states and how they can contribute to the global market. An outlier of this problematic barrier is Botswana. The diamond-filled country has a booming economy and a stable political system, allowing the state to fully take advantage of their resource wealth. Through the use of institutions and a democratic foundation, Botswana has flourished far between its equally as resource riched counterparts in Africa. The stability of Botswana has opened up doors for their economic success. The lack of civil war in the country brings in more revenue for Botswana, eliminating the need for resources to fund wars, unlike Sierra Leone and Liberia. Botswana's role in global markets also contributes to the growing of the world's economy as a whole, and proves that an African country can be lucrative and competitive on a global standard. This project will explain how Botswana has avoided the resource curse even though they have a surplus of diamonds.

The Role of Minority Parties in Coalition Governments

Elisabeth Beck

Mentor:
Dr. Rachel Schutte,
Political Science

This project examines the relationship between minority parties in coalition governments and how they affect decision making. I expect to find that minority parties make a large difference in the decisions made by the governments. This is significant because many of the world's governments are coalitions.

Foreign Aid and African Political and Economic Development?

DeVante Cosby

Mentor:
Dr. Virginia Beard,
Political Science

This project explores whether or not foreign aid helps or stunts the development of states in sub-Saharan Africa. One set of the available research argues that foreign aid stunts development because it creates an issue of dependency for many African cultures. Other scholars highlight with strong empirical evidence the benefits that have resulted from foreign aid in poverty alleviation, good governance support and other areas of political and economic growth in Africa. This project will use specifics from the country of Nigeria to investigate the strength of each sets of arguments. Does foreign aid do more harm or good in Africa?

POLITICAL SCIENCE

Public Opinion and Influences on Government Assistance

Molly Douma
Maryah Phillips

Mentor:
Dr. Virgina Beard,
Political Science

Previous research has found that most college students believe that politics is not about solving problems; rather, the report found that students saw politics as individualistic, divisive, negative, and often counterproductive to acting on the ills of society. Since this portrayal of college students' views of politics in the early 1990s, there has been an array of survey research, policy analysis, and commentary that attempts to define, understand, and document the political engagement of young people. Some additional research has found that, among the greatest dangers for American democracy, is that in the minds and actions of the youth politics has become a spectator sport rife with division, exclusivity and irrelevance. Furthermore, some argue that part of this increasing interest is focused towards the global political arena, especially since September 11, 2011 and the US engagement in a number of foreign wars, the global economic crisis and the recent Arab Spring. Additional findings suggest that US college students have turned dramatically more negative in their view of the political and economic trajectory of the United States, expressing concerns about the economy and the lack of bipartisan action and attitudes in the US Congress. When focusing on US college student views on US foreign policy, students were dissatisfied and skeptical. We are assessing these findings in the context of a small, liberal arts, faith based institution. Thus, we consider the views of Hope College students on the issue of state welfare spending globally and in the United States.

Trends in Roe Roll Call Voting

Kinzly Dressler

Mentor:
Dr. Rachel Schutte,
Political Science

This project examines public support for abortion access in the United States. I expect to find that gender, race, and economic class have significant impact on whether a person supports or rejects legalized abortion. This has immense implications in the current controversy over possibly overturning *Roe v. Wade* (1973) in the Supreme Court.

Swing Vote Influencers on Congressional Roll Call in 2018

Kinzly Dressler
Braden Griffin

Mentor:
Dr. Virgina Beard,
Political Science

What is the relationship between demographic characteristics (age, number of terms (tenure) in office, marital status, urban/rural residence, previous military service, education, etc.) and other factors, such as related economic activities of the state from which the representative comes, immigrant populations in their state, etc., of elected U.S. Congressional representatives and the voting decision a representative makes? Sampling from California, Michigan and Texas, we will assess why their members of the House of Representatives voted as they did on H.R. 4760: Securing America's Future Act of 2018.

Women and Political Participation

Abigail Finnegan

Mentor:
Dr. Rachel Schutte,
Political Science

This project will examine female representation in Western democracies and correlate those findings with public opinion on women. The main basis behind this project lies behind the recent "pink wave" in the United States and it seeks to disentangle competing theoretical reasons that explain women's participation in national politics.

Global Politics: Political Culture B

Maddie Smith
Nazareth Frezghi

Mentor:
Dr. Virginia Beard,
Political Science

This project examines political culture and the relationship between traditional hard and soft entertainment news media. Using an experimental design, this project will ask college students whether the Daily Show with Trevor Noah or a hard news clip from CNN effects their political knowledge, interest, and/ or sense of efficacy. We expect the soft news clip to be more engaging, while the hard news clip will be more informative. This has significance due to the current political climate and the rise of satirical news media.

Global Politics: Political Behavior A

Natalie Harten
Michelle Abraham

Mentor:
Dr. Virginia Beard,
Political Science

What is the relationship between demographic characteristics (age, number of terms or tenure in office, marital status, urban/rural residence, previous military service, education, etc.) and other factors, such as related economic activities of the state from which the representative comes, immigrant populations in their state, etc., of elected U.S. Congressional representatives and the voting decision a representative makes? With sampling from California, Wisconsin and Texas, we will assess why their members of the House of Representatives voted as they did on S. 1252: Global Food Security Act of 2016.

POLITICAL SCIENCE

Political Opinion

Isabel Hodson
Andrew Porter
Audrey Revercomb

Mentors:
Dr. Virginia Beard,
Political Science

Todd Wiebe,
Head of Research and Instruction, Van Wylen Library

Previous research has found that many U.S. college students believe that politics is not about solving problems; rather, research has found that such students see politics as complicated, untrustworthy, pressuring, and often counterproductive to acting on the ills of society. There has been an array of survey research, policy analysis, and commentary that attempts to define, understand, and document the political engagement of young people since this portrayal of college students' views of politics in the early 1990s. Some additional research has found that, among the greatest dangers for American political stability, is that politics in the minds and actions of the youth has become a nothing more than a negative, uninteresting topic that typically lacks significant representation. Furthermore, some argue that part of increasing political interest is focused towards the global political arena, the US engagement in a number of foreign wars, and the global economic crisis. Additional findings suggest that US college students have turned dramatically more negative in their view of the political trajectory of the United States, due to a feeling of higher connectivity between one another and a lack of faith in traditional politics. When focusing on US college student views on US foreign policy, students were dissatisfied and skeptical. We are assessing these findings in the context of a small, liberal arts, faith based institution. Thus, we consider the views of Hope College students on the issue of the immigration of Syrian refugees to the United States.

