Iowa Regent Universities present the

14th Annual Research in the Capitol

Monday, April 1, 2019
11:30am - 1:30pm
Iowa State House, Rotunda
Des Moines, Iowa

❧ Welcome ❧

Welcome to our fourteenth annual Research in the Capitol.

The participating undergraduate students from our three Regent's Universities have come to the Iowa Statehouse to share their enthusiasm for research and the education they are receiving with legislators, members of the Board of Regents, and the public. The nearly 800 students who have participated over the years have gone on to contribute to our state as doctors, educators, engineers, lawyers, nurses, and professionals in various disciplines. The opportunity for our students to share their knowledge and exuberance with legislators, Regents, and guests in the Iowa Capitol is a special honor that has stayed with them across the years.

Research involvement plays a central role in undergraduate education for a large number of our students. Their involvement helps them become more successful academically, more developed in their career and professional preparation, and more satisfied with their college experience. Research engagement helps students become problem solvers developing the critical thinking skills that benefit them as they move into the workforce or on to graduate or professional training.

The presentations before you today required countless hours of effort on the part of the students and their mentors outside of the classroom and represent the shared commitment our students, staff, and faculty place on the undergraduate experience. As you speak with these outstanding students, you will learn first hand the impact research involvement has on Iowa's students and the positive impact these students bring to our outstanding Iowa Public Universities.

Robert Kirby
Director, Iowa Center for Research by Undergraduates

Schedule

11:30am Opening Remarks

- Bob Kirby - Director, Iowa Center for
  Research by Undergraduates

- Sydney Ellis - Student Speaker - Iowa State University

11:45am-1:30pm

- Student Poster Presentations

Iowa Regents Universities Contacts

Robert Kirby
Director
Iowa Center for Research by Undergraduates
The University of Iowa
6 Gilmore Hall
Iowa City, Iowa 52242
Phone: 319.335.8336
bob-kirby@uiowa.edu

Jessica Moon
Director
University Honors Program
University of Northern Iowa
2401 College St.
Cedar Falls, Iowa 50614
Phone: 319.273.3175
jessica.moon@uni.edu

Svitlana Zbarska
Coordinator for Undergraduate Research
Honors Department
Iowa State University
2132 Jischke
Ames, IA 50011
Phone: 515.294.2064
szbar@iastate.edu

Student Presenters

1. Maya Altemeier—University of Iowa

2. Jenna Anderson – University of Northern Iowa

3. Sabrina Ash – Iowa State University

4. Nicole Baxter – University of Northern Iowa

5. Brandon Beecham – Iowa State University

6. Joseph Burba – University of Iowa

7. Stuart Burzette – Iowa State University

8. Victoria Cassady – University of Iowa

9. Philip Cordova; Jacob Shedenhelm – Iowa State University

10. Dexter Cox – University of Northern Iowa

11. Mackenzie Cross – University of Iowa

12. Gabrielle Duncan – University of Iowa

13. Breanna Dykstra; Alyssa Iverson – Iowa State University

14. Scarlett Eagle – Iowa State University

15. Sydney Ellis; Nicole Miller – Iowa State University

16. Alec Glidden – University of Northern Iowa

17. Lucas Goodman – Iowa State University

18. Jesse Gray – University of Iowa

19. Hannah Gregor – University of Northern Iowa

Student Presenters

20. **Yuwei Guo – University of Iowa**

21. **Cameron Hauser – University of Iowa**

22. **Ruben Hernandez Jr; Emily Vanek – Iowa State University**

23. **Ross Lanier – University of Iowa**

24. **Rikki Laser – University of Iowa**

25. **Collin Lint – University of Northern Iowa**

26. **Zoey Mauck – Iowa State University**

27. **Brennan McBride – Iowa State University**

28. **Emily McLain – University of Iowa**

29. **Christina Meadows – Iowa State University**

30. **Ellen Meis – Iowa State University**

31. **Christopher Merck – University of Northern Iowa**

32. **Madison Merfeld – University of Iowa**

33. **Marissa Mueller – University of Iowa**

34. **Nicole Nucaro; Jocelyn Roof – University of Iowa**

35. **Jenna Oftedal; Shibani Raje – Iowa State University**

36. **Cade Olmstead – University of Northern Iowa**

37. **Sam Ponnada – University of Iowa**

38. **Mallory Park – University of Northern Iowa**

Student Presenters

39. **Natasha Peterson – University of Northern Iowa**

40. **Sam Prophet – University of Northern Iowa**

41. **Delaney Ridgway – Iowa State University**

42. **Orion Risk – University of Northern Iowa**

43. **Marissa Roghair – Iowa State University**

44 **Miho Sanders – University of Northern Iowa**

45. **Nathan Schmidt – University of Northern Iowa**

46. **Allyse Shoeman – Iowa State University**

47. **Jeffrey Shymanski – University of Iowa**

48. **Megan Slattery – Iowa State University**

49. **Victor Soupene – University of Northern Iowa**

50. **Nicholas Stange – University of Iowa**

51. **Caleb Stekl – University of Northern Iowa**

52. **Alexandria Sturtz – University of Iowa**

53. **Zoe Swinton – University of Iowa**

54. **Lyn Tackett – University of Northern Iowa**

55. **Joseph Tibbs – University of Northern Iowa**

56. **Madison Thomas – Iowa State University**

57. **Brandon Vance – Iowa State University**

Abstracts

1. Maya Aletmeier
Hometown – Cedar Rapids, Iowa
Major – Public Health, Biochemistry
Mentor – Wen Liu, Ryan Carnahan

Characteristics of Staff-Resident mealtime verbal communication and relationship with intake in Nursing Home Residents with Dementia

As our population ages, increasing numbers of adults will be entering long-term care facilities. Relatively little research has been published on the relationship between caregiver-resident communication at mealtime and resident nutritional outcome. This poster summarizes patterns of and relationships between staff-resident mealtime verbal communication and intake in nursing homes. The study sample included 111 observations of 25 residents, 29 staff members, and 9 different nursing home locations. It was found that 78% of feeding attempts were successful, and 22% of attempts were unsuccessful. It was found that the feeding assistants spoke most frequently with 68% of the total verbal communication codes, and primarily to residents, with 72% of the feeding assistant's codes directed towards them. Both the resident and other person-types spoke most frequently to feeding assistants. Feeding assistant, other staff, and resident top three codes were all positive. Bivariate analyses were used to describe the relationship between verbal communication and intake. There was a significant and positive relationship between total intake and total communication, as well as successful intake and positive communication. This provides evidence that there is an important relationship between mealtime verbal communication and nutritional intake.

2. Jenna Anderson – University of Northern Iowa
Hometown – Cedar Rapids, Iowa
Major – Psychology
Mentor – Elizabeth Lefler

The Relation between Disordered Eating, Stress, and Anxiety in First-Year College Women

Research has shown that there is an increase in rates of stress and disordered eating for students transitioning to college. The current study examined this connection by determining the relation between disordered eating, stress, and anxiety in first-year college women. To this end, 99 college-enrolled women completed paper-and-pencil surveys in a psychology lab, such as the Depression Anxiety and Stress Scales (DASS-21) and the Eating Disorders Examination Questionnaire (EDE-Q). According to the results, the DASS-21 stress sum was significantly correlated with the EDE-Q total disordered eating sum ($r(92) = .330$, $p = .001$), but the DASS-21 anxiety sum was not ($r(92) = .075$, $p = .473$). Further detailed analyses will be presented examining the relation between various subscales of the DASS-21 and EDE-Q. These results suggest that college mental health resources should be focused on reducing stress and identifying eating problems in the transition to college.

3. Sabrina Ash – Iowa State University
Hometown – Des Moines, Iowa
Major – Psychology
Mentor – Craig Anderson

Exploring Relations between Dark Personality Traits, Media Violence Exposure, and Finding Humor in Media Violence

Who finds media violence funny? Several "dark" personality traits may predict this. We consider there to be six dark personality traits: narcissism (only has an interest in themselves), psychopathy (cruel disregard for others), Machiavellianism (can easily manipulate others), schadenfreude (finding pleasure in another person's pain), spitefulness (willing to incur a cost to cause harm towards another person), and everyday sadism (harming others for pleasure). People with these traits have little or no empathy towards others and, at some level, find pleasure in another person's pain. These features are what we believe leads people to find humor in media violence. People who are desensitized normally show little or no empathy towards others. It seems that desensitization at an extreme form would be shown as finding humor in media violence. We believe that people with these dark personality traits are desensitized and will find humor in media violence. We tested these hypotheses in a cross-sectional study and found that some of the dark personality traits were associated with finding humor in media violence.

