Undergraduate Research & Creative Achievements Forum

Spring 2016

Schedule of Events

Tuesday, April 26
1:30-3:00 p.m. — Session A, McQuinn Atrium
2:30-4:00 p.m. — Session B, McQuinn Atrium
3:30-5:00 p.m. — Session C, McQuinn Atrium

Wednesday, April 27
12:05 p.m. — Student & Mentor Recognition Ceremony, McQuinn Atrium

Abstract book prepared by:
Office of Undergraduate Research
Director: Dr. Linda Blockus
Assistant Director: Mike Cohen
Administrative Assistant: Katie Hays
Student Workers: Jessica Welsh and Kayla Symonds
Spring 2015 Forum Awards for Excellence & Honorable Mentions

Artistic Expression & Applied Design

Recognized for Excellence: Rachel Trout, Art, Kirkwood, MO (Hannah Reeves, Art); Womanhood: An analysis of abusive relationships between mother and daughter

Honorable Mention: Kathleen Kowalsky, Textile and Apparel Management, Castle Rock, CO (Dr. Jean Parsons, Textile and Apparel Management); Exploring sustainability in textile and apparel through minimal waste cutting and digital textile printing

Engineering Sciences

Recognized for Excellence: Janae Bradley, Bioengineering, St. Louis, MO (Dr. Sheila Grant, Bioengineering); In vitro investigation of a novel chitin NP-AgNP-collagen template

Honorable Mention: Alex Dodd, Mechanical Engineering, Wildwood, MO (Dr. Hongbin Bill Ma, Mechanical & Aerospace Engineering); Hydrophilic and hydrophobic nanostructures and their effect on heat transfer in oscillating heat pipes

Honorable Mention: Zhongyu Li, Bioengineering, Columbia, MO (Dr. Shramik Sengupta, Bioengineering); Rapid culture-based detection of Mycobacteria using multi-frequency impedance measurements

Humanities

Recognized for Excellence: Ginger Hervey, Journalism/Philosophy, Fairview, TX (Dr. Berkley Hudson, Journalism); White Southern mentalities: Two case studies of visual representation in the American South, 1920-1940

Honorable Mention: Ariel Blaser, Linguistics/English, Butler, MO (Dr. Matthew Gordon, Linguistics and English); Small town Missouri speech

Life Sciences

Recognized for Excellence: Jaime Hibbard, Biochemistry, Columbia, MO and Michael Miller, Electrical Engineering, Lee's Summit, MO (Dr. Lorin Milescu, Biological Sciences); 3D data mapping and real-time experiment control and visualization in brain slices

Honorable Mention: Edward Duqum, Biochemistry, Chesterfield, MO (Dr. Dongsheng Duan, Molecular Microbiology & Immunology); Establishment of basic blood biomarkers in Duchenne muscular dystrophy canine model

Honorable Mention: Emily Shoesmith, Biological Sciences/Spanish, Des Moines, IA (Dr. Dawn Cornelison, Biological Sciences); Identification of satellite cell mitogens and chemoattractants

Physical Sciences & Mathematics

Recognized for Excellence: Mary Ryan, Journalism/Statistics, The Woodlands, TX (Dr. Christopher Wikle & Dr. Scott Holan, Statistics); An analysis of bullying and suicide in the United States using a non-Gaussian multivariate spatial model

Honorable Mention: Nicholas Miller, Mathematics, O’Fallon, MO (Dr. Carlo Morpurgo, Mathematics); On extremals of conformally invariant functionals via rearrangement inequalities

Social & Behavioral Sciences

Recognized for Excellence: Emily Rolan, Psychology, Corder, MO (Anna Lindell & Dr. Nicole Campione-Barr, Psychological Sciences); Domains of sibling conflict in emerging adulthood

Honorable Mention: Brianna Kim, Occupational Therapy, Aurora, CO (Dr. Karen Hebert, Occupational Therapy); The relationship between mindfulness and occupational balance

Honorable Mention: Louis Christopher Markovitz, Psychology/Anthropology, Columbia, MO (Dr. Charles Borduin, Psychological Sciences); The relation of supervision, stress, and coping aggression in youths with autism spectrum disorders

2015 Outstanding Undergraduate Research Mentor Awards

Dr. D. Cornelison
Biological Sciences

Dr. Daniel Domingues
History
Undergraduate Research & Creative Achievements Forum

Student Abstracts
Listed in Alphabetical Order
Asad Abdullahi
Liberty, MO

Sophomore
Electrical Engineering

Faculty Mentor: Dr. Shubhra Gangopadhyay, Electrical & Computer Engineering
Funding Source: Grant to Faculty Mentor

Development of plasmatic gratings with Al-polymer Nanoenergetics deposited on-chip

Asad Abdullahi and Shubhra Gangopadhyay

Determining the characteristics and functionalities of various oxidizers and fuels such as: Molybdenum trioxide, Nitrocellulose, Aluminum and Graphene to approach high performance Nanoenergetics Composite. We are exploring the properties due to Nano energetic materials being described as heterogeneous composites of such oxidizers and fuels. The characteristics that is being most analyzed and is of most importance is the size of these oxidizers and fuels. This is of most importance because we are looking for Al-polymer Nanoenergetics films with different properties, and to see the effect it will have on the thickness of films being created. Another important aspect to the testing is to verify the size of these nanoparticles to make sure we have a bulky composite to determine the surface area of the particle. We test the size of these nanoparticles with varying concentrations and varying dilution solution, to determine the size distribution of the particles and to see if the particle are individuals or aggregates. To determine the size distribution and average diameters, dynamic light scattering test were conducted using Delta Nano HC. Then to determine the functionalities of the graphene we must conduct an Electrophoretic Light Scattering which is conducted by doing Zeta potential testing. Zeta Potential is used on the graphene to determine the surface charge, which will best help determine which sample of graphene to use for the “sheet”. In which that “sheet” will help self-assembly two highly positively charged particles in: Aluminum and Bismuth Oxide. At this time testing is still continuing and will plan on present results and conclusion for the experiments at the Forum.
Design of a non-antibody based test for HIV

Zachary Addison, April Baum, Rich McGhee, Joey O’Brien, Colin Grace, and Mario Pennella

One of the most effective tools for combating HIV is widespread testing in high-risk areas. Patients who know their HIV positive status are more likely to take precautions, and are less likely to transmit it to others. Unfortunately, current widely deployable tests aren't very stable in non-controlled environments, are expensive, or aren't accurate in the first three months. We are designing a system that would be simple to use, but tests directly for HIV viral particles. Our research looks at the interactions of three proteins, and uses them to activate a signal. HIV GP120 is the glycoprotein used by HIV to gain entry into the target cell. It actively binds CD4, a human immune T-helper cell receptor, during the first stage of entry. This binding causes a conformational change in GP120, allowing it to bind CCR5. In the second stage of entry, GP120 binds CCR5, which causes a conformational change in GP41, another HIV glycoprotein, and pulls the viral particle into the cell. Using the affinities of both human proteins, we are designing a system that will allow for one of these proteins to be a propagator of information. To do this, we designed a chimera of CD4/LacZ. This chimera will cause a color change in solution, but will only remain on the column in the presence of GP120. Using this, a device could be designed that tests directly for HIV, reducing the amount of time between potential infection and accurate testing.
Zinc-rich ores of West Fork mine: Multiple-fluid involvement in the southeast Missouri mining district

Tyler Adelstein and Kevin Shelton

World-class Mississippi Valley-type lead-zinc mines are hosted in the upper Bonneterre Dolomite (Cambrian age, ~500 m.y.) of southeast Missouri. The West Fork mine is an unusually zinc rich deposit (Zn/Pb = 2:1) compared to other more lead-rich mines (Pb/Zn = 5:1) in the district. Previous workers (Mavrogenes and Hagni, 1992) documented a distinct lateral zonation of ore metals/minerals within the West Fork mine that follows a general sequence, east to west, from iron- to zinc- to lead-rich sulfides. Recent drilling elsewhere in the district has found similar, vertically zoned Zn-rich mineralization deeper within the Bonneterre Dolomite (Cavender et al., 2016), which has been interpreted to reflect the influence of deep, metal-rich fluids that migrated along faults.

**Purpose:** I am testing whether the West Fork mine’s metal zonation is the result of a single evolving fluid or instead reflects interaction of deep fault-related fluids with shallower, basin-derived brines.

**Methods:** I utilized reflected light and cathodoluminescent (CL) microscopy to constrain the sequence and variability of ore-related minerals throughout the mine and their relation to metal zoning. I employed stable carbon, oxygen, and sulfur isotope analysis of ore-related sulfide and carbonate minerals to reconstruct the history of fluid-rock interactions associated with ore deposition.

**Results:** CL analysis of ore-related carbonate minerals from the West Fork mine in this study reveals unique crystal growth patterns that have not been observed previously in the district. Other patterns that are observed are related to lead-rich fluids that are more typical of the district. Isotope data indicate the involvement of multiple fluid and sulfur sources during ore deposition.

**Conclusions:** Microscopic observations and geochemical data are incompatible with a single evolving fluid and require the presence of multiple, chemically distinct fluids (deep, fault-related and shallower, basin-derived fluids) to form the unusual zinc-rich ores of the West Fork mine.
Pseudomonas aeruginosa is a gram-negative, anti-biotic-resistant pathogenic-bacterium that is the culprit of many hospital-acquired infections; it can thrive on medical equipment such as catheters and is difficult to eradicate. Normally, a person’s immune system will be able to fight off an infection of P. aeruginosa, but to those who are immunocompromised, this bacteria poses a serious threat. P. aeruginosa, as well as many other bacteria, use acyl homoserine lactones (acyl-HSLs) as signaling molecules to monitor their population density in quorum-sensing control of gene expression, which are created by members of the LuxI family of proteins (acyl-HSL synthases). Specifically for P. aeruginosa, the enzyme RhlI is implicated, and the acyl-HSLs it synthesizes are used to regulate a number of virulence factors.