Rural Brain Drain

Katheryn Irwin

Mentor:
Dr. Rachel Schutte,
Political Science

This project focuses on the phenomenon of college graduates migrating to big cities, and thus creating a loss of human capital in small towns. This phenomenon is also known as rural "brain drain." I expect to find that small towns engage in a variety of activities and development plans in order to create more opportunities and jobs for college graduates, and to gain back human capital. This phenomenon holds great significance as more and more young academics and professionals are moving to big cities and metropolitan areas than ever before.

Social Media Usage and Political Participation

PJ Johnson

Mentor:
Dr. Rachel Schutte,
Political Science

This project examines the relationship between social media usage and political participation. I expect to find that the more a person uses social media the less likely they are to participate in the political, democratic process. This is extremely relevant due to political candidates focusing much of their campaigning on social media during the 2016 and 2018 elections.

Geographical Coercion: Land Dividing the U.S. Along Partisan Lines

Emily Marino

Mentor:
Dr. Rachel Schutte,
Political Science

The past several decades have revealed a dividing trend between the voting behavior of urban and rural areas within and among states. This project seeks to identify and explain factors that are causing urban areas to affiliate with the Democratic party and rural areas to affiliate with the Republican party. This trend of division, based on geography, has significant implications for the U.S. electoral system as it will greatly impact how, when, and where candidates campaign as well as the outcomes of elections. Such division amongst cities, towns, and even neighborhoods is creating communities isolated from the lifestyles, concerns, and ideologies of those in different communities. The greater implication of this is a highly polarized and incompatible electorate. From this research design, it is expected that higher levels of globalization in urban areas create a disconnect between urban and rural constituents due to a sharp contrast in lifestyles. Urban constituents are expected to be more involved at the global level and rural constituents more involved in traditional democratic activities that promote their sense of nationalism. In addition, social pressure created by cultural trend setters in urban areas is expected to facilitate the division of party affiliation between areas and decrease variability within areas.

Does the Digital Divide Exist and How is it Affecting Africa?

Makena Mugambi

Mentor:
Dr. Virginia Beard,
Political Science

This research will seek to analyze and observe the topic of the "digital divide" and the role its existence has within sub-Saharan Africa. The purpose of observing the digital divide is to focus on the technological realities facing this region in comparison to regions around the world. There are numerous advances African states are making economically, governmentally and technologically. Although technological advances have increased in great and rapid measures, there are thousands who still lack access to the beneficiaries of these advances. Does the lack of internet access and electricity have an effect on the education system in sub-Saharan Africa? Through this research, we will review specific case studies on Kenya, Rwanda, Ethiopia and South Africa to evaluate the effects of this technological divide. Through various assessments, the content of this research will seek to bring understanding on how the digital divide exists and how the impact it has on the nations of sub-Saharan Africa.

Living in Fear: The Politics of Sanctuary Cities

Erick Núñez

Mentor:
Dr. Rachel Schutte,
Political Science

This research project examines the relationship among undocumented immigrants and the policies that keeps sanctuary cities running. In particular, this project will explore state and city practices that protect undocumented immigrants despite widespread public opposition to sanctuary cities.

POLITICAL SCIENCE

Global Politics: Political Culture A

Mike Boynton
Sophia Rachor

Mentor:
Dr. Virginia Beard,
Political Science

Does exposure to the soft/entertainment news when compared with exposure to traditional/hard news increase or decrease political knowledge, interest and/or willingness to participate in politics? Using an experimental design with pre- and post-exposure surveys, this project will ask college students whether viewing a soft news clip from the Daily Show or a hard news clip from BBC on the topic of immigration affects their political knowledge interest and/or sense of efficacy in different ways.

The Resource Curse in Africa

Luke Rufenacht

Mentor:
Dr. Virginia Beard,
Political Science

Many African countries are endowed with oil and mineral wealth that has the potential to transform their economies. But historically, research and experience have shown that these resources have often been more of a curse than a benefit. With Africa being the world's richest continent in terms of minerals and materials, the resource curse is an important topic to investigate both for African economic success as well as for what African states offer the global economy. Across Africa, many countries with a high demand resource on which a majority of their economy is based has not been beneficial to the political, economic, and social spheres of the country. Though this "curse" is true for most of the sub-Saharan countries with a single resource, it has not been the case for Ghana. Ghana discovered oil in 2007 and is a top fifty oil producer in the world, but maintains a Freedom House rating of 1.5, comparable to the United States. So, even though much of the continent is ridden with the resource curse, countries like Ghana give us a lens through which we can look at how the country has avoided the curse, and what can be done to help other countries. Ghana will be compared with other countries who have a singular resource to see where each country has had failures and successes. This paper will look at the legitimacy of the resource curse, and how countries have either successfully or failed to responded to it through policy. This paper will look specifically at Ghana, and how it has managed to be successful through its discovery of oil, and if stability before resource discovery impacts the scope of the curse.

Political Polarization and Voter Turnout

Madison Smith

Mentor:
Dr. Rachel Schutte,
Political Science

This project examines the relationship between political polarization and voter turnout. I expect to find that, at the state level, voters in the majority political party will be more likely to show up to the polls. This has significance due to the looming 2020 census as states will undertake significant redistricting efforts.

Influences of Political Scandals on Political Participation

Yung Yue Tneh

Mentor:
Dr. Rachel Schutte,
Political Science

This project examines how political scandals and corruption in the government affect public opinion and political participation. I expect to find that while political scandals might have a negative impact on both public opinion and political participation it does not have a big impact because political scandals have become a natural element in the politics today.

Does the Digital Divide Exist and How is it Affecting Africa?