4. Nicole Baxter – University of Northern Iowa
Hometown – LeClaire, Iowa
Majors – Political Science, Philosophy
Mentor – Yasemin Sari, Tessa Herren

Democracy, Climate Change and Mass Migration: What to do in the face of international displacement

Article 15 of the Universal Declaration of Human Rights (1948) states that all people hold the right to have a nationality. How is this right to be fulfilled when a land submerges below the sea or becomes inhospitable for human life, thereby displacing the nation as a whole? In response to Christopher Heath Wellman's defense of a legitimate state's presumptive right to self-determination (2008), exemplified in its ability to limit immigration, I take up the question of what we as a democratic nation are obligated to do in the face of a mass migration of displaced persons due to the ramifications of climate change. Contrary to Wellman's contention, I argue that a country is not a "country club" and that a radical modification of standards for admission is in order. At this juncture, a state's right to self-determination cannot unilaterally determine who lives and who dies, especially in cases where it is a matter of having a piece of land to stand on.

5. Brandon Beecham – Iowa State University

Hometown – Ankeny, Iowa
Major – Accounting & Finance
Mentor – Diane Janvrin

Analysis of Iowa Public Universities' Financials' Impact on Tuition Prices from 1990-2017

Iowa public university tuition prices have been rising over the past few decades which has made education unattainable for those unable to afford the large price tags. The financial statements of the three Iowa public universities from 1990-2017 were analyzed. Our research found that yearly tuition and fees per student, when adjusted for inflation, have increased by about $5,000 since 1990 for Iowa residents while the non-resident yearly tuition and fees increase has been around $10,000 -$30,000 depending on the university. Increased scholarship spending since 1990 has caused the tuition "sticker price" to increase by around $2,500 - $2,900. ISU and U of I currently have state funding per enrolled student in the range of 49% and 44% lower than their 1990 inflation adjusted amounts respectively; however, UNI has only seen a 6% decrease in state funding. These factors and others have caused the average student's tuition at ISU, U of I and UNI to increase $3,772, $7,449, and $1,479 respectively since 1990. If this trend toward rising tuition prices continues to increase, we could begin to see fewer students attending institutes of higher education which could negatively impact the future economic prospects of the state of Iowa.

6. Joseph Burba – University of Iowa

Hometown – Salem, Wisconsin
Major – Biochemistry
Mentor – Madeline Shea

Clinically Isolated Calmodulin Mutations and their Effects on Calcium-Dependent Ligand Binding

Calmodulin (CaM) is a very important, highly conserved protein that is necessary for cellular function. It is the primary intracellular calcium-signaling molecule and is responsible for the regulation of a myriad of target proteins. Recently, a number of CaM mutations have been isolated in conjunction with various cardiomyopathies, including CPVT and Long QT Syndrome. Our lab has begun to characterize the binding affinities of these CaM mutants with known target molecules in order to help pioneer treatments for these heart defects.

7. Stuart Burzette – Iowa State University

Hometown – Des Moines, Iowa
Majors – Community & Regional Planning, Environmental Science
Mentor – Monica Haddad

Examination of Economic Resilience and Regional Capacity in the Midwest

Micropolitan areas are between small towns and large cities, with a population over 10,000 and under 50,000 people, and they comprise 10% of the U.S. population. While Micropolitan areas include a significant part of the US population, they have been neglected from academic research. The dearth of research on Micropolitan areas is especially problematic when their existence is threatened by economic shocks that can happen, for instance, when a major employer decides to leave a region. This research will answer the following question: What are the economic characteristics that make certain counties with Micropolitan areas more resilient than others in the Midwest? Our methodology will use regression models to understand the relationship between employment growth and counties' economic characteristics such as related entropy, dependence on agriculture, and percentage of employment in manufacturing. The economic shock will be measured by the difference in establishments with 250 or more employees in 2008 and 2016. Results will allow us to deliver recommendations for Micropolitan areas' planners who are interested in designing strategies to increase economic resiliency.

8. Victoria Cassady – University of Iowa

Hometown – Iowa City, Iowa
Majors – Biochemistry, Microbiology
Mentor – Ronald Weigel

HER2+ Breast Cancer Outcomes are Associated with TFAP2C

Breast cancer affects one in eight women in the U.S., resulting in over 42,000 deaths annually. HER2+ breast cancer is associated with worse prognosis and higher risks of recurrence and metastasis, which was previously showed to be regulated by transcription factor activation protein C (TFAP2C). However, the mechanism of TFAP2C in HER2+ breast cancer remains unclear. Here we identify differential gene targets of the transcription factor TFAP2C within the HER2+ subtype and propose a mechanism of regulation. By comparing cell growth and invasiveness through MTT and invasion assay in TFAP2C eliminated HER 2+ breast cancer cell lines we found that TFAP2C regulates CDH5 and CDKN1A, two genes highly associated with HER2+ breast cancer outcome. A detailed understanding of differential gene regulation within the HER2+ subtype is crucial for understanding the biology of HER2+ breast cancer and informing treatment development.

9. Philip Cordova; Jacob Shedenhelm – Iowa State University
Hometown – Overland Park, Kansas; Grimes, Iowa
Majors – Computer Science; Software Engineering
Mentor – Anuj Sharma

TIMELI: Using Data Analysis to Improve Traffic Safety
The Federal Highway Administration (FHWA) estimates that a quarter of the congestion on U.S. roads is due to traffic incidents such as a crash, an overturned truck, stalled vehicles, or a variety of other impediments to normal traffic flow. Iowa State University (ISU) and its partners TransCore and Iowa DOT propose TIMELI (Traffic Incident Management Enabled by Large-data Innovations): a new, robust traffic incident management system integrating innovative data analysis techniques to monitor traffic incidents in real time, proactively control risk, quickly detect traffic incidents, identify the location and potential cause of these incidents, and suggest traffic control alternatives. Our goal in this project is to implement camera-based traffic incident detection and congestion detection algorithms on a statewide level and develop a user-interface to efficiently show the detected incidents to traffic incident managers (TIMs). The incident and congestion detection algorithms are being implemented in server-based multiple Graphical Processing Units (GPUs) to handle more than 300 cameras installed across the state of Iowa. These algorithms are based on state-of-the-art deep learning techniques to build a robust incident detection system. Our user-interface is also designed to minimize the time spent by TIMs in managing the detected incidents, thereby reducing their cognitive load.

10. Dexter Cox – University of Northern Iowa
Hometown – Parkersburg, Iowa
Majors – Chemistry, Physics
Mentor – Tim Kidd

Optimization of Ultrasonic Parameters for the Synthesis of Nanocellulose Aerogels

Nanocellulose is a renewable and biocompatible material that has a tensile strength similar to aluminum, is stiffer than Kevlar, and has a strength to weight ratio eight times that of stainless steel. There has been a range of studies on nanocellulose materials for potential use as a low-calorie food substitute, biomedical wound dressings, and as a structural component for buildings. Throughout this research experiment, nanocellulose aerogels of different mass compositions were created through a mechanical process using an ultrasonic processor with a titanium probe attachment. The purpose of this study was to develop a method that reduces the amount titanium contamination in the nanocellulose aerogels by influencing the sonication parameters. As a result, the ultrasonication processing time of nanocellulose aerogels was drastically reduced consequently reducing potential contamination from the titanium probe.

11. Mackenzie Cross – University of Iowa

Hometown – Massena, Iowa
Majors – Anthropology, Interdepartmental Studies (Zoology)
Mentor – Russel Ciochon

Specialized Forms of Moving in Lemurs Influence Behavior

Lemurs are a diverse group of primates which display an impressive range of adaptations. Many different species of lemur have specialized forms of moving such as the Sifaka (Propithicus coquereli) who leap in an upright posture from tree to tree in a style known as vertical clinging and leaping. Other lemurs, such as the Ring-tailed lemur (Lemur catta), are primarily quadrupedal. These different styles of movement confer different costs to the species. For instance, the Sifaka's vertical clinging and leaping is more intensive than the Ring-tailed lemur's quadrupedalism. To better understand how movement influences behavior, I gathered data on the frequency and type of movement for six species of lemurs, which spanned forty-one individuals. This work contributes to growing understanding of primate movement and behavior.