Besides the fact that RhlI catalyzes the formation of acyl-HSL from S-adenosylmethionine (SAM) and an acylated acyl-carrier protein (C4ACP), and that the acylation occurs before the lactonization, not much is known about the enzyme; neither the rate-limiting step in the reaction nor the structure. This makes finding an inhibitor for RhlI particularly daunting, because without knowledge of such things, the structure of the high-energy transition state is simply a guess.

My research aims to provide information as to the rate limiting step of RhlI by implementing the Observed Isotope Effect and studying enzyme kinetics. I may or may not have meaningful data by the date of the poster-presentation but I will be able to present on how these techniques in biochemistry can be used in conjunction to find real solutions to inhibit enzymes.

This project was completed to fulfill a Capstone requirement.
Outcomes in patients with abnormal myocardial perfusion imaging (MPI) and normal coronary angiogram

Sadie Allen and Thomas Dresser

Objective: Re-evaluation of the prevalence of cardiovascular events in patients with abnormal Myocardial Perfusion Imaging (MPI) test results and normal coronary angiograms. Significance: MPI is a sensitive method to detect coronary artery disease and the results of the studies are highly correlated in a positive relationship. Occasionally there is a lack of correlation. We looked at additional cardiovascular events (CE) that might occur in these patients. Methods: Medical record review was performed on patients who had both MPI and coronary angiogram within six months of each other. MPI was determined to be abnormal if a fixed or reversible perfusion abnormality of mild or greater was noted. Coronary angiogram was considered to be abnormal if a stenosis greater than 70% was noted in at least one major coronary artery.

Results: Previously we reported results obtained from correlation of results performed in 48 patients. CE were cardiac death, MI, percutaneous coronary revascularization, CABG, stroke, or peripheral revascularization. CE were found in 16 of 48 patients who had abnormal MPI and normal coronary angiogram. This 33% prevalence of CE seemed higher than expected for people with normal coronary angiogram. A second review of 176 patients included those who had normal coronary angiogram as well as normal MPI. CE occurred in 12.5% (15/120) of patients with abnormal MPI and normal angiogram and in 10% (3/30) of patients with normal MPI and normal angiogram.

Conclusion: Abnormal MPI was initially thought to predict a higher likelihood for cardiovascular disease than normal coronary angiogram results alone. However, when a cohort of patients with both normal MPI and normal angiogram were evaluated, the prevalence of CE were approximately the same 12.5% versus 10%. This suggests no enhanced predictability of the MPI.
Decreased food intake in zebrafish with defective migration of facial branchiomotor neurons

Badr Almadi, Kyle Schafer, and Anand Chandrasekhar

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Sternum morphology and locomotor adaptation in anthropoid primates

Morgan T. Alwell, Emily R. Middleton, and Carol V. Ward

Trunk shape varies among anthropoid primates and is thought to reflect locomotor adaptation. Hominoids, who are orthograde, below-branch primates that rely on suspensory behaviors, have broader, deeper rib cages than do pronograde quadrupedal anthropoids. Apes have more cranially-oriented glenohumeral joints than do humans, thought to orient the joint for use in suspensory postures during locomotion. The sternum represents a key part of the thoracic skeleton and contributes to overall rib cage morphology, yet variability in sternal shape across primates is undocumented.

In particular, hominoids should be expected to have a relatively broader manubrium and sternum than do monkeys. Further, apes should have more cranially-oriented sterno-clavicular joints than do humans, reflecting the higher position of the shoulder joint indicated by scapular morphology. In this study, we examined proportions of the manubrium and sternum in 199 anthropoid primates by taking linear measurements of the sternum from a series of calibrated digital photographs using the ImageJ software package. We also measured orientation of the sterno-clavicular joint across hominoids.

Results indicate that, as expected, manubrium and sternum breadth are absolutely and relatively greater in hominoids than in both Old and New World monkeys, correlated with the transversely broader ribcages of hominoids. The semisuspensory New World monkeys Lagothrix and Ateles show similarities to hominoids in manubrial proportions, supporting a hypothesized link between thoracic breadth and suspensory locomotion. In terms of sterno-clavicular orientation, humans have more laterally-facing articular surfaces than most apes. Contrary to expectations, Symphalangus resembled humans in average angle of the sterno-clavicular joint, suggesting a different configuration of the pectoral girdle in these apes that warrants further investigation. Overall, manubrial and sternal proportions appear related to locomotor adaptation in anthropoid primates, but relations between thoracic and pectoral morphology may be more varied than previously appreciated.

This project was completed to fulfill a Capstone requirement.
Intelligent dashboard for augmented reality based incident command response co-ordination

Olivia Apperson, John Gillis, Patrick Smith, and Prasad Calyam

In a disaster situation, communication and coordination between first responders and incident commanders is imperative. In today’s world, this vital aspect is often overlooked, leading to mis-triage and morbidity. In cases such as the 2011 Joplin Tornado where infrastructure is destroyed, it becomes extremely difficult to both triage a large volume of patients and allocate supplies properly. Furthermore, the current technology used in emergency scenarios has become outdated, as radios and paper triage tags are no longer as effective in these situations.

Our research presents a solution to these situations. Over the past two years, our lab has been working on Panacea’s Cloud, a platform for communicating and coordinating in disaster situations. Panacea’s Cloud provides first responders and incident commanders with real-time information about the current situation at hand, allowing for proper instruction and planning. This infrastructure-independent platform is comprised of an Intelligent Dashboard, heads-up displays, and Internet of Things technologies. First Responders can utilize heads-up displays, such as the Recon Jet or Google Glass, to send live video streams of the current situation to the Intelligent Dashboard, allowing the incident responder at the hospital to effectively coordinate. Additionally, Panacea’s Cloud’s Intelligent Dashboard contains real-time mapping capabilities, along with patient and first responder profiles, providing the incident commander with the locations of first responders and the locations and statuses of patients in the field. This GPS tracking is conducted through the use of Virtual Beacons and heads-up displays. By providing incident commanders with an abundance of information, we strive to provide emergency services with an effective platform to utilize during these dire situations. Our goal is to present a technology that allows for better triage, coordination, and communication among all emergency services involved.
Lysozyme sorption by pure-silica zeolite MFI films

Keisha Avery, Heather Williams, Marcos Barcellona, Matthew T. Bernards, and Heather K. Hunt

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Amrit Bal, Florian Seydel, David Stalla, Andrew Gillespie, Adam Smith, Mark Sweany, Mark Lee, and Peter Pfeifer

Hydrogen is a desirable alternative fuel source for vehicular applications because its full energy cycle produces less pollutants. However, hydrogen must be stored in large, heavy tanks and the storage must be under extremely high pressures. Adsorbent materials, such as nanoporous carbon (NPC), can increase the storage capacity of tanks by storing the gas at lower pressures. This opens up the possibility for more space-efficient tank design with thinner walls. Though NPC materials have a specific surface area ca. 2500 m²/g, they adsorb a low amount at ambient temperatures due to their relatively low binding energy to hydrogen. Therefore, new high binding energy materials need to be characterized. One possible material is graphitic carbon nitride (GCN). Theoretical calculations of the electronic structure suggest that this material has a higher binding energy and an increased surface area due to regular, in-plane voids. Thus, GCN materials may outperform NPC. Initial surface area measurements on bulk GCN showed that the specific surface area is between 5-20 m²/g. In order for GCN to compete with NPC, it is necessary to increase the specific surface area of the GCN. To accomplish this, we attempted to exfoliate the surface using sonication and high energy ball milling. We study the effects of these treatments using analyses of the structure via x-ray diffraction spectroscopy, nitrogen sorption, tunneling electron microscopy, and x-ray photoelectron spectroscopy.
Nonfouling polyampholyte hydrogels as drug delivery scaffolds

Marcos Barcellona, Nicholas Johnson, and Matthew Bernards

Common challenges in drug delivery are the factors of biocompatibility as well as controllable release rates. Nonfouling materials are a category of materials which possess the ability to resist nonspecific protein adsorption, which helps to reduce the body’s natural immune system response. Nonfouling materials also allow for the incorporation of functional end groups, allowing for a range of uses. Our experiments were conducted on mixed-charged polyampholyte hydrogels which were pre-loaded with three different model drugs, and the rate of release was explored under different settings, including varied cross-linker concentrations, different pHs, and different salt concentrations. Our data suggests that through manipulation of solution pH and salt concentration, as well as hydrogel cross-linker concentration, the rate of release of the molecules deviates from their corresponding controls, all without compromising the nonfouling characteristics.
Online integrated database for plant phenotype quantification

Mitchell Battles and Filiz Bunyak Ersoy

Automated image analysis and quantification are becoming increasingly useful and pertinent in a world where most individuals carry a smartphone with built-in high-resolution cameras. A promising application for the technology is mobile plant phenotype and disease quantification. Researchers can non-destructively analyze and quantify plant structures using their smartphones in the field. In this poster, we present our online database integrated to our mobile phenotype quantification app. This online integrated plant phenotype database allows systematic access to collected data and to analysis results. The database itself was constructed with MySQL. The images are stored in a separate web directory and linked to the database. To access the database from the front end web application we utilized PHP, as it interacts nicely with SQL databases. The front end of the web application was developed using several languages and frameworks. PHP and JavaScript were useful for displaying information pulled off of the database. The actual web application visuals were created using a modified version of the Bootstrap framework. Our online, searchable plant image database also incorporates storage of meta-data, expert annotations and quantification results gathered from our mobile plant image analysis application. This information is automatically parsed and processed; this enables users to generate graphical and quantifiable data based on any number of criteria quickly and easily using our built in chart generating function. The presented system provides the users, both expert and novice, a simple and fast means of collating relevant data. To that end, this website and the database behind it are built around the principle of providing a functional and easy to use experience for all users.
Dental wear, molar shape and dietary adaptation in early Australopithecus

Nathan Bauer, Emily Middleton, and Carol Ward

The evolution of the ability to process hard-to-chew food is considered to be a key innovation in the origin of the Australopithecus-human clade. This conclusion is based on consideration of the best-known species of early Australopithecus, A. afarensis. However, the discovery of an even earlier species A. anamensis has led to the realization that these species are likely two ends of an evolving lineage and that A. anamensis may not have been as specialized for chewing difficult foods. If so, this would lead to a significant reconsideration of the biology of the first Australopithecus and the origin of the genus.