Taylor White

Mentor:
Dr. Virginia Beard,
Political Science

Technological innovation many would argue is one of the main driving forces of economic and political advancement in the modern world. The push for global initiative and interconnectedness via new technologies is becoming increasingly important for industry, politics and cultures. But are all places and peoples able to access technological innovation and change? Are societies in so-called developing nations able keep up with the technological innovation and adoption seen in the rest of the world? I will explore the so called "digital divide" in the context of states in sub-Saharan Africa. I will investigate how such states have both accessed and have contributed to global technological advances and how they may have been hindered from having more advances because of the digital divide.

Foreign Aid and African Political and Economic Development

Sanny Yang

Mentor:
Dr. Virginia Beard,
Political Science

Is foreign aid good or bad for states in Africa? This research project will investigate whether or not foreign assistance to African states focused on their political and economic growth and stability brings more benefits or harms. The arguments for and against foreign aid targeted towards African development will be examined to reveal the advantages and/or disadvantages of such assistance. This project will use Tanzania as a case study to examine the presence of foreign aid in various forms and the political and economic experiences of Tanzania from the time of its independence to present day. Kenya and Malawi will also be examined as case studies to observe any correlations between foreign aid and political and economic outcomes in African states.

Child Speaker Identification: Accuracy, Reaction Time, and Engagement with Children

Darby Baird
Abby Meder
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Mentor:
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Psychology

This research was supported by the Jacob E. Nyenhuis Faculty-Student Collaborative Grant, the John H. and Jeanne M. Jacobson Endowed Fund, and the Hope College Department of Psychology

Adult listeners can successfully identify adult speaker gender and ethnicity (Thomas & Reaser, 2004), but outcomes are more variable with speaker identification in childhood (Lozser, Chiczewski, Meder, & Trent-Brown, 2018). Following the onset of puberty, acoustic voice quality parameters begin to change, enabling listeners to reliably identify voice quality characteristics (Berger, 2008). This study examines how the listeners' experience with children affects the accuracy and the reaction time with which they are able to identify the gender and ethnicity of child speakers. Male and female European American and African American children ages 8-12 were recorded producing /h-vowel-d/ words (e.g., heed, hid, hayed) and sentences (I hear the sound of heed some more.) in General American English. Adult listeners (n=79) completed a language background questionnaire including questions regarding their experiences with children. Participants then listened to four blocks of recordings: forward words, reverse words, forward sentences, and reverse sentences. Each block contained items spoken by children of each ethnicity, age, and gender. The listeners identified speaker ethnicity and gender. We predict that the more time spent with kids and the more enjoyment the listener has spending time with them, the higher their accuracy scores will be and the lower their reaction time. We also predict significant main effects for temporal condition, phonetic complexity, ethnicity and gender. This study will provide insight about the impact of a child speaker's age on the ability of an adult listener to identify their gender and ethnicity. Outcomes can be informative for professionals working with children and for speech-related practitioners. Variable accuracy in recognizing differences in speakers' gender or ethnicity based on personal language experience may lead listeners to make stereotypical assumptions and respond in ways that reflect implicit biases. Teachers, voice therapists, and speech-language pathologists can utilize this knowledge to reduce biases in their work.

Evidence for Equality?: Guatemalan Adolescents' Views on Gender

Amy Beasley

Mentor:
Dr. Kate Poelker,
Psychology

Guatemala is known for its beautiful landscapes, delicious food, and vibrant traditional textiles. Despite the country's many treasures, Guatemalans face many challenges including gender inequality and wealth disparity. Issues pertaining to youth are of particular importance, as approximately 56% of the population is under 25 years old (Central Intelligence Agency, 2018). Gender inequality in Guatemala may be perpetuated by traditional values of machismo and marianismo (Gibbons & Luna, 2015). Machismo refers to the expectation that men be dominant, respected, and strong providers for their family (Arciniega, Anderson, Tover-Blank, & Travey, 2008). Conversely, marianismo is the expectation that women be pure and gentle, like the Virgin Mary (Castillo, Perez, Castillo, & Ghosheh, 2010; Stevens, 1973). The Gender Intensification Hypothesis suggests gender roles become more rigid during adolescence, as young people prepare for adulthood (Hill & Lynch, 1983). Previous studies on Guatemalan adolescents' views on the ideal man and ideal woman have revealed a series of gender differences as well. Although machismo and marianismo still characterize society's views on gender for many Guatemalans, there is evidence that some young people's views on gender might be changing due to globalization and adaptation of more individualistic attitudes (Ashdown & Gibbons, 2012; Flores et al., 2016). The purpose of the current study was to evaluate age and gender differences among 297 Guatemalan adolescents on the following measures: Attitudes About Women Scale-Adolescent version (Galambos, Petersen, Richards, & Gitelson, 1985), the Ideal Man and Ideal Woman questionnaire (Gibbons & Stiles, 2004), the Revised Body Image Esteem Scale (Mendelson & White, 1993/1994), and the Child and Youth Resilience Measure (Liebenberg, Ungar, & LeBlanc, 2013). Findings from this study will contribute to culturally-sensitive efforts to empower Guatemalan youth and educate adolescents about gender equality. By shifting gender ideologies of youth in the region, macro-level improvements through policy change and overarching attitudes towards women are possible.

Self-Regulation Predicts Virtue and Flourishing, above and beyond Self-Control

Hannah Bugg
Victoria Gardner
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Mentor:
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Self-control and self-regulation have been widely viewed as equivalent in psychological literature, although viewed as psychological strength. However, we posit that these terms are related yet distinct. Specifically, we view self-regulation as automatic behavioral responses in line with one's desires whereas self-control requires an effortful choice, often overcoming inner desires (McCullough & Willoughby, 2009). Prior research has discovered relationships between virtue constructs and self-regulation (Doerr & Baumeister, 2010) and self-control (Baumeister & Exline, 1999). The distinction between self-control and self-regulation can be viewed as analogous to Aristotle's (1999) conception of continence (i.e., virtuous action despite conflicting desires) and virtue (i.e., virtuous action in accordance with inner desires). To test this modern conceptualization of Aristotle's typology, we hypothesized that both self-control and self-regulation would predict modern virtues and flourishing, but that self-regulation would act as a stronger predictor.

Undergraduate students (N = 148) completed items measuring modern virtues (i.e., forgivingness, gratitude, hope, humility, patience), flourishing, self-control, and self-regulation. We used bivariate correlations to examine the relationships among the modern virtues.