12. Gabrielle Duncan – University of Iowa

Hometown – Waukee, Iowa
Major – Biology (Cell and Developmental)
Mentor – Gen Shinozaki

Epigenetics of Delirium and Aging

Delirium is a sudden change in mental state with severe confusion and impaired brain function. It is common in elderly patients, and it is dangerous because it leads to increased mortality. The pathogenesis of delirium is not well understood, but major risk factors include aging and exogenous insults such as infection or surgery which release pro-inflammatory cytokines. Older individuals may have DNA methylation changes that influence increased cytokine release upon insult, which may lead to delirium. Our goal is to find an epigenetic biomarker that can identify individuals susceptible to delirium. In the Department of Psychiatry at UIHC, the relationship between aging and epigenetic marks on DNA (DNA Methylation) of pro-inflammatory cytokine genes was investigated. The results showed strong associations between aging and decreases in DNA methylation levels of cytokine gene CpGs in glia and blood which may influence the pathogenesis of delirium.
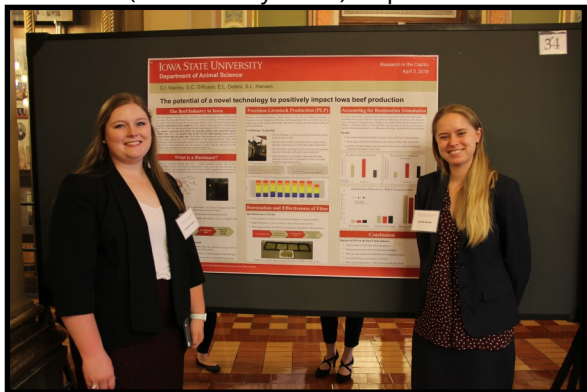
13. Breanna Dykstra; Alyssa Iverson – Iowa State University
Hometowns – Cedar Rapids, Iowa; Springfield, Nebraska
Majors – Biological Systems Engineering; Biological Systems Engineering
Mentor – Raj Raman

Emerging Markets for Switchgrass in the Midwest: Challenges and Opportunities

The objective of this CenUSA Bioenergy research project is to evaluate and summarize the current state of the market for switchgrass and to showcase the developing and alternative markets that are currently available for switchgrass. The driving force behind this effort is the EPA Renewable Fuels Standard's goal to produce 16 billion gallons of cellulosic biofuel by 2022. Switchgrass is a high-yielding perennial grass, both able to be grown on marginal land in the central U.S, and able to be used as a feedstock for cellulosic ethanol production. CenUSA-partnered researchers are still increasing the potential yield of switchgrass through ongoing research, but the established market for corn stover and the low price of corn has inhibited the take off the switchgrass market. This paper examines developing and alternative markets for switchgrass that could provide a supplemental income to Midwest farmers while also ensuring that an energy grass supply is in place when the cellulosic ethanol industry becomes fully established.

14. Scarlett Eagle – Iowa State University
Hometown – Johnston, Iowa
Major – Genetics
Mentor – Elizabeth McNeill

Examining the functional role of microRNAs implicated in Hypermobile Ehlers-Danlos Syndrome in maintaining connective tissue morphology

Ehlers-Danlos Syndrome (EDS) is a family of genetic connective tissue disorders characterized by mutations affecting the production and processing of collagens and related proteins. The cause of the most common type, Hypermobile EDS (hEDS), is still unknown. MicroRNAs (miRNAs) are a class regulatory molecules which are collectively predicted to regulate over 1/3 of human genes. MiRNAs exhibit intricate tissue- and stage-specific regulation of gene expression, making them a promising candidate for investigating the underlying causes and treatment of complex genetic disorders. The broad variation between patients, along with factors such as gender disparities and developmental implications, makes the possibility of microRNA dysregulation as a cause of hEDS promising. Using published data from hEDS patients, we identified potentially-pathogenic interactions that could be underlying the disease. This allowed us to manipulate microRNA levels to mimic those of patients in an attempt to model hEDS in fruit flies. Examination of collagen fibril morphology in flies modeling microRNA dysregulation patterns observed in Hypermobile Ehlers-Danlos Syndrome will begin to elucidate the possible functional role of miRNAs in this genetic disease.

15. Sydney Ellis; Nicole Miller – Iowa State University

Hometowns – Ames, Iowa; Springville, Iowa
Majors – Spanish, Psychology; Communication Studies
Mentor – Katherine Rafferty

Helping Health Care Professionals Understand Social Support Communication Needs for Parents of Children Living With Complex Chronic Conditions

More than 150,000 children in Iowa have special health care needs (University of Iowa, 2019). This means that approximately 2 out of 5 parents are tasked with the responsibility of caring for their medically complex child. This paper assesses these parents' social support needs. Parents were recruited from a pediatric and perinatal palliative care program from a large hospital in Iowa. We used Charmaz's (2006) grounded theory to analyze 18 interviews where parents discussed helpful and unhelpful support received from medical professionals. Parents discussed three major themes characterizing helpful support: (1) emotional intelligence, (2) aggregation of social capital, and (3) empowerment through education. From these themes we built a Supportive Communication Model for Health Care Professionals, which conveys the collaborative nature and equal significance of each theme. Our research lends credence to programs like the Title V Maternal and Child Health Service Block Grant Program, Iowa's Pediatric Integrated Health Homes and current legislation surrounding the Affordable Care Act that affect parent and child medical support. This study shows the value of enacted support from medical professionals and further enumerates the need for legislation that allows medical professionals to support and equip an underserved population.

16. Alec Glidden – University of Northern Iowa

Hometown – Cedar Falls, Iowa
Major – Biology (Ecology, Evolution, and Organismal)
Mentor – Mark Sherrard

Seed mix design and first-year management influence ecological outcomes in prairie reconstruction

In this study, we test whether prairie reconstructions can effectively provide both erosion control and high-quality pollinator habitat. Research plots were established with three seed mixes of varying diversity, grass-to-forb seeding ratio, and cost. To assess ecosystem services, we measured native stem density, canopy cover, and inflorescence production over a four-year period (2015 – 2018). The mix with the highest grass-to-forb ratio (3:1) had high native plant cover and stem density, but produced few inflorescences. The mix with the lowest grass-to-forb ratio (1:3) had high inflorescence production, but also had low cover and high weed abundance. The mix with a 1:1 grass-to-forb ratio, had high native cover and grass stem density (comparable to the 3:1 mix) and high inflorescence production (comparable to the 1:3 mix). Our results suggest that a well-designed seed mix, with a 1:1 grass-to-forb ratio can effectively address multiple conservation concerns in prairie reconstruction.

17. Lucas Goodman – Iowa State University
Hometown – Montezuma, Iowa
Majors – Animal Ecology, Environmental Studies
Mentor – Thomas Isenhart

Balancing conservation and economics to improve water quality in Iowa and beyond

Nitrogen and phosphorus runoff or nutrient pollution from agricultural landscapes affects water quality throughout the country, removing oxygen from the Gulf of Mexico and creating one of the largest dead zones in the world. The influx of these nutrients into waterways negatively impacts human health, biodiversity, the US economy, and efforts to purify drinking water. To address this issue at the state-level, Iowa introduced the Iowa Nutrient Reduction Strategy to reduce both nitrogen and phosphorus runoff to surface waters by 45%. One way to reduce nutrient pollution is through the use of best management practices (BMPs) to retain nutrients and enhance water quality. The federal government invests billions of dollars in the Midwestern United States towards BMP effectiveness; yet, local and regional water quality continues to decline. Our study uses geospatial data to identify the optimal placement of BMPs in a Central Iowa watershed by strategically locating BMPs to align with nutrient concerns and cost-effectiveness. We compare our model to existing BMPs to improve conservation planning within agricultural landscapes, maximize nutrient removal, and minimize land taken out of production. The success of our efforts could advance conservation strategies in a cost-effective manner and help preserve our health, habitats, and ecosystems.

18. Jesse Gray – University of Iowa
Hometown – Coralville, Iowa
Major – Human Physiology
Mentors – Ryan LaLumiere, Victoria Muller Ewald

Neurons in the infralimbic cortex adapt to promote cocaine abstinence

A central issue in cocaine addiction is that addicted individuals are vulnerable to relapse despite extended periods of drug abstinence, inspiring researchers to investigate the neural circuitry underlying this occurrence. Previous research using a rat model of addiction revealed that the infralimbic cortex (IL) is crucial in extinction learning and the suppression of cocaine-seeking behavior. However, most investigations involve manipulations of the IL—little research has directly recorded the activity of this brain region. This study used in vivo electrophysiology to record neurons within the IL as rats self-administered cocaine and experienced withdrawal from cocaine. This study demonstrated that there are subgroups of neurons within the IL that respond to lever pressing, the availability-onset cue, and the decision to press the lever. Additionally, firing patterns in the IL change as animals learn to decrease their cocaine seeking. This study illustrates the involvement of the infralimbic cortex in modulating cocaine-seeking behavior.