Here, we test two hypothesized differences between A. anamensis and A. afarensis that have led to these interpretations. First, we test the hypothesis that A. afarensis had relatively lighter wear on its anterior teeth compared with the earlier A. anamensis. Total occlusal area and area of exposed patches of dentine were measured from photographs of fossil specimens using the ImageJ software package. We calculated the amount of dentine exposure relative to occlusal area on each tooth and standardized the amount of dentine exposure on the first molar. Second, we tested the hypothesis that A. afarensis had higher tooth crowns with straighter sides, and possibly relatively larger occlusal areas. To quantify tooth crown height and contours, casts of molar teeth were scanned with a NextEngine scanner, and 3D polygonal models were created for each molar tooth. Pairs of teeth were scaled to the same cervical area and a best-fit algorithm used to align the models. Comparison of minimum distances between the surfaces was calculated and a heat map of surface difference created. Magnitude of deviations between the crown surfaces was calculated along the crown, which allows comparison of differentially worn teeth.

Sample sizes are small, but compared to the rate of wear on the first molar, A. anamensis anterior teeth were more heavily worn anteriorly than those of A. afarensis. Molar crowns were also taller with more sloping sides, seen in significant increase in average deviation from A. anamensis crowns away from the base of the tooth. These results support the observations that A. afarensis shifted its dietary behavior from greater processing with the anterior dentition and increased emphasis on mastication with taller molar crowns with relatively larger occlusal surfaces that could withstand more wear. Thus, the dietary adaptation of A. afarensis likely did not fully characterize the origin of the lineage.

This project was completed to fulfill a Capstone requirement.
Design of a non-antibody based test for HIV

Zachary Addison, April Baum, Rich McGhee, Joey O’Brien, Colin Grace, and Mario Pennella

One of the most effective tools for combating HIV is widespread testing in high-risk areas. Patients who know their HIV positive status are more likely to take precautions, and are less likely to transmit it to others. Unfortunately, current widely deployable tests aren’t very stable in non-controlled environments, are expensive, or aren’t accurate in the first three months. We are designing a system that would be simple to use, but tests directly for HIV viral particles. Our research looks at the interactions of three proteins, and uses them to activate a signal. HIV GP120 is the glycoprotein used by HIV to gain entry into the target cell. It actively binds CD4, a human immune T-helper cell receptor, during the first stage of entry. This binding causes a conformational change in GP120, allowing it to bind CCR5. In the second stage of entry, GP120 binds CCR5, which causes a conformational change in GP41, another HIV glycoprotein, and pulls the viral particle into the cell. Using the affinities of both human proteins, we are designing a system that will allow for one of these proteins to be a propagator of information. To do this, we designed a chimera of CD4/LacZ. This chimera will cause a color change in solution, but will only remain on the column in the presence of GP120. Using this, a device could be designed that tests directly for HIV, reducing the amount of time between potential infection and accurate testing.
Jonathan Baumstark
Hermann, MO

Junior
Bioengineering

Faculty Mentor: Dr. Heather Hunt, Bioengineering
Funding Source: College of Engineering Undergraduate Research Option; 3M Non-tenured Faculty Award

Studying biomaterials dissolution of MgF₂ thin film with Optical Tunneling Photoacoustic Spectroscopy (OTPAS)

Jonathan Baumstark, Yowting Tsay, and Heather Hunt

Thin films are essential in the development of optical applications, such as improved chemical sensors based on surface plasmon resonance devices. Particularly, MgF₂ films are frequently used as antireflective coatings on lenses and other optics, many of which may come into contact with aqueous environments. It is important to characterize these films by determining the refractive index and thickness. Standard characterization techniques, such as Ellipsometry, rely on empirical equations and require highly reflective/polished films, limiting the types of the materials that can be explored. Optical Tunneling Photoacoustic Spectroscopy (OTPAS), on the other hand, can be used without empirical equations or in cases of low optical reflection, as is common in most biomaterials. OTPAS uses an evanescent field to induce a photoacoustic effect in the surface of a biomaterial, allowing us to spectroscopically probe materials on the nanoscale. Here, we apply this technique to the study of materials biocompatibility, and in particular, the study of materials dissolution, which provides insight into how long a material is expected to survive in biologically relevant conditions. In this work, we demonstrate OTPAS’s ability to track the dissolution of standard MgF₂ thin films in aqueous solution by dissolving small amounts of the MgF₂ film away over time and monitoring the change in film thickness and refractive index with both ellipsometry and OTPAS. We will, for the first time, use OTPAS to track this process, and demonstrate the use of this technology for biocompatibility assays.
Using the chi square test to determine statistically significant association rules

Alexander Bay, Lori Thombs, and Chi-Ren Shyu

Association Rule Mining has been a popular data mining technique since the Apriori algorithm was published in 1994 [Agrawal, Rakesh, and Ramakrishnan Srikant. “Fast algorithms for mining association rules.” Proc. 20th int. conf. very large data bases, VLDB. Vol. 1215. 1994.]. Apriori quickly prunes out irrelevant results to prevent from generating results that are exponential with increasing data size. However, it still creates hundreds of thousands of potential outcomes that are impossible for users to hash through or have a comprehensive view of the mined results. Measurements like support and confidence have been implemented to filter out as much data as possible without losing meaningful associations. These measurements, however, fail to identify infrequent rules with strong relationships as well as negative correlations among items. The chi square test was proposed by Silverstein et al [Brin, Sergey, Rajeev Motwani, and Craig Silverstein. “Beyond market baskets: Generalizing association rules to correlations.” ACM SIGMOD Record. Vol. 26. No. 2. ACM, 1997] to create what they called dependence rules that measure both the positive and negative correlation among items when mining a dataset for meaningful associations. In this research we implement the chi square test as a measurement of interestingness in the Apriori algorithm and analyze its efficacy when the size of the data is large. Since the chi-square statistic was computed as a function of sample size, the statistics grew with the size of the data, producing p-values approaching zero in most of the rules. Interpretation of these p-values failed to provide any useful information about the correlation among items. These results provide evidence for why measurements that are independent of sample size (like odds ratio) are more appropriate when mining large datasets.
Lindsay Beachner
Lee’s Summit, MO

Social skills instruction to reduce bullying involvement among middle school youth

Lindsay Beachner, Jennifer Buehler, Mikaela Henke, Kirsten Zemke, and Chad Rose

Bullying has become a pervasive problem among school aged youth. According to recent data approximately 1 in 4 students report being victimized within American schools. Two of the most common predictors among youth that experience prolonged victimization are social and communication skills deficits. This is especially true for students with disabilities, who are disproportionately involved within the bullying dynamic. Therefore, it’s critical to examine the relationship between social skills instruction and youth who have been identified with low social skills.

The current study used existing data collected by the partner schools’ school climate survey coupled with their social behavioral screener to assess the individualized needs of youth. Students identified by their teachers as having low social skills at the beginning of the 2015-2016 academic year were eligible for involvement in the study. Each school identified approximately 20% of their total population who would benefit from Tier 2 social skills instruction. Of the 20%, a total of 55 students returned parental consent allowing them to enroll in the study. Once enrolled, students received weekly, targeted social skills instruction in ten critical areas. These areas include: Listen to Others, Follow the Steps, Follow the Rules, Take Pride in Your Work, Ask for Help, Conversations, Working with Peers, Self-Management, Do the Right Thing, and Respect Others. Each student received approximately 10 hours of social skills instruction.

These students have demonstrated increased self-awareness, group participation, confidence, peer relationships, and engagement in organized social activities. All of these skills are critical for adolescent development as well as reducing bullying involvement. While the results of this study are preliminary, the improvements are promising and have direct implication in curricular development and implementation. These data suggest that schools should consider implementing targeted interventions to improve the social and behavioral outcome of middle school youth.
Experimental design and current numerical results of finger plate expansion devices

Jessica Beckmann and Hani Salim

This project investigates the causes of premature failure of MoDOT finger plate expansion devices under highway traffic, and then uses that information to design new and improved finger plates. Experimental testing was conducted on the finger plate device on eastbound I-70 Blanchette Bridge in St. Louis. The results were used to validate numerical models of the current expansion device designs. The numerical models were used to study failure scenarios, evaluate repair techniques, and analyze the new proposed designs. A group of experimental tests are prepared on prototype samples for the old and new finger joint designs. These samples will be tested under static and impact loads until failure. Numerical models will be developed to investigate the stress concentrations and the sources of failure. The analysis of the finger plates showed the dynamic impact is generally between 40% and 70% and could be as much as 160%. Increasing the number of stiffeners results in a decrease in the stress concentrations. The new design of the finger plates is currently being fabricated, and design calculations are used to determine the maximum load the prototype will allow before failure. The value of the maximum load will then be used in the planned experimental testing of the finger plates.
Student attitudes toward LGBTQ patients

Bryant Bender and Carolynn Orbann

As future health care professionals, it is important that health science students understand that sometimes varying health care needs of different demographics of patients. Some research suggests that the education of health care professionals is lacking in terms of its attention to the needs of LGBTQ individuals. Most education of this kind takes place during graduate work, in master’s programs or in medical schools. The staff of the University of Missouri’s Sexual Health Advocate Peer Education (SHAPE) program, students and faculty members from the Department of Health Sciences created a survey that was distributed in an introductory Health Science class to discover the knowledge and attitudes of incoming health science students had regarding LGBT health care needs. Over the course of 5 semesters (Spring 2013-Spring 2015), an educational intervention was deployed and tested using pre and post-test surveys to measure changes in knowledge and attitudes. Quantitative responses were analyzed to discover trends among demographics (race, gender, and sexual orientation) and questions measuring open-mindedness towards LGBT patients and coworkers. We have learned from the results of these survey questions that most students like to believe that they do not see the difference between providing healthcare for a person of the LGBTQ community and a person who is not part of the LGBTQ community. However, we learned that the students are overall unknowledgeable about the different health care needs of LGBTQ patients. We feel that interventions during undergraduate education are productive and can lay the groundwork for more developed curriculum during professional and graduate education.