Modern virtue measures correlated with dispositional self-control (*r*s=.18-.37) and self-regulation (*r*s=.26-.43); ; all modern virtues also correlated with flourishing (*p*s<.001). When evaluating the specific variance associated with self-regulation and self-control, and controlling for the other construct, only self-regulation correlated with the modern virtues (*p*s=.005; except patience, *p*=.21); Self-control yielded weaker predictive power for the virtues (*p*s>.10). These results support our hypothesis that self-regulation predicts virtue and flourishing, above and beyond self-control. Indirect effect models demonstrated that self-regulation predicted greater flourishing through the individual virtues, while controlling for self-control. These data provide initial support for the value of continence and virtue as proposed by Aristotle, as relevant constructs for positive psychologists in the 21st century.

The Impact of Parent Awareness on Preschoolers' Sleep

Lauren Evert
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Mentors:
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This research was supported by the Caplan Foundation for Early Childhood and the Hope College Department of Psychology.

Interviews exploring parents' assessments of the "right amount" of sleep have shown that parents have low awareness of the actual amount of sleep recommended for child health and welfare (National Sleep Foundation, 2004). Early development is a critical period when disruptions in sleep patterns can be detrimental for health (Turnbull, Reid, & Morton, 2013). Few studies have examined sleep patterns in preschoolers in their home environment. Sleep affects psychosocial and interpersonal behavior for optimal functioning at school and at play. This is why engaging parents in thinking about their child's sleep hygiene, increasing parent awareness, and providing parent education are of critical importance. Parents completed the Children's Sleep Health Screen (CSHS), Parenting Styles and Dimensions Questionnaire (PSDQ), and the Sleep Beliefs Scale (SBS). Demographic items included age, height and weight (to compute BMI estimate), race/ethnicity, gender, marital status, household income, education, occupation/shift, and language spoken in the home. Additionally, parents maintained a daily sleep journal for their child during the 12-week session. Multiple linear regression analysis determines the significant predictors of positive sleep hygiene outcomes across demographic variables and scores on the CSHS (Harsh et al., 2002), PSDQ (Robinson et al, 2001), and SBS (Adan et al., 2006) measures. We hypothesized that positive sleep beliefs, positive sleep hygiene, and authoritative parenting scores would predict more successful sleep health indicators in the sleep journals and sleep outcomes. We hypothesized that demographic variables such as age, education, income, and marital status would predict positive sleep habits more so than gender, race/ethnicity, or language spoken in the home. This study has implications for parent awareness and education about the impact of parenting style and sleep belief patterns on their child's sleep habits. As parents successfully navigate daily routines, their children will experience more effective sleep, health, and developmental outcomes.

2018 Celebration of Undergradurate Research and Creative Activity. Photo courtesy Hope College Public Affairs and Marketing. Photo credit: Steven M. Herppich.

Mixed Mood State Behaviors and Circadian Dysfunction following Homocysteic Acid Treatment: Potential Animal Model for Bipolar Disorder

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Mentor:
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Psychology

This research was generously supported by the Jacob E. Nyenhuis Grant for Faculty-Student Collaboration and by the Towsley Scholars Research Award at Hope College.

Bipolar disorder is a neuropsychiatric disease characterized by cyclical fluctuations of mood states between mania and depression. Circadian rhythm abnormalities and inconsistent sleep patterns are two common symptoms of bipolar disorder (Millar, Epsie, & Scott, 2004). Elevated levels of homocysteine, in the blood or cerebrospinal fluid, commonly occurs in patients with neuropsychiatric illnesses, including bipolar disorder (Bell et al., 1992; Boushey, Beresford, Omenn, & Motulsky, 1995). Homocysteic acid (HCA), an endogenous metabolite of homocysteine, has been implicated as a harmful neurotoxin and agonist of NMDA receptors. We have previously shown that postnatal administration of HCA (from postnatal day 3-21) in Sprague Dawley rats results in both mania-like and depressive-like behaviors, suggesting that this may serve as a novel animal model for bipolar disorder. The purpose of the present study was to characterize any circadian abnormalities that may be present in HCA-treated rats, as sleep and circadian dysfunction are common symptoms of bipolar disorder. In addition, we also characterized the developmental onset of the mania-like and depressive-like behaviors in this model. Prior to puberty, we found that HCA-treated rats exhibited no manic-like behaviors and only a trend toward depressive-like behaviors. After puberty, however, HCA-treated rats presented a mixed mood-state of both manic-like and depressive-like behaviors, along with significant dysfunction in the circadian clock. Specifically, both the free-running period and the amplitude of the rhythm were significantly reduced following HCA treatment. We are currently using microarray analyses to determine differences in circadian gene expression levels between HCA treated animals and controls. Additionally, we are examining the therapeutic role of lithium for reversing the circadian disruptions exhibited by the HCA-treated animals. Altogether, the findings of the present study provide strong evidence in support of the HCA model's face validity for bipolar disorder, allowing us to better understand the mechanisms underlying the development of this disease.

The Psychophysiology of Accountability

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We will present current research on accountability as a relational virtue, with the goal of understanding the construct psychologically and psychophysiologically. People with the virtue of welcoming accountability are responsive to the input of people to whom they rightly owe a response, and they show responsibility for their attitudes, thoughts, emotions, and actions—working to make corrections and improvements in light of these relationships.

The aims of this research are: 1) to assess the relationship of accountability to empathy and self-regulation variables at the trait level in national and college samples, 2) to identify predictors of accountable responding to a novel situation in a college sample, and 3) to assess the neuroscience underpinnings of accountability in a college sample.

Toward this end, we aim to test a specific genetic variation (the oxytocin receptor gene single nucleotide polymorphism—OXTR SNP—rs53576) associated with empathy, as well as a cardiovascular variable (heart rate variability; HRV) associated with self-regulation. We will test whether the genetic variable indirectly predicts accountability through empathy and whether the cardiac variable indirectly predicts accountability through self-regulation.

It may be that people vary in their welcoming of accountability due to factors associated with empathic perspective-taking and regard for others, as well as factors associated with self-regulation and the capacity to enact behavioral change when appropriate. Thus, we also aim to study a pre-appraisal intervention that may cultivate accountability by facilitating perspective-taking and recognition of one's own capacity to adapt as appropriate.