19. Hannah Gregor – University of Northern Iowa
Hometown – Solon, Iowa
Major – Political Communication
Mentor – Cara Burnidge

Students in the Margin: The Creation of Evangelical Ministries on College Campuses

My research focuses on how evangelical ministries help students create their identity as individuals and members of a social group through rituals and language. I use videos and promotional materials from the SALT Company Ministry to understand how students and the organization understand performing their role as evangelicals. Using this information, I found that identity creation of SALT ministries and members can come into tension with perceived hegemonic campus culture, such as disagreements about liberal social values and party culture. Members of evangelical denominations have framed themselves as the minority, but empirically they make a large portion of our campus. My research is to understand what happens when a majority of students create their identity by being in conflict with the larger campus and what this means for students who are not evangelicals that represent the campus culture the SALT Company denounces.

20. Yuwei Guo – University of Iowa
Hometown – Urumqi, XinJiang, China
Major – Biochemistry
Mentor – Huojun Cao

Profiling gene expression in the epithelial and mesenchymal compartments of developing rodent incisor

The epithelial tissue of the dental placode instructs the development of the tooth by synthesizing signaling molecules including Shh, Wnt, Bmp and Fgf signals. These signaling pathways control the expression of specific transcription factors in the epithelium and mesenchyme. One of the earliest transcription factors to be expressed in the dental epithelium is Pitx2 (paired-like homeodomain transcription factor 2). We are interested in what initiates the expression of the transcription factor Pitx2 and the formation of the primary tooth germ.

21. Cameron Hauser – University of Iowa

Hometown – Plymouth, Wisconsin
Major – Human Physiology
Mentor – Gordon Buchanan

Involvement of the locus coeruleus in CO2-induced arousal from sleep

CO_2-induced arousal is a protective mechanism which allows for the detection of increased blood CO_2 and signals for arousal from sleep to prevent harmful buildup. This process may be involved in conditions such as sudden unexpected death in epilepsy (SUDEP) and sudden infant death syndrome (SIDS), where failure to arouse to increased CO_2 could contribute to death. Despite its importance, mechanisms for CO_2-induced arousal are not fully understood. Determining the structures involved could provide insight on the malfunctions occurring in these conditions. To test the involvement of a brainstem structure known as the locus coeruleus, mice were injected with a toxin (DSP4) to destroy its cells and exposed to CO_2 during sleep. It was found that DSP4-injected mice took longer to arouse to CO_2, supporting locus coeruleus involvement. This finding advances our understanding of the CO_2-induced arousal mechanism and may be important in the prevention of SUDEP and SIDS.

22. Ruben Hernandez Jr; Emily Vanek – Iowa State University

Hometowns – Creston, Iowa; Dubuque, Iowa
Major – Community and Regional Planning
Mentor – Sara Hamideh

Damage, Dislocation, and Displacement of Renter and Immigrant Households after Low Attention Disasters

Natural hazards impact communities and people in disproportionate ways, and Iowa is no exception to this. The goal of the research we conducted in Marshalltown, IA after an EF-3 tornado was to examine the impacts of low attention disasters with respect to damage, dislocation, and displacement of renter and socially vulnerable households. Marshalltown was extensively affected by an EF-3 Tornado on July 19th 2018, but was not a presidential-declared disaster until roughly two months after. Marshalltown has higher than average renter-occupied housing and immigrant community members for a small town. Research has shown that in events such as these, socially vulnerable and low-income neighborhoods tend to recover slower than more affluent neighborhoods. Our team conducted surveys on a random sample of 660 households and recorded structural housing damage in the tornado path from September to November. The preliminary findings of our analysis indicate that houses in low-income neighborhoods were more heavily damaged compared to other neighborhoods, especially renter-occupied houses, and despite lack of alternative housing options these neighborhoods had not made significant progress towards repairs, due to their limited access to financial recovery resources.

23. Ross Lanier – University of Iowa

Hometown – Tea, South Dakota
Major – Biochemistry
Mentor – Miles Pufall

Alternate splicing of LEF1 affects the treatment sensitivity of B-cell acute lymphoblastic leukemia

Glucocorticoids (GC) are a key component of the combination chemotherapy regimens for treating all lymphoid cancers, including B-cell precursor acute lymphoblastic leukemia (B-ALL). These small steroid-based molecules function by activating the Glucocorticoid Receptor (GR) a transcription factor, which in turn regulates genes that induce cell death. Unfortunately, a subset of patients are either resistant to treatment or relapse. Importantly, whether a patient responds to GCs predicts whether they will respond to any treatment, suggesting that restoring sensitivity to GCs will improve treatment. Our goal is to understand how GCs kill B-ALL cells and how resistance arises. Using a genome wide shRNA screen targeting every protein coding gene in the genome we identified genes that contribute to GC-induced cell death, and proteins that modulate GC efficacy. Through this study we found that GC-suppression of B-cell development genes contributes to cell death. Among the hits was LEF1, the terminal effector of WNT signaling, which is important for pro-B cell survival and proliferation. The screen also identified another protein, MBNL1, that has a powerful effect of restraining GC cytotoxicity. MBNL1 is an RNA binding factor that regulates splicing and RNA localization. Importantly, knockdown of MBNL1 caused a quantitative exclusion of Exon 6 from LEF1, suggesting that MBNL1 works through LEF1 to regulate GC sensitivity. The goal of my project is to determine whether MBNL1-enforced inclusion of LEF1 Exon 6makes B-ALL cells more resistant to GCs, and whether this mechanism is an important checkpoint in B-cell development.

24. Rikki Laser – University of Iowa

Hometown – Vernon Hills, Illinois
Major – Neuroscience
Mentor – Marc Blumberg

Deficits in REM sleep twitching indicate developmental delay in a mouse model of autism

Autism is a neurodevelopmental disorder that affects approximately 1% of the population. Although autism usually expresses itself in children as impaired social behavior, movement irregularities are also common and may be better indicators for the early diagnosis of this disorder. Here, we studied differences in twitching ″ the jerky movements that occur exclusively during REM sleep and are particularly abundant in early infancy. Using high-speed videography and motion tracking, we found reduced twitching in mice from a strain designed to model autism. Our findings suggest that twitching can be used to assess risk for autism sooner than other currently available assessment approaches.

25. Collin Lint – University of Northern Iowa
Hometown – Cedar Point, Iowa
Majors – History, Political Science
Mentor – Ken Basom

Can Human Rights be Ignored for a Price? An Analysis of Lobbying Power and U.S. Foreign Policy Toward Human Rights

This thesis analyzes the incredible growth that the lobbying industry in the United States has experienced in the past forty years. In particular, the thesis explores how foreign states have utilized this industry to influence U.S. governmental policy towards their own governments, despite evidence of massive human rights violations. This thesis, through several case studies, makes the argument that the U.S. federal government should impose tighter regulations on lobbying in the U.S. by these human rights abusing states. The case studies include UNITA fighters in Angola throughout the 1980's, the delinking of human rights and trade between the U.S. and China in the 1990's, and Saudi Arabia's U.S. backed involvement in Yemen currently. These case studies demonstrate how lobbying has enabled these foreign actors to continue their human rights abuses, despite criticisms in the U.S.

26. Zoey Mauck – Iowa State University
Hometown – Des Moines, Iowa
Major – Landscape Architecture, Community and Regional Planning
Mentor – Ben Shirtcliff

The Case for Car-Free Communities

Air pollution, obesity, traffic fatalities, poverty, accessibility, and overall human happiness might seem to be entirely separate issues, but there is one thing that sits at the root of them all: the car. Our world has become consumed, and in turn congested, with single-passenger vehicles that affect each of these issues. Some issues (traffic fatalities) might seem more obvious than others (human happiness), but in the end, all deserve equal attention when considering how straightforward the solution could be: creating car-free communities. By exploring the many reasons for and benefits generated by going car-free, providing examples of communities that have been successful in making this change already, and analyzing a small town, Perry, Iowa, with great potential to go car-free as a case study, this analysis aims to reveal how challenges can be overcome to achieve success in creating human-centered, healthy, equitable, and livable communities.
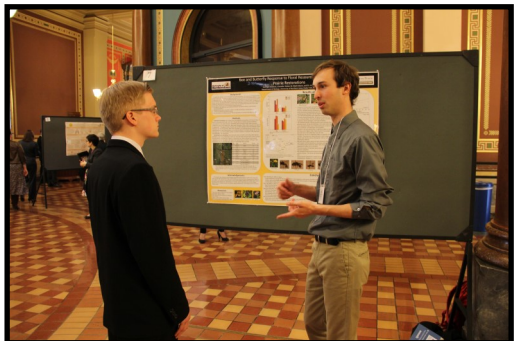
27. Brennan McBride – Iowa State University

Hometown – Altoona, Iowa
Major – Chemistry
Mentor – Kirill Kovnir

Synthesis and Structure of Ternary Rare Earth Silicon Pnictides

Ternary rare earth tetrel pnictides have been studied since the eighties and various different crystal structures have been discovered, yet no properties have been reported. Solid-state flux reactions have been used in attempts to optimize the syntheses of these ternary phases, in order to measure their properties. Tin, lead, and bismuth fluxes are the primary techniques being used. Our reactions have led to a new crystal structure, $LaSiP_3$, which crystallizes in the monoclinic space group, $P2_1/c$ and is predicted to be a semiconducting material with a band gap of 0.69 eV. Unlike previously reported structures, such as $LaSiA_3$ and $CeSiP_3$, this new phase is composed of alternating layers of La and SiP_4 tetrahedra, connected through edge sharing and P-P bonds.The discovery of novel compounds and their properties is one of the driving forces for the technological development of our society. Specifically, semiconducting materials are present in almost all forms of electronics today.