This project was completed to fulfill a Capstone requirement.
Nicholas Bergesch
Chesterfield, MO

Senior
Mechanical Engineering

Faculty Mentor: Dr. A. Sherif El-Gizawy, Mechanical & Aerospace Engineering
Funding Source: College of Engineering Undergraduate Research Option

Medical device for femoral stem insertion

Nicholas Bergesch and A. Sherif El-Gizawy

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Modulation of voltage-gated sodium channels by auxiliary proteins

Benton R. Berigan, Tyler G. Carron, Marco A. Navarro, and Lorin S. Milescu

Voltage-gated sodium (Na_v) channels play a key role in the initiation and propagation of action potentials (APs) in mammalian neurons. Na_v 1.2 and 1.6 subtypes are highly expressed in the axonal initial segment (AIS), the site where APs are generated. Fibroblast Growth Factor Homologous Factors (FHF's), members of the Fibroblast Growth Factor (FGF) family, have been shown to co-localize and interact with Na_v 1.2 and 1.6, competing with the intrinsic inactivation of the channel. This competition can alter the availability of the Na_v channels to conduct current and generate APs, thus changing the firing properties of the neuron. We are investigating the relationship between FHF's and Na_v channels using immunohistochemistry, to determine their relative expression levels within the neuronal circuits responsible for generating respiratory rhythm in mammals. Our preliminary data indicate that FHF's associate with Na_v channels in specific regions of the brain, as determined by two-photon microscopy. Thus, we hypothesize that FHF's play an important role in the electrical signaling mechanisms in these areas of the brain. To explore the functional relationship between FHF's and Na_v channels, we are currently using electrophysiology, imaging, and computational techniques.
Examining the success of redevelopment projects in a low-income urban neighborhood: West End, St. Louis

Thomas Bernhard and Michael Goldschmidt

This study targets the community response to redevelopment projects in the West End neighborhood of St. Louis. The goal of the study is to gauge the level of community involvement and to better understand the success of past and future projects. In an online survey, West End residents responded to a series of questions providing their attitudes and experiences related to this topic. Participant feedback found a high level of community awareness toward redevelopment but low levels of community input. Through demonstrating the large degree of public interest in redevelopment, this study highlights the potential for community involvement as a tool to predict and maximize the success of future projects in low-income urban neighborhoods.
Factors affecting GPR signals in reinforced concrete bridge decks

Anna Beyer and Glenn Washer

The objective of this research is to evaluate the factors affecting Ground Penetrating Radar (GPR) signals in reinforced concrete bridge decks. GPR is a nondestructive evaluation method used to image structures for the detection of subsurface defects in reinforce concrete bridge decks. GPR utilizes electromagnetic waves directed at the various interfaces in a bridge deck. These waves are reflected back to the surface due to changes in dielectric properties of materials within the deck and are recorded for analysis. Factors such as water, chlorides, corroded rebar and variation in rebar depth can affect the amplitude and velocity of the electromagnetic waves in concrete. This research explores the literature and previous efforts to characterize these effects as well as design an experiment to better understand these phenomena.

Three concrete slabs have been designed to replicate a reinforced concrete bridge deck, each focusing on a different factor affecting the attenuation of the GPR signal. A fourth slab with good rebar at a set depth will be used as a control. Testing will be done daily to determine the effects of moisture as water leaves the slabs and to ensure repeatability of the GPR measurements. Results from this testing will show how water content, chlorides in the slab, corroded rebar and variation in rebar depth affect the attenuation of the GPR signal.
Daphanie Bibbs
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Junior
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Faculty Mentor: Dr. Stephen Whitney, Educational, School & Counseling Psychology
Funding Source: State Farm Insurance Community Grant

Academic engagement and motivation as predictors of reading achievement

Daphanie Bibbs, Jennifer McIntyre and Stephen Whitney

This study examines the relationship between academic engagement and motivation by class and race. The Early Childhood Longitudinal Study (ECLS-K) from National Center for Education statistics data was used. ECLS-K is a nationally representative sample of students, parents, teachers, and administrators from Kindergarten to 8th grade. The current study utilizes 9,725 students and their teachers in the 3rd and 5th grade. The sample was divided into White, Black, Hispanic, Asian, and Native American and socioeconomic status was divided into quintiles. Within groups multiple linear regressions revealed engagement was a better predictor of reading achievement than motivation. Black and Native American students reported lower engagement, but not lower motivation. Engagement showed a linear relationship with socioeconomic status, but no difference in self-reported motivation was found. The results may indicate that Black and Native American students are equally motivated to read however do not engage in school reading due to a lack of cultural connection with the reading material or the structure of reading within schools. Further research exploring the differences between motivation and engagement within class and race may suggest potential pedagogical changes to increase reading scores for all students.
Identifying actively transcribed U8 snoRNA genes in humans: How genomic position affects splicing of adjacent genes

Sarah Biehn and Brenda Peculis

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Elizabeth Bier
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Communication Science & Disorders

Faculty Mentor: Dr. Teresa Lever, Otolaryngology
Funding Source: School of Health Professions Undergraduate Research Mentorship Program

**Thickening fluids for pediatric patients with dysphagia: The challenges of achieving and maintaining safe viscosities**

Elizabeth Bier, Kate Robbins, John Gianladis, Chesney Willis, and Teresa Lever

Background: Dysphagia (feeding/swallowing impairment) in infants results from multiple etiologies, such as prematurity, compromised respiratory status, neurological deficits, congenital anomalies, and gastroesophageal reflux. A common sign is aspiration of liquid into the lower airway while drinking. Treatment typically entails increasing viscosity of fluids using various thickening agents to reduce aspiration risk. Commercial grade thickeners (e.g. Xanthum gum) are linked to necrotizing enterocolitis in infants under one year. For this reason, only rice or oat cereals are FDA-approved thickening agents for premature infants; however, there are no standards for use. Toward this goal, we are investigating rheologic properties of infant formula and breast milk with various thickening agents added.

Methods: Three types of infant formula (19, 22, and 24 calorie) and breast milk are paired with single or whole grain rice. Each 15mL sample contains 5mL of rice, tested at room temperature over 30 minutes (i.e., average infant feeding duration). Viscosity readings are obtained every 15 seconds using a cone and plate rheometer.

Results: Rheometric parameters were established using a constant shear rate of 50 inverse seconds. We have tested 19 calorie formula alone and with single and whole grain rice added. Viscosity of thickened formula remained remarkably stable for 30 minutes, however values for single grain did not consistently reach the target nectar consistency range (50-350 cP). Testing of 22 and 24 calorie formula and breast milk is underway.

Conclusions: Preliminary results suggest single or whole grain rice are stable thickening agents in 19 calorie formula. However, to reach nectar consistency using single grain rice, more than 5mL may be needed to prevent aspiration. We expect results from 22 and 24 calorie formula and breast milk in combination with single or whole grain rice will identify the optimal combination that produces stable nectar consistency liquid for use with dysphagic infants.
Nicholas Bira
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Faculty Mentor: Dr. Trent Guess, Physical Therapy

Improvements on methods of 3-dimensional scanning and manufacturing of foot orthoses

Nicholas Bira and Trent Guess

Shoe lifts are orthotic devices that provide assistance with individuals who need adjusted gait due to various conditions. They come in many shapes and sizes, depending on the needs of each individual. Simple changes to gait as a result of orthotic footwear can significantly improve comfort and function in gait. Lifts are often custom made to fit the contours of a shoe and their production necessitates a professional with the necessary tools. When shoe lifts are needed for an infant or adolescent, they result in large expenses just for footwear, since the individual would frequently need new pairs of shoes due to growth. These are obstacles to individuals receiving adequate footwear for their needs, as the high cost, slow turnaround, and high replacement make acquiring them difficult for most people. This project will consist of two parts: 1) The design of a 3D scanning setup to accurately and reliably create full scans of individuals’ feet to produce custom orthotics shaped to their needs 2) Testing and comparison of 3D printed materials and some materials used in producing traditional orthoses. The outcome of this project will allow someone with little experience or skill with 3D scanning technology to consistently produce useable 3D scans of feet. These scans will have the capacity to eliminate the need for older techniques such as casting, and will significantly reduce the costs and discomforts previously needed to produce a model of the foot. The material tests will also provide information about the viability of commercially available 3D printed materials as replacement materials for current foams and rubbers. Potentially these materials could be used to 3D print orthoses and remove the need to carve and shape orthoses by hand.
Kevin A. Bird, Michael A. Gore, Joanne Labatte, Larry Robertson, and Chris Pires