The Relationship between Resilience and Acute Stress

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Caitlyn Heidenga
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Mentor:
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Psychology

There are a multitude of ways to respond to stress. Resilience, the ability to overcome adversity, is one common stress response (Bonanno, 2004). We wanted to examine resilience in the context of everyday stress, since there is a gap in resilience literature, despite its commonality. We used the Resilience Resource Scale (RRS), among various other scales, to assess resilience. Resilience resources are factors that predict resilience (e.g., social support) in people. We predicted RRS scores would not change significantly relative to an acute stressor, but other scales measuring resilience and stress would. We also hypothesized that lower perceived stress would correlate with higher resilience, and better use of resilience resources. Our study was longitudinal and consisted of two stages. In addition to the RRS, we used the perceived stress scale (PSS) adapted from Cohen and Williamson (1988), and measured other constructs (e.g., religiousness, health, depression, anxiety, personality, demographics). We incorporated an acute stressor from Mills and D'Mello (2014) to test resilience, and a values affirmation task from Meagher and Marsh (2017) to mitigate potential distress. Sixty-six participants were recruited through an online subject pool during the fall 2018 semester. Participants completed an online survey containing the RRS, PSS, and a battery of other measures. After five to ten days, participants came into the lab and completed the acute stress task, an autobiographical emotional memory task, and a post survey measuring resilience and stress, then the values affirmation task.

Our prediction that resilience resources would correlate positively with resilience and other positive psychosocial health outcomes was supported. However, we did not find a difference in resilience levels before and after the acute stress task. We presume that our acute stressor did not stress out participants enough. Future research will seek to find a new acute stress task that may illuminate our predictions.

Revealing Functional Brain Activity Following Excitotoxic Injury to Retinal Ganglion Cells in a Diurnal Rodent Model

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Mentor:
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Psychology

This research was generously supported by the Jacob E. Nyenhuis Grant for Faculty-Student Collaboration and by the Towsley Research Scholars Award at Hope College.

Intrinsically photosensitive retinal ganglion cells (ipRGCs) transmit light signals to the brain and contribute to non-image forming vision, such as synchronizing circadian rhythms to the light-dark cycle. Our lab recently showed that ipRGCs are resistant to excitotoxic damage and remain functional following N-methyl-D-aspartic acid (NMDA) administration to the retina, in a diurnal rodent, the Nile grass rat (Arvicanthis niloticus). Importantly, whereas non-image forming vision remained functional due to the survivability of ipRGCs, image-forming vision was significantly impaired due to damage to traditional retinal ganglion cells (RGCs). Specifically, RGC damage led to behavioral deficits in the Morris Water Maze, a test that requires rodents to use visual cues in order to find a hidden platform. We hypothesized that brain areas that are critical for image-forming vision in NMDA-treated grass rats would have significantly less neuronal activity than controls. To test this hypothesis, we used cFos, a marker for neuronal cell activation, to visualize neuronal activity in the brains of NMDA-treated grass rats and controls. We predicted that the primary visual cortex (V1), a brain region that is involved in image-forming vision, would exhibit significantly less cFos in NMDA-treated grass rats vs. controls. In contrast, we predicted that the suprachiasmatic nucleus (SCN) and intergeniculate leaflet (IGL), brain areas that are involved in non-image forming vision, would exhibit no difference in the amount of cFos in NMDA-treated grass rats vs. controls. Staining of brain tissue using cFos is complete, and we are currently mounting brain tissue on slides. We will image the brain areas and count the number of cells expressing cFos in V1, SCN, and IGL. Altogether, the present study aims to reveal the functionality of retinorecipient brain regions that are involved in visual functions following excitotoxic injury to RGCs in a diurnal rodent model, the Nile grass rat.

Photo courtesy Hope College Public Affairs and Marketing.

Associations between Social Support and Positive Psychosocial Variables in Pregnant Women

Anna Langholz
Allie Thiel
Trevor Sooy

Mentor:
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Psychology

Social support is something that can be valuable to those dealing with adverse circumstances, depression, or other hardships. A particularly notable population in which social support has been identified as beneficial is pregnant women who can be more susceptible to symptoms of anxiety and depression. Furthermore, social support has been linked to important pregnancy outcomes, including birth defects in infants (Nylen, O'Hara, & Engeldinger, 2012). There is also evidence to suggest that psychosocial risk factors for preterm birth and low birthweight include multiple forms of stress, prenatal anxiety, and possibly depression in mothers (Accortt, Cheadle, & Dunkel Schetter, 2015). Protecting against these negative outcomes could drastically improve the health of mothers during and after pregnancy and the health of infants at birth. In light of this, we conducted a study that examined the associations between social support and other positive psychosocial variables in pregnant mothers. In the current study, 250 pregnant women were recruited from Denver Health and Hospital Authority (DHHA) in Denver, CO and from Cedars Sinai Medical Center (CSMC) in Los Angeles (LA), CA. Once during each trimester, the mothers completed an interview that included mood screenings, a pregnancy-specific affective states survey, and a sleep quality survey. We hypothesized that pregnant mothers who are higher in perceived social support will also have higher forgiveness, gratitude, positive affect, and optimism ratings than those low in perceived social support. Results of this study indicated that perceived social support did show slight positive correlations with optimism, gratitude, and forgiveness, but was only significantly positively correlated with positive affect. To further test this hypothesis, we plan to run additional regressions. These results suggest that perceived social support has the potential to increase other psychosocial variables, but more research is required. Future studies should strive to investigate the relationships with other psychosocial variables not examined in the current study. Overall, our hope is that this study aids in the understanding of how important it is for pregnant women or new mothers to receive social support as it dramatically influences other psychosocial variables in their life, as well as their newborn.

Our prediction that resilience resources would correlate positively with resilience and other positive psychosocial health outcomes was supported. However, we did not find a difference in resilience levels before and after the acute stress task. We presume that our acute stressor did not stress out participants enough. Future research will seek to find a new acute stress task that may illuminate our predictions.