28. Emily McLain – University of Iowa

Hometown – Bussey, Iowa
Majors – Criminology, Law, & Justice, Communication Studies
Mentor – Wayne Jacobson

Taking Temperature: Looking at Student Experiences

This study seeks to further develop previous research looking at what perceived meaningful experiences students at the University of Iowa experience. For the context of this study, we asked undergraduate respondents about their most meaningful, or significant, experience. Their responses created the guidelines for our response categories and concepts. The data that is presented here seeks to understand student experiences. In doing so, this research can help the University of Iowa better accommodate, construct, and support its students.

29. Christina Meadows – Iowa State University
Hometown – Bettendorf, Iowa
Majors – Environmental Science, Geology
Mentor – Michael Castellano

Investigation of Discrepancies between Methods of Quantifying Soil Nitrogen in Agricultural Fields

Quantifying soil nitrogen in agricultural fields is an essential component of nutrient management for crop system production and environmental performance. Accurate and actionable soil nitrogen measurements are required to meet the Iowa Nutrient Reduction Strategy goals. The most common method for soil nitrogen measurement consists of shaking a soil sample in a concentrated salt solution for 30-120 minutes and measuring the concentration of nitrogen in solution. However, recent research questions the accuracy of this method for estimating plant-available nitrogen. Salt extraction can alter soil water status and disrupt soil structure, thus overestimating plant-available nitrogen. An alternative, but more laborious method, consists of directly suctioning soil solution and measuring the concentration of nitrogen in the solution. This method is thought to better represent the amount of nitrate that is available for plant uptake and loss to the environment. I hypothesized that salt extractions would produce consistently higher nitrate concentrations than lysimeters. Salt extractions did generally produce higher nitrate concentrations. However, there was no clear relationship between the concentrations of nitrate found in the soil solution and salt extracts. Therefore, salt extractions may not be a suitable replacement for analyzing plant-available nutrients until the relationship between these methods is better understood.

30. Ellen Meis – Iowa State University
Hometown – Le Mars, Iowa
Majors – Biology, Environmental Science
Mentor – Josh Beck

Optimizing CRISPR interference for Conditional Gene Regulation in Malaria Parasites

To continue fighting malaria, identification of new drug targets or life cycle intervention points and a better understanding of malaria parasite biology are crucial. While the ability to genetically manipulate the parasite in order to assess gene function is key to this goal, the tools to study important parasite genes are limited. CRISPR interference (CRISPRi) has emerged as a powerful and simple approach for conditional gene knockdown using enzymatically inactive Cas9 (dCas9). This project aims to develop and optimize a CRISPRi system in the most virulent human malaria parasite, Plasmodium falciparum, by determining optimal guide RNA design to achieve maximum target gene knockdown. To this end, we established a dual luciferase reporter system to test the activity of a tiled array of guide RNAs around the start codon of a gene target. We hypothesize that as the guide RNA location approaches the start codon, knockdown via dCas9 interference with transcription by RNA polymerase will increase. After determining the optimal guide RNA placement, the system can be used to screen putative transcriptional effector proteins to enhance knockdown. This system has the potential to provide a robust approach for studying essential P. falciparum genes with increased throughput. Current results will be discussed.

31. Christopher Merck – University of Northern Iowa

Hometown – Marion, Iowa
Major s– Mathematics Teaching, Political Communication
Mentor – Ryan McGeough

"It's Important to Just Have Your Voice Heard": Young Voters Changing Perceptions of Political Efficacy

Youth voter turnout in Iowa spiked in the 2018 midterm election. This paper attempts to figure out why. By replicating a 2004 study examining the voting behavior of young Iowans during the 2002 midterms, my study identified significant shifts in how young voters think and communicate about voting. After conducting 37 open-ended interviews with 18-24-year-olds, I found that although young people identified many of the same concerns in 2018 as they had in 2002, they were far more likely to vote. Respondents were more likely to identify the consummatory effects of voting, which in turn led to an increase in the identification of the instrumental effects of voting. I argue that their belief in the efficacy of their vote contributes to their more optimistic outlook on politics.

32. Madison Merfeld – University of Iowa

Hometown – Nevada, Iowa
Major – Biology
Mentors – John Wemmie (Psychiatry), Brian Dlouhy (Neurosurgery)

Evaluating the Role of ASIC1A in the Sedative Effects of Alcohol

Alcohol abuse and addiction are widespread problems. Sensitivity to alcohol is a risk factor in the development of alcohol use disorder. A molecule in the brain that may influence alcohol response is acid-sensing ion channel 1A (ASIC1A). We previously found that mice without this molecule have different motor behavior after receiving alcohol. To see how mice with and without ASIC1A react to higher, sedating doses of alcohol, we assessed behavioral changes by testing whether they were able to right themselves following an injection of alcohol, and by rating their behavior on a scale to see how sedated the mice became. We saw that mice without ASIC1A did become intoxicated, but tended to become less sedated. This suggests ASIC1A may be involved in mediating the sedating effects of alcohol, and may alter risk for development of alcohol use disorder. This information could be useful in identifying people at risk for alcohol use disorder and for developing treatments.
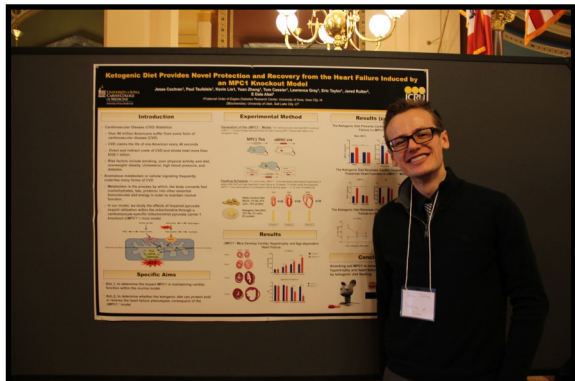
33. Marissa Mueller – University of Iowa

Hometown – Petrolia, Ontario, Canada
Major – Biomedical Engineering
Mentors – Laura Frey-Law, Ruth Chimenti

Comparing Methods of Quantifying Physical Activity using Actimetry

Objective measures of physical activity (PA) have growing applications in personal recreation, preventative/rehabilitative medicine and biomechanical analysis. Researchers rely on clinical-grade actimetry platforms such as ActiGraph to quantify PA; however, the specific effects of existing data-filters and algorithms are not well understood. A lack of standardization in converting raw accelerations to useful measures of step counts, energy expenditure (EE) and time spent in moderate-to-vigorous-activity (MVPA) remains problematic; therefore, the purpose of this study was to quantify the influence of analysis methods on PA metrics. GT3X-accelerometer data from 134 participants was analyzed using exhaustive combinations of 10 algorithms, the low-frequency-extension and wrist-hip correction. Measures of EE (kCal/METs), MVPA, and steps varied $\leq 83\%$, $\leq 100\%$, and $\leq 40\%$ respectively, demonstrating that PA estimates are highly dependent on analysis specifications that, though previously validated, are not interchangeable. Standardization protocol should be implemented to enforce detailed actimetry method documentation for accurate data validation and interpretation.