Biofortification — the enhancement of crop nutritional quality through plant breeding — is potentially a sustainable and cost-effective strategy for addressing micronutrient deficiencies throughout the world. Success of biofortification depends on the identification of favorable genes associated with nutritional quality, followed by increasing the nutritional value of locally adapted crop varieties by selecting favorable alleles of identified genes in breeding populations. Without connection of phenotype to genotype, biofortification will likely be ineffective for improving targeted nutritional traits. *Brassica rapa* L. is an agriculturally important vegetable crop, with 100 million tons harvested globally in 2012. It is a source of numerous essential mineral nutrients including iron — the most commonly deficient micronutrient in human populations. Plants in the Brassicaceae family also contain a unique class of sulfur-containing compounds called glucosinolates that show anti-carcinogenic activities. Successful genetic dissection of these traits requires knowledge of the genetic diversity of the species and implementation of quantitative genetic methods like Genome Wide Association Study (GWAS). Population structure analysis based on STRUCTURE analysis suggests five main subpopulation groups make up *Brassica rapa*. Genetic diversity analyses suggest minor population differentiation between subspecies with an average FsT of .16, and the most genetically distal subspecies being the oilseed type yellow sarson (subsp. trilocularis). Inbreeding coefficients suggest this may be due to extreme outcrossing in the sampled accessions. An Analysis of Molecular Variance (AMOVA) showed most genetic variance to be from within populations (83%) compared to among populations (17%). Selective sweeps were computed by FsT outlier and Composite likelihood ratio to identify loci under positive and balancing selection and were compared to a GWAS that used Multi-locus Mixed Models to find candidate loci controlling glucosinolate and mineral content across the species. This study is one of the most comprehensive genetic diversity analyses of *Brassica rapa* and the first GWAS in *Brassica rapa*. 
Characterization of a new method for laryngeal adductor reflex testing

Brett Blake and Teresa Lever

**Objectives:** There is no modern method to assess the laryngeal adductor reflex (LAR), or the brief closing of the vocal folds in response to mechanical stimuli. LAR impairment is highly correlated with dysphagia (swallowing impairment) as a consequence of numerous medical conditions, including stroke, Parkinson’s disease, and amyotrophic lateral sclerosis (ALS). Previously, the procedure was performed using an electronic air pulse device that is no longer commercially available. We developed a new, inexpensive “low-tech” option for LAR testing and performed *in vitro* characterization.

**Methods:** A 100 cm long polyethylene catheter was attached to a 10cc syringe via a 22-gauge blunt-tip needle. The catheter was inserted through the working channel of a human laryngoscope and aimed at a pressure sensor. The two authors delivered air pulses at working distances of 1 cm and 1 mm, corresponding to actual working distances with human subjects using our new versus antiquated device. At each distance, three sets of five air pulses were delivered using 5cc and 10 cc volumes, with each set followed by a one-minute rest period to avoid a fatigue effect. Additionally, a 3D transient computational fluid dynamics (CFD) model is currently under construction using ANSYS Fluent.

**Results:** At 1 cm, the air pressure at the tip was 20-30 mm Hg with a pulse width of 150-250 ms. Similar pressures were produced between both authors and air volumes. The ANSYS Fluent CFD model should show a good profile of airflow out the catheter tip.

**Conclusions:** A new methodology to perform LAR testing has been developed and characterized *in vitro*. Our low-tech device produces air pressures 2-3 times higher than the 10 mm Hg maximum of outdated electronic air pulse devices. We are currently testing this simple methodology with people and horses to determine its clinical utility in human and veterinary medicine.
“It takes me back to my memories”: Examining the affordances of sharing high quality Latino picturebooks for students’ Language Arts learning and self-efficacy

Tia Blasi and Angie Zapata

For this qualitative discourse analysis, we drew upon data produced with 5 bilingual 3rd grade students of diverse socio-cultural backgrounds, Latino heritages, and linguistic histories. Students responded to and examined high quality Latino picturebook authors and illustrators to learn craft (when they use English vs. Spanish, word choice, word placement, colors, textures, lines, and modes of illustration) that would serve their own work as picturebook writers. The data set drew exclusively from pre- and post- annotated picturebook interviews conducted by Dr. Zapata. During the initial interview, students utilized a think-aloud protocol to share their responses to and understandings of the text’s construction. Students repeated the same protocol for the final interview and then articulated how they put their learning to work in their own picturebook productions.

A constant comparative and discourse analysis was employed to identify salient themes from both the pre- and post- student interviews. Through this process we found that students appropriated craft that reminded them of the following: 1.) their home/family; 2.) their culture; and 3.) their language. The connections they made to the mentor picturebooks gave them space to authentically relate their experiences to the books and construct knowledge of craft and its function. Students were able to transfer this knowledge and create picturebooks that brought together aspects of their identities with their learning from the mentor authors and illustrators. In this process students gained a deep knowledge and understanding of writer’s craft and the purpose of craft in writing and illustrating. This helped them form epistemic beliefs that translated into their own experiences creating their picturebook. They understood that there are influences behind the books that they read, and were able to look at those influences with a critical eye. They gained clues from the text that tell them why the author might have written in the style they did, or chose to illustrate in the way they did. This helped students become active consumers of texts, and synthesize their knowledge with the information presented in the book, and the hidden beliefs of those who wrote and illustrated the books. This is a skill needed throughout life-to look at text and analyze influences for potential bias. Students also developed a deep sense of self-efficacy in communicating through their book. They were comfortable in communicating the three big themes of home/family, culture, and language and perform aspects of their identities. These findings suggest several implications for teaching craft through picturebooks, and teaching with high quality, diverse books picturebooks that will elicit meaningful connections from all ethnicities in your classroom.
Characterization and mapping of the *Suppressor of sessile spikelet 3* (Sos3) mutant which functions in paired spikelet development in maize

Amanda Blythe, Mahliyah Adkins-Threats, Shelbie Wooten, and Paula McSteen

*Zea mays* (maize) and rice are two of the most important cereals in the world due to their central roles in agriculture. One of the main differences between these grass species is the number of spikelets (branches that bear florets) that are produced. This difference is important because the spikelet is the fundamental unit in grass inflorescence architecture. In particular, maize produces paired spikelets, while rice, barley and wheat produce single spikelets. However, the *Suppressor of sessile spikelet 3* (Sos3) mutant of maize produces single instead of paired spikelets. Therefore, the Sos3 gene may play a role in the evolution of the paired spikelet. Furthermore, Sos3 mutants are phenotypically characterized by reproductive defects in the development of the male (tassel) and female (ear) inflorescences, such as fewer tassel branches and fewer kernels on the ears. Characterization of mutant phenotypes through histology and scanning electron microscopy (SEM) shows that single spikelets are produced in place of paired spikelets, thus indicating that the Sos3 gene functions in reproductive development. To determine the location and identity of the mutated gene, the Sos3 mutant is being mapped. Linkage analysis with microsatellite markers shows Sos3 maps to chromosome 1 (bin 6) between markers umc1988 and umc2025, and fine mapping is continuing. Identifying the gene responsible for the Sos3 mutation will provide valuable insight into spikelet development not only in maize, but also in other cereals, such as rice.
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Faculty Mentors: Dr. John Boyer and Dr. Priyamvada Voothuluru, Plant Sciences; Dr. David Braun, Biological Sciences
Funding Source: Freshman Research in Plant Sciences

Seedling growth phenotyping of maize sucrose transporter2 mutant

Hannah Boatright, Kristen Leach, Priyamvada Voothuluru, David Braun and John Boyer

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
This is Ice

Haley Boeschen and Alexis Callender

There is a balance between a minimal component and the history of landscape using contrast in material and process. The vibrant red over the glacier landscape gives the scene a dramatic moment of harmony and collision. This censorship is not only a denial of an issue but also the physical denial of the image behind it. To cover a section of an image increases the need to see what is behind, and makes what is given of the landscape less remarkable. Glorifying glaciers is not my intent, but to point out the foreign body or bodies in the landscape. In this moment, the censor itself is a color not included in the colors of the landscape, as John Baldessari does in his work. In some images, the red compasses corners of the page, behaving as a frame and environment that holds the scenery. The nature of the piece changes as the red shapes move to the edge, shifting an understanding of what the outer image means as a container. This developing project emphasizes the contrast between red and blue and the stability of a geometric flat surface compared to a landscape we know as unstable. The marriage of two colors is apparent in my work; its purpose is to compare an issue to its driving force. An issue and its cause coexist the same way red and blue sit next to each other on the color wheel and rely on each other to form additional hues. The work shows collision between a historical landscape and a foreign object. These objects harmonize and seduce an audience when paired with a landscape it is out to destroy.
Data mining on Missouri congress data: Association rule mining on the access Missouri dataset

Kurt Bognar, Mike Phinney, and Chi-Ren Shyu

Access Missouri is a state government data project developed by a multidisciplinary team with the purpose of increasing transparency in the Missouri state congress. AccessMissouri.org launched in November of 2014 and accomplished that goal by aggregating data from the Missouri Ethics Commission, the Missouri Secretary of State, scraping legislative journals, voting records and other sources. The Access Missouri data opens the door for a wide array of data mining and machine learning analyses. In particular, this project focused on data mining in areas such as identifying cliques of legislators whose voting records are similar, correlations between campaign contributions and bill passing, legislator votes relative to bill topics, etc. Association-rule-mining (ARM) is well suited for this type of exploratory analysis. ARM is used in a variety of applications; from Market Basket Analysis to hurricane escalation and solar storm peak prediction. In our experiments, we utilize the Apriori algorithm on an in-memory computing cluster running Apache Spark. In this poster, we share our initial results and provide details for future research.
Expanding the methods of low-temperature nonequilibrium plasma diagnostics with RF attenuation