Work Stress and Pregnancy

Reece Lindemann
Kimberly Paquette

Mentor:
Dr. Alyssa Cheadle,
Psychology

There is no shortage of research being done when it comes to work stress and its detrimental effects on employees. Work stress, a negative affective or emotional state due to adverse experiences in the workplace, is costing the United States economy an estimated $300 billion a year. Work stress is composed of both stressors, demands faced in the work environment, and strains, which are the psychological or physiological reactions to these stressors. One crucial stressor in the workplace that is becoming an up and coming topic of research is an individual's perception of their fit in their working environment. An individual's perception of it can be based significantly on the correspondence between work demands and the availability of coping resources. The job demands-control (JDC) is split into two basic hypothesis. The strain hypothesis refers to the additive nature of work characteristics such that the prevalence would be increased in situations of high demands and low control. The buffer hypothesis argues that control mitigates the effects of demands on strain. We will be looking into these theories using the Behavior in Pregnancy Study (BIPS), which was conducted from 1992-1995 at the University of California, Los Angeles and examined the effects of psychological stress on birth outcomes by measuring multiple psychosocial and biological variables. Our research includes using the data from BIPS to further analyze workplace stress and its effects on gestational age along with the birth weight of preterm and term infants. When assessing workplace stress, we will also include psychosocial variables such as perceived stress, daily activities, work strain, physical environment exposures, work problems, job activities, and postpartum employment.

Acoustic Parameters of Child Speech

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Mentor:
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This research was supported by The Jacob E. Nyenhuis Faculty-Student Collaborative Grant, The John H. and Jeanne M. Jacobson Endowed Fund, and the Hope College Department of Psychology

Prior research demonstrates that vowels are acoustically based on their formant frequencies (Peterson & Barney, 1952; Hillenbrand et al., 1995). Measures have been established for adult speakers across gender, but these studies included neither measures with respect to ethnicity nor acoustic targets for child speakers. This study investigates vowel production across age, gender, and ethnicity for 8- to 12-year-olds. There is a gradual lowering of the voice with the onset of puberty, which begins as early as age 10 (Berger, 2008). The fundamental frequency of a child's voice lowers as well, influencing the phonological space, which could result in differences across gender, especially for the 11- to 12-year-olds (Tavares, Labio, & Martins, 2010). Sixty-six children recorded neutral consonantal context /h-vowel-d/ words (e.g. hid, head, had) and sentence-length stimuli (I hear the sound of who'd some more). The /hVd/ words contained one of 12 General American English vowels and three diphthongs for a total of 30 utterances per speaker. We hypothesize that fundamental and formant frequencies will be higher for 8 to 9 year olds than for 10 to 12 year olds and higher for females (by age 10). We also predict that voices will not significantly differ between ethnicities. Finally, we predict higher rates of jitter and shimmer for 10 to 12-year-olds and males. Outcomes will describe the acoustic variation in vocalic production in European American and African American children and will increase our knowledge of developmental trajectories for specific acoustic parameters. As gender and ethnicity are vital cues for adult speakers, it's important to investigate the stability of the acoustic parameters for child speakers and determine the ages at which child parameters begin to approximate adult measures. Results will have implications for audiologists, speech language pathologists, developmental/speech scientists, and others in the field of communication sciences and disorders.

Biopsychosocial Correlates of Sleep Hygiene in Preschoolers

Rebecca Messnick
Lauren Evert
Cameron Everse
Micah Manthei
Abby Rakus

Mentors:
Dr. Andrew Gall, *Psychology*

Dr. Sonja Trent-Brown, *Psychology*

This research was supported by the Caplan Foundation for Early Childhood and the Hope College Department of Psychology

Most children don't get enough sleep (Dement, 2005; Maas, 2011), and 77% of preschoolers experience sleep related disruptive behaviors at least a few nights per week (National Sleep Foundation, 2004). Sleep is especially crucial during early development to promote health, education, brain development, physical growth, and quality of life. Insufficient sleep is a public health problem, and this is clearly true for young children (CDC, 2015). The National Institutes of Health reported that preschoolers need 11–12 hours of sleep daily (NIH, 2012). Good sleep hygiene includes consistent bedtimes and morning rising times, and avoiding large meals, caffeine, and light sources (e.g., night lights, smart phones, iPads, computers) before bedtime (CDC, 2015). Three memory tests, a sleep hygiene scale, a socioemotional assessment, and height and weight measurements (to calculate BMI) were administered to preschoolers. Following testing, Fitbit devices were worn on each child's ankle for the 12-week data collection period. Fitbit parameters included steps per day, total activity time, and time of day at which most physical activity occurred (morning, afternoon, or evening). Sleep quality and sleep habits parameters included number of restless minutes, awake minutes, total hours spent sleeping nightly, child's bedtime, and the child's wake time. We hypothesized that more physically active children would experience better sleep quality, a later bedtime, and an earlier wake time than children who are less physically active. We also hypothesized that children who are most active in the evening would exhibit better sleep quality than children who are most active in the morning or afternoon. We expect better sleep quality to be associated with higher scores on cognitive and socioemotional measures. Results provide greater knowledge regarding the association between sleep, physical activity, and biopsychosocial outcomes that may be useful in implementing better education for parents and children geared toward improving sleep.

Sit Down. Be Humble: Assessing Intellectually Humble Behaviors in Groups and Individuals

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Caitlyn Heidenga
Bailey Butler
Sarah Altieri

Mentor:
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Intellectual humility (IH), one's tendency to own their limitations in light of contradictory information, is a potentially vital trait in a group setting. For example, intellectual humility may help groups function more effectively by allowing members to feel more comfortable sharing their ideas, increasing the likelihood of minority information being shared, and decreasing social loafing by making each member's contribution of equal value. Our research has sought to explore intellectual humility in a group setting specifically by having participants work cooperatively on a battery of tasks together. In our previous work, we have found that IH can both benefit and hinder group performance, depending on the task at hand. In this study, we follow up on this finding to test what specific behaviors linked to IH are helping or hurting groups. To do this, we had groups complete two tasks: a conceptual mastery task and quantity estimation task. Each task required participants to answer questions individually followed by the group coming together and collectively completing the same questions. We recorded their interactions while coming to a collective answer and coded them for behaviors we predicted to be correlated with IH, such as asking questions of groups members and reinforcing good ideas. The intellectual humility of group members was measured using both self-ratings and evaluations provided by fellow group members. We hope to decipher what behaviors are most beneficial to groups that are intellectually humble.