34. Nicole Nucaro; Jocelyn Roof – University of Iowa

Hometowns – West Des Moines, Iowa; Waterloo, Iowa
Majors – Ethics & Public Policy, Interdepartmental Studies; Sociology, Political Science
Mentor – Sarah Bruch

Research Partnership with the Iowa City School District: Student Perceptions of Teacher and Mentor Relationships

The Equity Implemented Partnership (EIP) is a research-practice partnership between researchers at the University of Iowa's Public Policy Center (UIPPC) and ICCSD. The aim of the EIP is to improve the equitability of school experiences and outcomes.

Education research has established that students who feel supported by their teachers have more confidence in their academic ability and are more engaged in learning. To gain further insight into student perspectives of teacher and mentor relationships, qualitative analysis was used to examine written comments from a student survey. Comments were double-coded and several themes emerged, including barriers and facilitators of positive teacher-student relationships and the impact on academic experiences. Related quantitative survey results are included to provide a broader context of the experiences represented in the qualitative themes. The results of this analysis can be used to inform policy decisions and teaching practices to make learning environments more equitable for each student.

35. Jenna Oftedal; Shibani Raje – Iowa State University

Hometowns – Dubuque, Iowa; Naperville, Illinois
Majors – Industrial Engineering; Industrial Engineering
Mentor – Leslie Potter

Developing a TRIZ-based Design for Flexibility Tool for Manufacturing Facilities

As manufacturers evaluate assets and long-term production plans, they struggle with how best to meet complex building requirements that maximize building flexibility and minimize costs. Research shows that manufacturers highly prioritize facility flexibility. However, infusing flexibility into facility design can be complex and achieving it can be costly. These issues could be mitigated with a dedicated tool for addressing flexibility in facility design. TRIZ (Theory of Inventive Problem Solving) is a problem-solving method that exploits information contained in millions of patents to identify solution genres and standard contradictions to drive inventive design principles. This user-friendly, decision support tool can efficiently reduce the complexity of incorporating flexibility into manufacturing facility design. Using this tool as a platform and incorporating information from fifteen case studies, construction-specific terms were mapped to TRIZ parameters and principles to create a construction industry specific TRIZ contradiction matrix. This paper describes basic TRIZ theory and previous uses in the construction industry. It then discusses industry input and case studies that helped make it construction-specific. Finally, it addresses the modified TRIZ tool's potential benefits to the construction industry regarding flexibility considerations.

36. Cade Olmstead – University of Northern Iowa

Hometowns – Ankeny, Iowa
Majors – Sociology, Philosophy
Mentor – Yasemin Sari

Hegelian Political Theater

This research focuses on the public sphere and the discourses which comprise it. Varying kinds of rhetorical techniques are used to achieve actors' ends, and this is true of all regardless of their political ideology. Analyzing the kinds of rhetorical devices and the effects they produce on political outcomes is essential for developing and maintaining a proper democratic discourse. This research attempts to do so through an analysis of the philosopher G.W.F. Hegel's Phenomenology of Spirit, specifically his discussion of Ancient Greek theater. Focusing on comedy, I formulate a rhetorical strategy for oppressed agents to use in the face of state coercion, so that they may reclaim agency and push for democratic change.

37. Sam Ponnada – University of Iowa

Hometown – Cedar Falls, Iowa
Major – Physics & Astronomy
Mentor – Philip Kaaret

X-ray Binaries in Early Galaxies

A High Mass X-ray binary (HMXB) is a system consisting of a massive star and an object with a strong gravitational field like a black hole or neutron star. The early Universe almost completely consisted of hydrogen and helium. Astronomers call elements heavier than helium 'metals', and these formed later by nuclear fusion in stars. The heating of the early, metal-poor Universe may have been partly due to radiation from HMXBs. To see how metal abundance (metallicity) impacts the production of HMXBs, we study a sample of blue compact dwarf galaxies (BCDs), which are small, optically blue galaxies, over a broad range of metallicity. We find an increase HMXB production at lower metallicity and a drop-off at higher metallicities. Our results suggest that metallicity is an important factor in the formation of HMXBs, and consequently that HMXBs may have contributed significantly to the heating of the early Universe.

38. Mallory Park – University of Northern Iowa

Hometown – Atkinson, Illinois
Major – Communication Disorders
Mentor – Jaimie Gilbert

Informed Hearing Loss Prevention for Theatre UNI

This project will explore noise-induced hearing loss (NIHL) in the demographic of theatre workers affiliated with Theatre UNI, the department of theatre at the University of Northern Iowa. Consideration will be given to the current common education of workers at Theatre UNI as well as the causes, symptoms, effects, and prevention of NIHL. Studies regarding NIHL can be applied to theatre workers to promote their health and wellness. To obtain data, a questionnaire will be sent via a department- wide email to gather information on the current climate at Theatre UNI in regards to hearing loss prevention. This questionnaire will include questions to determine whether students are already displaying signs of hearing loss, if they are concerned about hearing loss, and if they engage in hearing loss prevention. A sound level meter will be used in the scenery and costume construction areas to determine the noise level to which workers are exposed.
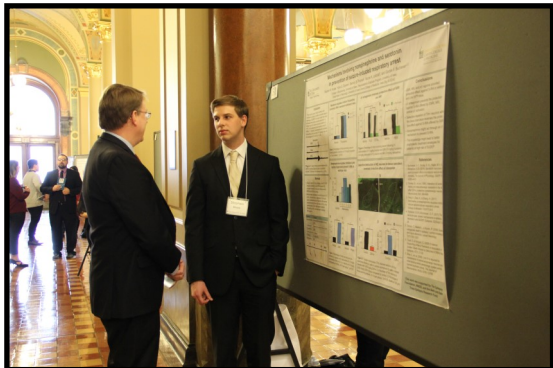
39. Natasha Peterson – University of Northern Iowa
Hometown – Whittemore, Iowa
Majors – Gerontology, Psychology
Mentor – Jiuquing Cheng

Decision Experience in Hyperchoice: The Impact of Age, Mental Fatigue, and Numeracy

With the world's older adult population expanding rapidly, it is important to understand how decision-making abilities change across the lifespan. The objective of this research is to study the effects of age, numeracy, and mental fatigue when faced with a consumer or gamble choice situation, in which many options are available (hyperchoice). Due to the development of technology, the scenario of hyperchoice is common. While people have more options to choose from, they may also feel overwhelmed. A total of 114 older adults and 112 younger adults were surveyed. Results of this study indicate that too many options may deteriorate decision satisfaction and increase decision difficulty, particularly in older adults and those with higher mental fatigue and lower numeracy. These findings support the importance of math education and strategies to maintain cognitive health into old age to avoid negative consequences of poor decision-making.

40. Sam Prophet – University of Northern Iowa
Hometown – Cedar Falls, Iowa
Major – Physics
Mentor – Pavel Lukashev

First Principles Study of Surface States and Tetragonal Distortion in Half Metals

Magnetic materials have been an increasingly popular area of research over the past decade. Half-metallic materials, in particular, are of specific interest due to their high degree of spin-polarization. One application of these materials that is of interest is spintronics. Electronics utilize the electric charge of electrons, while spintronics utilizes the spin of these electrons instead. Half-metals are very promising for this application, as they generally hold their magnetic properties up to high temperatures, and are relatively cheap compared to other metals. The following research has two goals for two different half metals. Firstly, identify the so called 'surface properties' of $Ti_2MnAl_{0.5}Sn_{0.5}$,. Second, determine the crystal structure of Mn_2PtSn.

41. Delaney Ridgway – Iowa State University
Hometown – Eldon, Iowa
Major – Animal Science
Mentor – Aileen Keating

The effects of glyphosate exposure on liver protein abundance

Glyphosate, commonly known as "Roundup," is a broad-spectrum herbicide widely used in the United States to kill unwanted weeds. Humans and animals are exposed to glyphosate orally and via inhalation. Chemicals are metabolized in the liver, thus we hypothesized that glyphosate exposure would alter abundance of proteins that are involved in chemical detoxification. The three proteins we studied were AhR, CYP1A1 and CYP1B1. The aryl hydrocarbon receptor (AhR) is a ligand-activated transcription factor that regulates chemical metabolism proteins. CYP1A1 and CYP1B1 are both members of the cytochrome P450 family of enzymes. These enzymes regulate reactions involved in drug metabolism and synthesis of cholesterol, steroids and other lipids. CYP1A1 is also known to be up-regulated through the AhR. My objectives for this study were to determine if exposure to glyphosate initiates a response in the abundance of enzymes critical for liver metabolism, learn common laboratory techniques such as Western Blotting and become better prepared for advanced education by furthering my knowledge in verbal scientific language and scientific practices.