Derek Bolton, Peter Norgard, and Scott Kovaleski

Atmospheric pressure plasma technology has a wide range of applications and is utilized in the biomedical field for sterilization and gene transfection, as well as surface decontamination in many industrial settings. Understanding the dynamics of low-temperature, non-equilibrium plasma is essential in furthering the research and development in these areas. An important physical characteristic of the plasma is the electron density. Accurately determining plasma density at high neutral gas pressures is difficult. A piezoelectric transformer can be used to generate electrodeless high voltage on a helium-filled quartz tube which produces the non-equilibrium, low-temperature plasma. Radio frequency (RF) resonant cavity perturbation is a plasma diagnostic technique that can be used to find the plasma conductivity. Analyzing the impact of a non-equilibrium atmospheric pressure plasma on a cavity resonance will be used to measure the plasma density.
Hepatitis B virus antivirals that target the viral capsid and work by different mechanisms of action

Kelsey N. Boschert, Dallas Pineda, Thomas Laughlin, Maritza N. Puray-Chavez, Dandan Liu, Anna T. Gres, Juan Ji, Eleftherios Michailidis, Andrew D. Huber, Karen A. Kirby, Michael Parniak, Zhengqiang Wang, Charles M. Rice, and Stefan Sarafianos

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Carbohydrate partitioning is the process of assimilating carbon into photosynthates and the allocation of carbohydrates produced in source tissues (e.g., leaves) to non-photosynthetic sink tissues (e.g., seeds, roots, stems). Plants with mutations in the genes controlling these processes are unable to effectively transport sugars throughout the plant, and are therefore deemed carbohydrate partitioning defective (cpd). Due to their inability to efficiently transport sucrose from the leaves, hyperaccumulation of starch is observed. In association with this overabundance of starch, a number of notable phenotypes are used to distinguish these individuals in the field, such as the accumulation of anthocyanin in leaves, chlorosis of the leaves, and stunted growth. The aim of this study is to identify and characterize the Cpd29 mutation, which exhibits a dominant inheritance pattern. Upon introgression into the Mo17 genetic background, the mutant phenotype was more severe than in the B73 background; therefore, the Mo17 population was primarily used for genetic mapping studies. The gene responsible for the Cpd29 mutation was determined to be on chromosome 10 by Bulk Segregant Analysis (BSA) mapping. Fine mapping using polymorphic PCR-based markers narrowed down the gene’s location. The region has been refined to a small region and potential candidate genes are being sequenced. Once the causative gene responsible for the Cpd29 mutation is identified, we will determine the specific role it plays in carbohydrate transport and allocation in maize. With the identification and characterization of this gene, we will further expand our understanding of carbohydrate partitioning, and apply this knowledge to increase crop yield and food security.
The feasibility of consuming a high protein breakfast in a free-living environment

Erica Braham, Jessica Gwin, and Heather Leidy

Obesity is one of the greatest threats to public health this century. The health consequences related to obesity can begin as early as childhood, and many overweight young people already have at least one, if not multiple cardiovascular risk factors along with an increase for risk of Type 2 Diabetes. Thus, there is a great need to develop successful strategies targeting weight and glycemic control to reverse the obesity epidemic and prevent and/or delay serious health complications in young people.

Data from our lab and others suggest that eating protein, particularly at breakfast, stimulates several mechanistic pathways that modulate indices of weight management. Based on these findings, we completed a series of breakfast studies that to examine the acute effects of consuming a high protein (HP) Breakfast on the signals controlling energy intake regulation in ‘breakfast-skipping’ adolescents. Greater reductions in appetite, greater increases in satiety, and greater reductions in food craving-based neural responses were observed.

No studies to date have assessed the feasibility of consuming a HP breakfast every day in a free-living environment in young people. We propose a 3-month behavioral modification trial in overweight, ‘breakfast-skipping’ adults to assess the feasibility of consuming a high protein breakfast in a free-living environment. Because adolescents typically live in an environment controlled by an adult, this is significant.

Twenty-four overweight, habitual breakfast-skipping adults will complete the following long-term trial. Participants will complete a 3-month behavioral intervention specific to the consumption of 350 kcal breakfasts. At baseline, the participants will receive dietary counseling to acquire skills necessary to choose appropriate breakfast foods that will lead to the consumption of the recommended amount of energy and protein. The following outcomes will be assessed during baseline and at the end of each month: body weight, daily food intake, breakfast choices, satiety, and mood state.
Quantifying environmental justice impacts of civil engineering advancement projects using GIS-based methodology

Emily Brengarth, James Cole, and Kathleen Trauth

The effects of infrastructure advancements create multiple intended and unintended outcomes that can positively and/or negatively affect community members. Furthermore, inaccurate tools for detecting underrepresented populations affected by municipal projects may lead to further marginalization and is therefore an environmental justice (EJ) concern. Geographical information systems (GIS) analysis when combined with Census data represents a more precise depiction of a neighborhood’s landscape. By applying GIS-based methodology a more accurate evaluation of environmental impacts can be determined in order to properly account for the effects of structural growth. The main parameter of concern within this report focuses on noise pollution and provides a means to compare impacts on at risk populations for design alternatives. Additionally, the implementation of Highway 74/34 in Cape Girardeau, MO acts as a case study testing the utility of the GIS methodology in order to determine the efficacy for predicting environmental justice impacts for at risk populations. Further research and attention should be paid to populations at risk to undesirable outcomes of infrastructure projects in order to satisfy environmental justice standards.
Grating fabrication: Preparation and procedure

Jason Briggs and Shubhra Gangopadhyay

Plasmonic gratings have been studied for various applications such as fluorescence based sensors. Our groups developed a method to duplicate nanostructured gratings from commercial CD, HD, DVD, and Blu-ray discs by a micro-contact printing method by using poly(methylsilsesquioxane) (PMSSQ) as ink. With this method our gratings are produced at a significantly lower cost when compared to traditional lithography techniques. The gratings have shown to produce up to 130 times fluorescence enhancement when compared to a flat glass. Nanostructured grating fabrication by a micro-contact printing method is an important procedure in fluorescence based bio-detection and bio-imaging research. With a constant need to fabricate gratings in order to continue research, a cost efficient procedure that produces high quality gratings must be developed and refined.
Integrating physical activity with numeracy in the preschool classroom

Alicia Brueggemann, Emily Konecek, Mackenzie Mertens, Shahrukh Nesser, and Sara Gable

Poor math achievement and childhood obesity are topics of national concern. If short bouts of physical activity can be integrated with teaching the number knowledge and skills that predict later math proficiency, there is potential to favorably influence short- and long-term numeracy and physical health. The proposed project aimed to determine if physical activity can be integrated with number learning games to improve preschoolers’ number knowledge and counting skills. We hypothesized that integrating an age-appropriate large motor skill, such as jumping, with an evidence-based number board game, would produce improvements in preschoolers’ numeracy outcomes that are at least equivalent to those from sitting to play the game. A pilot study is underway with 28, 3-year-olds from the Columbia Public Schools Title I Preschool Program. After parents gave consent for their child’s participation, preschoolers were pre-tested (fall 2015). Pre-assessments evaluated participant’s non-symbolic quantity discrimination and symbolic knowledge of counting, numerals, ordinality, and cardinality. After pre-testing, children were randomly assigned to one of two intervention conditions: 1) the original seated number board game; and, 2) a number game that is played by jumping on a game board floor mat. The intervention began in January, 3 months after children were pre-tested. Preschoolers in both conditions met individually with the same experimenter for two, 15- to 20-minute game-playing sessions over a two-week period; post-testing occurred one week after the second intervention session. As of March 15, 2016, 24 children will have completed pre-testing, 2 intervention sessions, and the post-test. Data scoring, entry, and analysis are underway. Our hypothesis will be tested with ordinary least squares regression (OLS). If the proposed study shows that preschoolers’ early numeracy is improved by playing a game that integrates jumping, our next step will be to evaluate the impact of the game on children’s moderate-to-vigorous physical activity (MVPA).
Bullying has become a pervasive problem among school aged youth. According to recent data approximately 1 in 4 students report being victimized within American schools. Two of the most common predictors among youth that experience prolonged victimization are social and communication skills deficits. This is especially true for students with disabilities, who are disproportionately involved within the bullying dynamic. Therefore, it’s critical to examine the relationship between social skills instruction and youth who have been identified with low social skills.

The current study used existing data collected by the partner schools’ school climate survey coupled with their social behavioral screener to assess the individualized needs of youth. Students identified by their teachers as having low social skills at the beginning of the 2015-2016 academic year were eligible for involvement in the study. Each school identified approximately 20% of their total population who would benefit from Tier 2 social skills instruction. Of the 20%, a total of 55 students returned parental consent allowing them to enroll in the study. Once enrolled, students received weekly, targeted social skills instruction in ten critical areas. These areas include: Listen to Others, Follow the Steps, Follow the Rules, Take Pride in Your Work, Ask for Help, Conversations, Working with Peers, Self-Management, Do the Right Thing, and Respect Others. Each student received approximately 10 hours of social skills instruction.