Who I Am: A Mixed-Methods Analysis of Guatemalan Adolescents' Identity Development

Jana Sahyouni
Sydney Hudock

Mentor:
Dr. Katelyn Poelker,
Psychology

Identity development is the paramount task of adolescent development and globalization seems to shape identity. Recent research with the world's adolescents suggests that adolescents hold culturally traditional views of self while adopting some self-identifications of other cultures. Remote acculturation contributes to formation of a remixed identity, and it occurs when an individual internalizes cultural values and identities from a region in which they have *never* lived. Indirect exposure to other cultures, especially through the media, facilitates the adoption of a remixed identity and the process of remote acculturation. Remote acculturation and adolescent identity formation was examined in 129 sixth through twelfth grade students (47.3% male, 52.7% female), at a bilingual school on the south coast of Guatemala. Adolescents completed an open-ended 20 item "I am" test and a remote acculturation measure in English. "I am" responses were coded using an adaptation of Cheek & Cheek's (2018) identity typology; the codes included personal identity orientation, relational identity orientation, public identity orientation, collective identity orientation, and personal hobbies/activities. For each participant, the number of responses per category was recorded. Across all participants, personal identity was the most commonly endorsed orientation (M = 9.91, SD = 3.71) followed by public identity (M = 3.41, SD = 2.43), then hobbies/activities (M =3.08, SD = 2.93) and collective identity (M =2.16, SD =1.96), and finally, relational identity (M = 2.06, SD =1.57). A series of Analyses of Variance (ANOVAs) were used to compare gender and age differences across the identity domains and revealed a main effect of gender in the hobbies/activities domain; boys were more likely to identify with hobbies/activities than girls. The higher prevalence of responses from the personal identity domain over relational or collective domains suggests potential acculturation among the Guatemalan adolescent sample.

The Association between the Postpartum Period and Depressive Symptoms

Nicholai Shaw
Lilly Hemesath
Nina Cuthrell

Mentor:
Dr. Alyssa Cheadle,
Psychology

Postpartum depression (PPD) is a mental health condition that affects half a million women each year (Horowitz & Goodman, 2005). This mental illness poses several risks to the mother and the child. These consequences include issues with breastfeeding, partner relationships, and possible cognitive and behavioral effects on the child. Though prior research indicates that individuals who are more religious and spiritual have fewer symptoms of major depressive disorder, little research has been done in connecting religion and spirituality with PPD (Cheadle & Dunkle Shetter, 2017). Thus, to bridge this literature gap, we recruited 147 pregnant participants and tested their levels of religion and spirituality and levels of depression. Our hypotheses were that those who reported higher levels of religiousness and spirituality would have fewer depressive symptoms. After recruitment, individuals were followed throughout the pregnancy process and interviewed once during each of the three trimesters, and three times postpartum. The interviews at the trimester and postpartum time points included assessment of depression and religiousness and spirituality. Levels of depression were assessed via PHQ-9 and religiousness and spirituality were assessed via survey questions. Despite predictions, our preliminary results showed no significant correlations between depression and religion and spirituality. Future work will look at controlled regressions to reveal if there are underlying variables that affect this relationship.

Resilience and Health in College Students

Lauren Thorne
Allison Darnell
Yuankun Gu

Mentor:
Dr. Alyssa Cheadle,
Psychology

Resilience is an ambiguous construct. Although it has been previously studied, there is no concrete definition or clear measure of resilience. In light of this discrepancy, resilience researchers (Julian et al., under review) have developed a new theory-based scale entitled the Resilience Resource Scale (RRS). Their hope was to develop a way to measure resilience in adolescents specifically through resilience related constructs. The RRS measures resilience resources, which are factors that cultivate resilience such as social support, optimism, and positive affect. The focus of this study was to assess the reliability, concurrent, and predictive validity of the RRS in college students. Participants were emailed a 45-minute pre-survey which measured demographics, resilience, life satisfaction, stress, anxiety, optimism, coping, social support, personality, depression, religious identity and involvement, emotional intelligence, and general health. Five to ten days after completion of the pre-survey, participants came into the lab for an hour to complete a stressful task along with a post-survey and an affirmation task. The post-survey measured resilience, perceived stress, anxiety, and health symptoms. Participants were then debriefed. We found the RRS to be a valid measure of resilience that was moderately and positively correlated with other measures of resilience such as the Connor-Davidson Resilience Scale and the Brief Resilience Scale, and psychosocial resources including conscientiousness, religion, active coping, instrumental support use, positive reframing, planning, emotional intelligence, emotion regulation, emotional stability, extraversion, positive affect, satisfaction with life, and social support. The RRS also negatively correlated with certain constructs such as stress, anxiety, and depression. Additionally, the RRS had good predictive validity, specifically in predicting positive health outcomes.

Exploring the Effects of Contextual Influences on Cognitive Processing through the Use of Silent Centers

Nathalia Santos
Elizabeth Woodford
Abigail Meder
Darby Baird

Mentor:
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Psychology

This work was supported by the Jacob E. Nyenhuis Faculty-Student Collaborative Grant, the John H. and Jeanne M. Jacobson Endowed Fund, and the Hope College Department of Psychology.

Silent centers are where the target formant frequencies are removed from the center of the vowel, leaving the sound lacking the segment which is considered to be the key identifier of the vowel (Peterson and Barney, 1952). In a study conducted by Strange, Edman, and Jenkins (1979), it was found that listeners' ability to accurately identify the silent center vowels increased when given consonantal context. This study seeks to expand the scientific knowledge of silent centers relating to cognitive processing as well as basic human communication and articulatory production. Participants were asked to correctly identify blocks comprised of sentences containing h/vowel/d words in congruent contexts (blocks where sentences make sense with the target word, e.g., *"He **heard** the sound of a bus"*), and then those same h/vowel/d sentences with silent centers. Lastly, listeners were asked to correctly identify vowels in context manipulated sentences containing silent centers (blocks where sentences do not make sense with the target word; *"He **hoed** the sound of a bus"*). Participants also rated their confidence on a scale of 1 to 7 and reaction time rates were measured throughout the experiment. We predict listeners to have high accuracy with silent center vowels in contextually congruent sentences; lower accuracy with silent centers in contextually manipulated sentences; and slower reaction times and lower confidence scores in the identification of contextually manipulated silent center sentences than the contextually congruent sentences. If predictions are met, congruent silent center blocks will provide fewer identification errors than contextually manipulated blocks, indicating that semantic contextual clues have great influence on cognitive processing and acoustic identification. This study will provide knowledge into mechanisms behind cognitive processing, and allow for exploration into tools which aid in communication as well as identify key elements in the cognitive process concerning auditory discernment.