42. Orion Risk – University of Northern Iowa
Hometown – Cedar Falls, Iowa
Major – General Studies
Mentor – Amy Osatinski

She's Not Allowed to Do That: Practice-As-Research on Actors Embodying Female Same-Sex Sexuality

The art of acting requires the authentic embodiment of another being; what happens in this process when a performance requires taking on a stigmatized sexuality? In summer 2018, an emerging theatre company in Cedar Falls, Iowa, produced Stop Kiss by Diana Son: a show that required its two female leads to embody same-sex sexuality. Guided by scholarship from Judith Butler, Jill Dolan, and Jerzy Grotowski — and following principles of practice-as-research — interviews and observation were used to explore and interpret how the actors in Stop Kiss experienced similarities and differences between their characters' experiences and their own. Findings led to further questions about what positions an actor to be strongly affected by their work and the transformative power of publicly performing stigmatized sexualities in theatre spaces.

43. Marissa Roghair – Iowa State University

Hometown – Ankeny, Iowa
Majors – Genetics, Microbiology
Mentor – Donald Sakaguchi

Investigation of cell-seeded gelatin implants as a novel cell transplantation strategy using zebrafish as a model system

Nearly a billion people worldwide suffer from neurological disorders, including Alzheimer's and Parkinson's disease, traumatic brain injury, and others. These diseases and conditions result in a loss of cells in the nervous system, resulting in impaired brain function. It is thought that replacing these lost cells could slow disease progression and facilitate recovery of function. These types of therapies are known as cell transplantation strategies. However, these strategies often result in low cell survival and integration into the host tissue, providing little benefit to the patient. For this reason, there is an urgent need to develop novel cell delivery therapies. The goal of this project was to use gelatin, a biocompatible material, to make a three-dimensional scaffold that serves as a cell delivery platform. As a proof-of-concept, these scaffolds were then implanted into zebrafish brains, a biomedical model system due to their transparency, allowing for visualization of transplanted materials. Cells within scaffolds were labeled with a fluorescent dye and were visible up to 5 days post-transplant. Ideally, this type of implant will support cell delivery survival during and post-transplantation. This project has implications for advancing current therapeutic strategies for neurological diseases.

44. Miho Sanders – University of Northern Iowa

Hometown – Cedar Falls, Iowa
Major – Computer Science
Mentor – Andrew Berns

Lightweight Formal Methods for Improving Software Security

This research examines how software specifications could be used to build more-secure software. For this project, we analyzed known vulnerabilities for open source projects to identify the corrective actions required to patch the vulnerability. For each vulnerability, we then augmented the program with formal assertions in an attempt to allow a static analysis tool to find the vulnerability. Using the information gathered from these assertions, we hope to determine which assertions are most effective at finding vulnerabilities with today's tools and evaluate new assertions that could be added to the static analysis tool to help uncover more vulnerabilities. My work focuses on a common vulnerability type across multiple projects. In particular, I am examining if vulnerabilities caused by missing authentication could be prevented with proper tool usage.

45. Nathan Schmidt – University of Northern Iowa
Hometown – Waterloo, Iowa
Majors – Mathematics, Computer Science, Physics
Mentor – Seyed Tabei

Image processing of cellular aggregates

Image processing is a common task in the biological sciences. This project explores the development and design patterns of programs created for this purpose through the creation of an image processing program meant to determine the area occupied by cellular aggregates. The python programming language was utilized due to it being a free and open-source general purpose language. This facilitated exploratory programming and allowed the use of outside tools, such as Gnu Parallel, to be leveraged while running the program. The resulting programs effectiveness in comparison to manual image processing, both in terms of the total time spent and the methods accuracy, is also discussed.

46. Allyse Shoeman – Iowa State University
Hometown – Johnston, Iowa
Major – Nutritional Science
Mentor – Peter Clark

The Impact of Ethanol Consumption on Gut and Brain Neurochemicals

Alcohol abuse is a risk factor for a number of neurodegenerative and psychiatric disorders, such as Alzheimer's, Parkinson's, and depression, among others. Bi-directional communication between the central nervous system and the gastrointestinal tract (i.e. gut-brain axis) has been shown to influence host mood, and may contribute to disease pathogenesis. Therefore, acute alcohol abuse may alter neurochemical signatures in the gut that, in turn, influence changes in brain chemistry in manners contributing to the development or protection against neurological and psychiatric disorders. We employed a mouse model of alcohol abuse, 'drinking in the dark', that promotes ethanol ingestion at pharmacologically relevant levels. Adult female and male C57BL/6J mice received free access to 20% ethanol (compulsive alcohol consumption) or water (control) for 2-4 hours during their active period over four consecutive days. On the fourth day, mice were sampled immediately after access to ethanol (or water) to measure gut and brain neurochemicals. Monoamine neurotransmitters, along with pre-cursors and metabolites, were measured using uHPLC in micro dissected brain areas and at different levels of the gastrointestinal tract. These data may provide insight into the etiology of neurological and psychiatric conditions related to alcohol abuse.

47. Jeffrey Shymanski – University of Iowa
Hometown – Carroll, Iowa
Major – Speech & Hearing Science
Mentor – Elizabeth Walker

Competitive Learning Processes: The Role of Verbal Mediation in Sequential Learning

Sequential learning is a general learning tool allowing the brain to extract meaningful patterns of language during speech perception. Children who are born deaf lack early access to spoken language, and some research suggests this period of deafness prevents development of sequential learning. This produces sequential learning deficits that persist even after gaining access to spoken language via cochlear implant. The current study investigated how language competencies support or interfere with sequential learning depending on task demands. We assessed sequential learning in children with normal hearing using two tasks, which either included or excluded easily verbalized stimuli. We hypothesized that greater language demands in the verbalized task would negatively impact sequential learning. Consistent with our hypothesis, children demonstrated significant learning on the nonverbalized but not the verbalized task. These results suggest a competition of general and higher-order learning systems, motivating future study of these constructs in children with hearing loss.

48. Megan Slattery – Iowa State University
Hometown – Calamus, Iowa
Major – Nutritional Science
Mentor – Marian Kohut

Monocyte response to Influenza A virus is altered in pre-diabetics.

Diabetics are at increased risk of developing complications from influenza infection. The goal of this study was to assess immune response to influenza in a population with higher rates of diabetes (Mexican immigrants). Monocyte response to Influenza A virus A H1N1 (IAV) was compared in pre-diabetics (HbA1c > 5.7-6.4) to healthy (HbA1c < 5.6). Blood monocytes were isolated from pre-diabetics and healthy participants, and incubated with IAV for 24 hours. Cell culture supernatants were analyzed by multiplex assay to measure cytokines and chemokines. The results showed that monocytes from pre-diabetics produced 2-4 fold more GMCSF, IFNα, IL-1β, IL-10, TNFα, CCL4 and CCL5 in response to IAV than normal healthy subjects. These findings suggest that the pre-diabetes condition may be associated with an increased inflammatory response by monocytes during IAV infection. We observed that monocytes from pre-diabetics also demonstrate greater inflammasome activation, as monosodium-urate stimulated monocytes produced significantly more IL-1β. A greater inflammatory response during IAV infection could potentially contribute to further tissue damage, possibly resulting in greater vulnerability to secondary infection.

49. Victor Soupene – University of Northern Iowa
Hometown – Cedar Falls, Iowa
Majors – Biology, Health Promotion (Science-Intensive Environmental Health)
Mentor – Nilda Rodriguez

Induction of lipid bodies in Leishmania infantum-infected C57BL/6 macrophages of male versus female origin

Worldwide, 12 million people are infected with Leishmania spp. parasites. Leishmania are transmitted by the bite of sand flies. The parasite is internalized by immune cells where they develop, reproduce, and spread to new immune cells causing disease. Epidemiological studies have shown that males are more likely to develop disease. We recently demonstrated that Leishmania infantum survive better in immune cells of male origin than in cells derived from females. We also showed that L. infantum infection is characterized by fat accumulation. Additional experiments have shown that infected immune cells from males accumulate more fat than cells from females. We hypothesize that increased fat accumulation in immune cells of male-origin facilitate parasite survival and provide a basis for the increase male susceptibility in L. infantum infection.