These students have demonstrated increased self-awareness, group participation, confidence, peer relationships, and engagement in organized social activities. All of these skills are critical for adolescent development as well as reducing bullying involvement. While the results of this study are preliminary, the improvements are promising and have direct implication in curricular development and implementation. These data suggest that schools should consider implementing targeted interventions to improve the social and behavioral outcome of middle school youth.
The dehumanization of villains: An analysis uncovering why prominent authors portray villains as inhuman

Nicole Bunte and Elizabeth Chang

My research project delves into the nature of criminals and how society views criminality. Through researching and reading stories that involve nonhuman or dehumanized villains, such as Edgar Allan Poe’s “The Murders in the Rue Morgue,” Edgar Allan Poe’s “The Black Cat,” Arthur Conan Doyle’s “The Adventure of the Speckled Band,” and more, I will be able to analyze how authors portray villains as animals and their reasons behind the nature of their villains. My research delves into society’s anxiety about being the victims of crime or being around criminals, and that society needs to associate criminals with animalistic elements to enforce their belief that they will not fall victim to the crimes. When a villain seems completely human, people seem to experience cognitive dissonance because their belief system that associates criminality with inhumanity is challenged. This project requires a psychological and historical approach in my research and my analysis. This research displays the naivety that many people hold about crime and the anxiety that people feel in association with crime.
Development of an *in silico* method for visualization of pelvic fractures and reconstruction

Kate Burkhardt, Lauren Cook, Brett Crist, and Ferris Pfeiffer

The goal of this project is to develop a computational method for segmentation and manipulation of pelvic CT data such that pelvic fractures can be visualized, as well as analyzed systematically. Current methods for evaluation of complex pelvic fractures is insufficient. Therefore, computational *in silico* methods are required which can allow for a more complete 3D visualization for the patient anatomy. This will require designing algorithms, programing computer code, analyzing data collected, segmenting CT scan data, and generating a report of findings.

In this project, there is expectation to contribute to the development of computer algorithms for segmentation and manipulation of CT datasets. Also, designing and assisting with the implementation of FORTRAN code for manipulation of CT data will be required. After this process is completed computational analysis in the form of finite element analysis will be done. This will give an additional understanding of core engineering content related to biomechanics. Finally, there will be data analysis of results including statistical analysis performed, a report of project findings upon completion generated. It is expected that this project will be submitted for peer reviewed publication/presentation.
Leading up to the Nazi occupation of France in 1940, Paris was the spotlight of the fashion world. Home to some of the most influential fashion houses and trendsetters of the time period, Parisian taste was considered the utmost desirable in the industry. This demand for French designs pushed designers around the globe to concoct new ways of pirating these coveted designs. Caroline Gershel Davis was an American designer who systemized fashion piracy and brought hundreds of stolen Parisian designs to the United States by sketching designs from French design rooms and shows. The Missouri Historic Costume and Textile Collection recently acquired 2000 of these sketches.

Caroline Gershel Davis’ efforts to illegally copy designs speak to an ill that has always affected the fashion industry. However, her story goes beyond the controversy of fashion piracy. Our findings suggest that the timeline in which Davis was obtaining and mimicking these designs may challenge current conceptions of the fashion industry during World War II.

In order to further our understanding of Caroline Gershel Davis and the timeline in which she obtained these sketches, we began by comparing Davis’s sketches to fashion publications of the time period, in order to find the original French designs, as well as copies. We were able to uncover exact matches in Vogue, Women’s Wear Daily, and The New York Times. Finding these matches allowed us to pinpoint the seasons and year of a significant group of Davis’ sketches.

We found that at least some of Davis’s sketches were linked to designs published in 1940, including at least a few from after the beginning of Nazi occupation in June 1940. These findings allow us to not only understand the ways in which Americans were accessing “Parisian-inspired” fashion, but also how designs were making their way out of Nazi-occupied France.
Dual tasking while speaking: To do or not to do?

Denisha Campbell and Mili Kuruvilla-Dugdale

A significant part of daily communication requires speakers to coordinate speech production demands while simultaneously processing ongoing verbal exchanges. This daily communication context requires the regulation of speech, language, and cognitive processes, including verbal working memory (WM) that is used to process short-term verbal information. Most prior research has focused on these systems separately and there is a significant gap in our knowledge on how older adults with declining functions perform in such daily dual task contexts. The objective of the proposed project is to determine the effects of competing cognitive demands on speech performance in older adults. For this purpose, 20 older adults between the ages of 60-90 will be recruited and asked to complete a dual task paradigm that requires them to simultaneously process (encode and maintain) words in verbal WM while repeating sentences. First, a list of three multisyllabic words will be presented auditorily and subjects will be asked to retain the words for later recall. Then, subjects will be required to say sentences taken from the Sentence Intelligibility Test while actively holding the list of words in verbal WM. We predict that there will be significant decrements in speech performance, as indexed by perceptual (intelligibility) and objective (kinematic) measures, due to the competing verbal WM demands. The results and conclusions for this study will be further discussed and presented at the forum. The study results will help determine if using dual tasks for speech assessment will allow clinicians to collect samples that are more representative of functional speech than samples obtained from a typical assessment that focuses on a single task.
Researchers from all over the world have released studies hoping to reveal any information on how to understand, predict, and finally prevent school shootings. Unfortunately, often the most insightful piece of the story is missing from such episodes, which is the perpetrator’s perspective. Many speculate that the homicide-suicide trend in school gun violent events could be a premeditated idea or a sudden escape from being prosecuted, if not a combination of the two (Kalish, 2010), but there has been little in the way of formal statistical inference and prediction models to identify the likelihood of suicide by shooters.

By using advanced statistical methods such as logistic regression, linear and quadratic discriminant analysis, k-nearest neighbors, and tree-based random forests, we were able to identify the statistical model able to predict whether a school shooting will end in suicide or not, with over 80% accuracy, and reveal the variables that increase the likelihood of the suicide occurring.
Cassandra Casteel
Ashland, MO

Senior
Art History & Archaeology; Anthropology

Faculty Mentor: Dr. Christine VanPool, Anthropology
Funding Source: McNair Scholars Program

The development of morphologies of the feathered serpent in Mesoamerican and the American Southwest

Cassandra Casteel and Christine VanPool

Mesoamerican and Southwestern researchers debate the origins, meanings, and influence of the feathered serpent. Some believe that the Southwestern horned serpent is derived from the Mesoamerican feathered serpent, while others believe the Southwestern serpent tradition developed largely independently from other regional traditions. Those contending that Southwestern and Mesoamerican serpents are connected rely on similar meanings of the serpents, such as its association with rain and fertility, while those arguing for local developments rely on differences in morphological traits of the serpents (e.g., Aztec’s Quetzalcoatl being a rattlesnake with a body covered in quetzal feathers whereas Zuni’s Kolowisi has a smooth, featherless body with a headdress of turkey feathers and a wooden horn). Both perspectives tend to view the relationship in an “all-or-nothing” manner, without really considering the possibility for combinations of historically shared and independently developed traits. Here we use phylogenetic analysis to examine morphological data (e.g., placement of plumes, tail form, and mouth and eye shape) and archaeological context (e.g., associated mural images, architectural features, etc.) to identify homologous and analogous traits. Our results break down the dichotomy by identifying which traits reflect historical connections, and reconstructing the historical development of classes of serpents (e.g., Aztec and Maya).
Relinquishing the Senate seat: A study on the dynamics of U.S. Senate Retirements (1919-1937)

Anurag Chandran and Marvin Overby

For long, scholars have examined legislative turnover and its consequences on the U.S. Congress. These studies have concluded that although reelection rates remain high, an important outcome of our current era of incumbency advantage is that voluntary retirements, not electoral defeats, are the greatest cause of membership turnover in Congress. Given that studying membership change is the gateway to understanding decision making in the legislature, considerable scholarly literature has explored the retirement patterns of members of Congress. However, an overwhelming majority of these studies are focused on the U.S. House of Representatives with only a handful of them dedicated to the U.S. Senate. We aim to add to the understanding of legislative retirements by pushing the historical analysis back to the beginning of the popularly elected Senate, in an effort to ascertain whether the institutional differences between the two houses of Congress contribute to disparities in the career decisions of legislators. We compare the rates of retirements to electoral defeats and determine if the partisan disparity seen in the House (with Republicans retiring at higher rates than Democrats) is also historically present in the Senate. This research is part of a larger, on-going data collection and analysis effort that eventually will lead to multivariate analysis of the determinants and consequences of Senate retirements.

This project was completed to fulfill a Capstone requirement.
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Faculty Mentor: Dr. Matthew Burns, Educational, School & Counseling Psychology

**PALS: Effectiveness in classwide K-2 reading intervention**

Vivian Chang, Sara Thompson, and Matthew Burns

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
The effects of collision avoidance technology on driving behavior

Alain Chen, Jackson Smith, and Jung Hyup Kim

Thousands of car accidents happen every year due to lack of attention. To help combat this, many companies have created devices using collision avoidance technology (CAT). The issue is, “how effective are these devices?” A predetermined route through many different road terrains, such as an interstate, a highway, and a college campus was developed to help test these devices. The route also contains many events, for example lane changes, to create instances where a CAT device may go off. This project is testing the Garmin NuviCam LMTHD, Audiovox LDWS100, Mobileye 560, and Safedrive RD 140. These devices provide alerts for forward collision and lane departure warnings. The effectiveness of these devices are measured through EMG (electromyography) muscle strength data, eye tracking glasses, and reaction times. The route takes about twenty minutes to complete, each session includes 4 trials, one control and three with warnings on. Each device will have at least 5 participants.
A study of power distribution system reconfiguration based on SAIFI index performance

Milan Chen, Zhe Chen, and Robert M. O’Connell

Distribution network reconfiguration is a process that alters the feeder topological structure, changing the open/close status of the tie switches in an electrical distribution system, with the objective of improving performance. One measure of performance is reliability, and the SAIFI index is an important measure of system reliability. All reliability indices, including SAIFI, require elaborate and complex calculation. The purpose of this poster is to provide an analysis of the SAIFI reliability index using 5-bus and 16-bus test systems. As few, if any, published articles include detailed methods for calculation of the SAIFI index, the first part of the poster includes a detailed explanation of the calculation process and the algorithm for programming it. The second part of the poster describes SAIFI performance results obtained by applying the algorithm to different topologies of each system. Finally, conclusions concerning the relation between optimum system topologies and SAIFI values are drawn.
Biomodulatory hydrogels

Emily Cheng, Mary Josselet, Sidney McMillan, and Bret Ulery

Hydrogels are of great interest for the treatment of osteoporosis due to their potential as non-invasive drug delivery carriers. The hydrogel components can be injected into an osteoporotic fracture site where they will combine to form the water swollen network *in situ*. Ionic crosslinking is one method that can be used to form hydrogels for which ions can be chosen that have potent biochemical properties. Of particular interest are phosphates which are known to induce bone pro-forming effects. Ionic crosslinking alone, however, has resulted in mechanically weak hydrogels. To mitigate this issue, covalent crosslinking using genipin was carried out and its impact on hydrogel mechanical properties was studied using rheology.