Hope College and Ready for Life: Kate's Story

Hannah Kenny
Kate Veldink

Mentors:
Dr. Dennis Feaster,
Sociology & Social Work

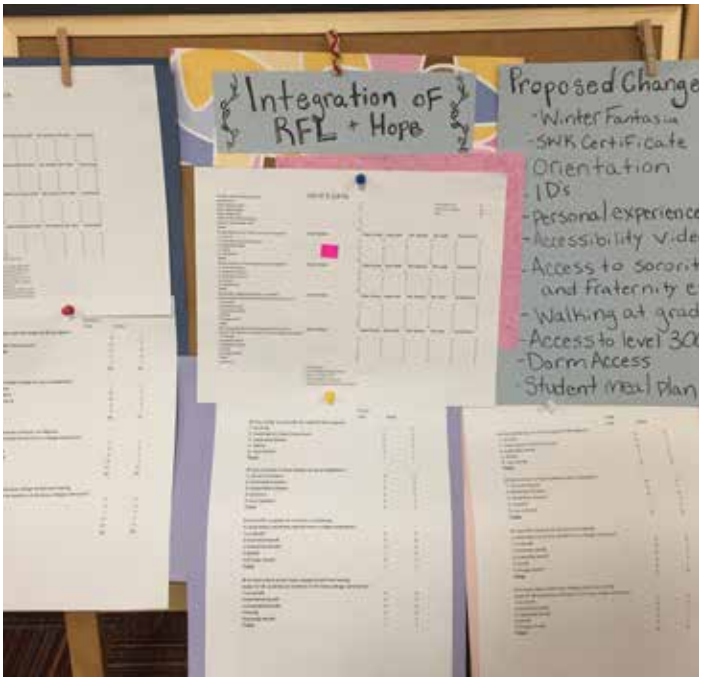
Dr. Marsely Kehoe
Mellon Scholars Program

This research was supported by the Hope College Mellon Scholars Program.

In an effort to merge social science and humanities methodology, I undertook an ethnographic case study of Hope College and Ready for Life (RFL) student Kate Veldink, seeking to answer this question: What are the day-to-day experiences of a RFL student on Hope College's campus? I was able to secure consent from Kate and her family, enabling us to embark as research partners in this query. Through the Mellon Scholars Program of Hope College, we created an inquiry-into-research project as an extension to the class Human Behavior and the Social Environment in the department of Sociology and Social Work. We investigated accessibility and awareness for students with disabilities on-campus in the RFL program.

Under the mentorship of advisor Dr. Dennis Feaster, we developed a project to showcase Kate's vision for greater integration between the Hope College and RFL. We used oral history methodology to conduct a series of interviews with Kate and her family, friends, and community supports. Both the Grounded Theory and Cooley's looking-glass self concept further informed our process as these interviews were then analyzed and compiled into a short documentary that brings to light the story of Kate and her peers as they navigate Hope College through the RFL program, and calls to action the administration of Hope College to recognize and react to these students' realities.

A central theme that emerged from this process is the paradox between accessibility and barriers for RFL students. Hope College welcomes RFL students into the campus community, but inviting these students into our daytime routine is not enough. We must embody the words of our Mission Statement of life in a global society, which embraces and appreciates all individuals wholly.



Kate Veldink conducting her research. Photos courtesy Nicole Mosterd.

SOCIOLOGY & SOCIAL WORK

Less Confusion, More Inclusion: Hope College Attitudes toward the RFLA Program

Katherine Veldink
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Mentors:
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This study was inspired by an interest in further inclusion of people with disabilities on Hope College's campus. The goal is to grow our institution's awareness of the Ready For Life Academy (RFLA) and the ways in which students feel included and marginalized. At the beginning of this process, we wanted to understand how much Hope College students, faculty, and staff knew about the RFLA program. In addition, we wondered whether our community believed they would benefit from additional integration of RFLA students. Our hypotheses were as follows: "Most Hope College students, faculty, and staff, will not have an adequate understanding of the RFLA program" and "A majority of Hope College students believe that further inclusion of the RFLA students would benefit our community." To test these hypotheses, we surveyed people from Hope College's campus. After collecting our data, we noted that the majority had *"heard about (RFLA), but didn't know much,"* suggesting confirmation of our first hypothesis within the limitations of our study. Our other findings noted that 67.2% of our respondents believing that Hope College would *"strongly benefit"* from having RFLA students as members of Hope College's community, suggesting support of our second hypothesis. Limitation of this study include the size of our sample (n = 64) and our reliance on convenience sampling, and would have liked to have more input from staff and faculty. We hope that our findings will lead to additional discussion for change and further opportunities for inclusion of people of all abilities on our campus.

Medical Students and the Kind of Doctors They Are Becoming

Jacob Wantoch

Mentor:
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This research was supported by the Hope College Mellon Scholars Program.

Medical school is a notoriously difficult process that is best known for being competitive and time consuming. In 2011, a large survey was sent to 960 3rd-year medical students at 24 randomly selected schools across the United States.The survey consisted of a battery of quantitative scales as well as a few open ended short answers. This research project focused on one of the two open ended responses, which asked the students to describe how their experiences in medical school are shaping the kind of physician they are becoming. Using NVivo, the open ended answers were coded by major themes. The most dominant experiences shaping them were those relating to caring for patients, positive role models, a combination of both, and negative events. These themes were further sorted by their self-reported religiosity, spirituality, and church attendance. Those who emphasized patient care tended also to be the most religious and spiritual. However, church attendance did not appear to be related to the students' responses.

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