50. Nicholas Stange
Hometown – West Des Moines, Iowa
Major – Biomedical Sciences
Mentor – Gerene Denning, Charles Jennissen

Off-highway vehicles (OHVs), which include all-terrain vehicles (ATVs) and side-by-sides (SxSs), are designed for off-road use only. Despite this, an increasing number of states, counties and cities are opening up public roads to OHV traffic, leading to potential increases in deaths and injuries. Ordinances or resolutions that allowed OHVs on Iowa's public roads were requested from all counties and reviewed. From 2011-2017, 38 of Iowa's 99 counties passed enactments allowing OHVs on public roads. Speed restrictions, time restrictions, and age restrictions are quite varied, while safety requirements, such as helmet use, seatbelt use, and visibility requirements, are largely absent. County regulations related to OHV use of public roads in Iowa vary greatly, and often do not address known safety and injury prevention issues. These data will be vital in future studies comparing roadway injuries and deaths in Iowa counties before and after OHV public roadway use enactment.
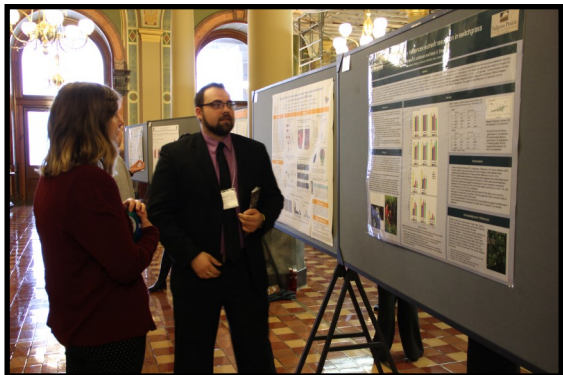
51. Caleb Stekl – University of Northern Iowa
Hometown – Cedar Rapids, Iowa
Majors – Sociology, Philosophy
Mentor – Yasemin Sari

Chasing the Idea: Love and the Impossible

Egalitarian society is impossible. Contemporary politics, however, is premised on the idea that egalitarian society is possible, that justice and equality can be realized if we pass just laws and elect honest leaders. We have limited the definition of these emancipatory terms into narrow, archaic rights and privileges. My claim is that society is unjust precisely because we treat the impossible as possible. We lack the idea of a future where this impossible might take shape. My research aims at accomplishing the following: I will formulate a new politics capable of guiding a praxis in relation to the Idea of egalite. I will describe the modern political subject who lacks both the idea of a future and an intimate relation to their political identity. Finally, I will argue love is the singular force capable of bringing into reality this new politics.

52. Alexandria Sturtz – University of Iowa
Hometown – Elkhart, Iowa
Major – Microbiology
Mentor – Noah Butler

Novel combinational therapy provides protection against malaria

Despite decades of research worldwide, malaria causes nearly half a million deaths each year. The global burden of malaria persists in part because the acquisition of anti-malarial immunity is often delayed and low quality. Furthermore, people in endemic areas are vulnerable to new infections and repeated bouts of malaria. To try and enhance resistance to malaria, we repurposed a cancer immunotherapy agent (3H3) which invigorates specific types of immune cells. Surprisingly, in our experimental mouse model of malaria, treatment with 3H3 transiently increased and prolonged the parasite burden. However, 3H3 treated mice showed enhanced protection when challenged with a lethal strain of malaria parasite. To circumvent the initial increase in parasite burden following 3H3 treatment, we co-administered an antimalarial drug with 3H3 and found that mice were still highly resistant to reinfections. Thus, our data support 3H3+Artemether as a combination therapy to elicit durable protection against repeated malaria infections.

53. Zoe Swinton – University of Iowa

Hometown – Des Moines, Iowa
Majors – Ethics & Public Policy, Psychology, Anthropology
Mentor – Sarah Bruch

The significance and effects of the current disciplinary climate in the Iowa City Community School District

Racial disproportionality in school discipline practices is a major concern for districts in Iowa and more broadly in the United States. Both the U.S. Department of Education and the Every Student Succeeds Act (ESSA) encourage states and districts to address this disproportionality and point to a substantial body of research that documents the negative consequences of exclusionary discipline. By examining the specific student populations affected by exclusionary discipline, our research aims to show how the Iowa City Community School District's current disciplinary climate specifically impacts students and their experiences of school disciplinary climates. The data are collected and analyzed as part of the Equity Implemented Partnership, a research-practice partnership between the ICCSD and the University of Iowa's Public Policy Center which aims to improve the equitability of student experiences and outcomes. Coupled with research regarding amelioration of discipline disparity in other school districts, we will use our findings to provide recommendations for ICCSD to reduce its own discipline disparity.

54. Lyn Tackett – University of Northern Iowa

Hometown – Waterloo, Iowa
Major – Anthropology
Mentor – Donald Gaff

Prehistoric Plant Resources in the Cedar Valley: How Prehistoric People Utilized Flora In Subsistence Practices

Over the last 10,000 years, the Cedar Valley in northeastern Iowa has seen an influx of plants and people; both of which have impacted the native flora of the region. Prairie grasses, wetlands, and other natural features of the Iowa landscape have been altered to accommodate the use of the land by humans. Some of the clues to what attracted various cultures to this region are hidden within the native flora. Therefore, a comparative study of the Cedar Valley area was done to determine what plants were available to Prehistoric native people when they came to the Cedar Valley. After collecting data and compiling a database for comparative purposes, it was discovered that a high ratio of the trees and herbaceous plants used contained high levels of sugar. Future research will be conducted to determine what implications this may have had in terms of health issues and subsistence practices.

55. Joseph Tibbs – University of Northern Iowa
Hometown – Alden, Iowa
Major – Biochemistry, Physics
Mentor – Seyed Tabei

Novel Data Analysis Methods in Multi-Channel and Multi-State Binding Experiments

Single-Molecule studies use advanced microscopy techniques to view biomolecules, such as proteins and DNA, individually. On a slide, fluorescently-labeled molecules are immobilized and imaged using lasers, and the patterns of fluorescence can give important information about the interactions of multiple molecules. To extract this information, advanced, customizable data analysis tools must be created. The first goal is to create a method to robustly normalize (correct for brightness) single-channel fluorescence data. The second goal is to extend pattern recognition of binding order to multi-state and multi-channel binding patterns. The KERA 3.0 suite links creative pattern-recognition and normalization techniques with the abilities of exiting idealization software to extract this information from previously intractable data. This allows researchers to study protein complexes, their inhibitors, and their mechanisms, more holistically and more efficiently.

56. Madison Thomas – Iowa State University
Hometown – Cedar Rapids, Iowa
Major – Chemistry
Mentor – Young-Jin Lee

Use of Image Quality Scores to Determine Fingerprint Age in MALDI imaging

Fingerprint age determination is valuable to forensic investigations because of its relevance to crime instance. Previous research has established that ridges diffuse over time using subjective manual ridge measurements. As a more objective and quantitative approach, we suggest the use of image quality score as a measure of fingerprint age. This method is applied to matrix-assisted laser desorption/ionization mass spectrometry imaging (MALDI-MSI) and optical images. Two sets of fingerprints were collected for comparison, and aged zero, three, or seven days under ambient conditions. Fingerprints for optical comparison were dusted with carbon development powder. Fingerprints for chemical analysis were coated with a sodium and gold matrix and analyzed using the MALDI-LTQ-Orbitrap Discovery. Images were aligned using enhanced correlation coefficient maximization (ECC) and compared using the structural similarity index (SSIM) algorithms to provide a quality score. Both chemical and optical images indicated diffusion over time. This was consistent with SSIM quality scores, which consistently decreased over time for each set of images. Future work will utilize shorter time points, the creation of a quality score calibration curve for fingerprint age determination, and a comparison of optical and chemical image scores to find the best method for determining fingerprint age.

57. Brandon Vance – Iowa State University

Hometown – Des Moines, Iowa
Major – Chemical Engineering
Mentor – Jean-Philippe Tessonnier

Fueling Space Exploration: Engineering Catalysts to Produce Rocket Fuel on Mars

One of NASA's future goals in space exploration is to send crewed missions to Mars. However, sending the fuel needed to return the crew to Earth is logistically and financially impossible. NASA's solution is to produce the return rocket fuel directly on Mars by using a supported-metal catalyst to facilitate the generation of methane gas from Mars' natural resources: carbon dioxide and water. This conversion requires harsh reaction conditions that induce irreversible deactivation of the catalyst, which has proven to be a major obstacle in engineering a catalyst for Mars applications. To design a robust catalyst, we must fully understand every factor that affects the catalytic activity, including the ability of the metal catalyst to increase the rate of methane generation. This study examines the influence of the support's thermal conductivity on methane production to determine the catalytic activity's dependence on heat transfer within the catalyst particle. Our results demonstrate that the activity of supported-metal catalysts is directly affected by the support's ability to remove the heat of reaction from the metal nanoparticles. Coupling these findings with future investigations will enable a catalyst to be engineered for the production of rocket fuel on Mars.

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