This project focuses on studying the effect phosphate ions and genipin have on chitosan hydrogel crosslinking time and mechanical properties. Chitosan is used as the biopolymer because of its biodegradable and biocompatible characteristics. A number of experiments were conducted varying the concentrations of both phosphate ions and genipin. Using the inversion test, uniform gelation is witnessed around four minutes; however, the hydrogel continues to further gelate over the next twenty-four hours. Rheology was also performed on the crosslinked hydrogels to measure their mechanical properties. This process was repeated with bicarbonate ions, which have no bioactive properties and serve as a control. By determining the effect of phosphate and genipin solutions on crosslinking time and the physical properties of the hydrogels, these parameters can be tuned to produce a range of hydrogels capable of treating a variety of osteoporosis-related injuries including vertebral compression fractures and long bone pathological fractures which require different mechanical properties and gradients of biological repair cues. Also, by changing the bioactive crosslinker used, the hydrogel technology can serve as a regenerative engineering platform in the treatment of post-traumatic osteoarthritis and peripheral nerve damage.
Is information power?: Uncovering college students’ loan decision-making processes

Brian Chervitz, Lisa Scheese, Laura Page, and Casandra Harper

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
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Faculty Mentor: Dr. Heather Hunt, Bioengineering
Funding Source: College of Engineering Undergraduate Research Program; UM FastTrack Program

Metal-clad waveguide characterization for contact-based light transmission into tissue

Jeffrey Chininis, Paul Whiteside, and Heather Hunt

As contemporary laser dermatology procedures, like tattoo removal and skin resurfacing, become more popular, the complications of their operation are also becoming more prevalent. Frequent incidences of over-exposure, ocular injury, and excessive thermal damage represent mounting concerns for those seeking such procedures; moreover, each of these problems is a direct consequence of the standard, free-space method of laser transmission predominantly used in clinical settings. Therefore, an alternative method of light transmission is needed to minimize these problems. Here, we demonstrate and characterize an alternative method that uses planar waveguides to deliver light into sample tissue via direct contact. To do this, slab substrates made from glass were clad in layers of titanium and silver, constraining the light within the waveguide along the waveguide's length. By creating active areas on the waveguide surface, the propagating light could then optically tunnel into the tissue sample, when the waveguide was brought into contact with the tissue. SEM and EDS were used to characterize the metal film thickness and deposition rates onto the glass substrates. Laser light from a Q-switched Nd:YAG source operating at 532nm was coupled into the waveguide and transmitted into samples of pig skin. The amount of light transmitted was measured using photoacoustics techniques, in conjunction with a photodiode and integrating sphere. Transmitting light into tissue in this manner effectively resolves or circumvents the complications caused by free-space propagation methods as it reduces the operating distance to 0, which prevents hazardous back-reflections and allows for the ready incorporation of contact cooling technologies.
Environmental factors affecting predator-prey ecology among gastropods in Bahamian settings

D. Clapp, J. Schiffbauer, J. Huntley, and T. Selly

The unique ecosystem found at Pigeon Creek in San Salvador, Bahamas provides an interesting analysis of different gastropod species to differing environmental factors such as salinity, sediment type, and temperature to gather insight into predator-prey ecology. The purpose of this study is to get an insight into how gastropods and their predator’s behavior may vary throughout a salinity gradient, as well as other environmental controls. Samples were collected from a 1cm sieve across 26 different localities within the intertidal Pigeon Creek on the island of San Salvador. A total of 3,291 specimens were sampled which included 47 identified and 3 unidentified species, with certain species occurring in nearly every site sampled. Samples were then sorted by species (excluding shells without an aperture) and separated each sample site into two groups; those with or without predatory drill holes. The specimens were imaged then later measured using ImageJ. The measurements taken include specimen length and width, the presence of a drill hole, drill diameter, drill location in relation to the apex, and the quadrant of the shell where the drill hole was present. Taphonomic data was collected to assess deterioration of the apex, aperture, and shell as a whole, as well as, for the presence of worm tubes, percentage of encrustation, borings, fractures, and damage done to the sample. The data was then analyzed using a canonical correspondence analysis to determine what environmental factors cause the most variation within the sample sites and amongst the sites throughout the entire creek. These analyses will allow us to interpret whether predatory habits are being altered by factors of salinity, sediment type, and/or temperature.
Exploring the genetic interaction between clathrin-coat components in plant immunity and development

Alexander Clarke, Erica LaMontagne, and Antje Heese

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Aldosterone acutely enhances coronary artery contractile responsiveness without inducing endothelial dysfunction

Hannah Cleeton, Alex Meuth, and Shawn Bender

Inappropriate activation of the renin-angiotensin-aldosterone system (RAAS) contributes to increased contractility of the vasculature in many disease states. Activation of vascular mineralocorticoid receptors (MR) has recently been identified as an important regulator of vascular function. Little is known regarding non-genomic MR signaling as a modulator of vascular contractility.

Based on available evidence, we hypothesized that acute aldosterone incubation of murine coronary arteries ex vivo would enhance coronary contractility via non-genomic MR activation in smooth muscle cells (SMC). Wire myography experiments were conducted on isolated coronary arteries from C57BL/6J mice. Contractile responses to KCl (10mM-45mM) were determined with and without one hour aldosterone treatment (10nM or 100nM). KCl generated dose-dependent coronary vasoconstriction that was enhanced by aldosterone incubation.

Vasoconstriction to 20mM KCl was doubled following incubation with 10nM aldosterone and increased >3-fold following incubation with 100nM aldosterone. Pretreatment with the MR antagonist eplerenone (10µM) did not significantly reduce enhanced KCl vasoconstriction in response to 100nM aldosterone. Furthermore, neither dose of aldosterone for one hour impaired endothelium-dependent vasodilation to acetylcholine.

In conclusion, acute aldosterone incubation enhances coronary vasoconstrictor responses to KCl that does not seem to be dependent on MR activation. This effect appears to be smooth muscle-specific and not secondary to aldosterone-dependent endothelial dysfunction since acute aldosterone incubation did not impair endothelium-dependent coronary vasodilation.
Ephrin-A3 promotes and maintains slow muscle fiber identity during postnatal development

Nathan Coffey, Laura Arnold, Danny Stark, and Dawn Cornelison

Each adult skeletal muscle is composed of a distinct ratio of fast and slow muscle fibers that are innervated by fast- or slow-firing motor neurons, respectively. Slow muscle fibers contract slower and with less force than fast muscle fibers and are more fatigue-resistant than fast muscle fibers. The proper proportion and arrangement of fast and slow muscle fibers is essential for appropriate formation and function of each skeletal muscle by providing the necessary balance of contractile force and endurance. Muscle fiber type is maintained in adult tissue by the muscle fiber’s connection to the correct type of motor neuron. How muscle fibers and motor neurons are appropriately matched up with each other remains unclear.

Our work demonstrates that a protein called ephrin-A3 is specifically expressed on slow muscle fibers and is essential for keeping slow muscle fibers from transforming into fast muscle fibers by repelling fast-firing motor neurons. Mice lacking ephrin-A3 were born with the same number of slow muscle fibers as healthy mice, but many of these slow muscle fibers converted to fast muscle fibers over time because they were innervated by fast-firing motor neurons. Conversely, inducing fast muscle fibers to express ephrin-A3 promoted their conversion to the slow muscle fiber type because the fast muscle fibers were not innervated by fast-firing motor neurons.

Our findings suggest that Ephrin-A3 promotes and maintains slow muscle fiber identity by preventing fast-firing motor neurons from innervating them incorrectly. Our lab has discovered how slow muscle fibers are paired with their correct motor neurons, which will help lead to novel therapeutic targets for treating neuromuscular diseases, such as ALS.
Electrodeposition of copper for metamaterial fabrication

Nicholas Cole, Shendu Yang, and Patrick Pinhero

Metamaterials are a class of artificial composite materials with exceptional properties derived from their periodic metal-dielectric structures. These optically-active materials possess a negative index of refraction and demonstrate tunable wave propagation control that is being explored for applications including energy harvesting, acoustics, and controlling heat flow. In the fabrication of the metamaterials utilized in this study, copper is selected as the metallic component of the metamaterial due to its high thermal and electrical conductivity, excellent mechanical properties, and relative ease of acquisition.

Electrodeposition from a highly-acidic copper electrolyte is the most attractive approach for fabricating the conductive component of the metamaterial in this study due to its ease of control and rate of deposition. However, since our metamaterial design possesses a high-aspect ratio, the copper deposition process requires bottom-up superfilling and leveling of micron and sub-micron scale volumes. To accomplish this, additives such as chloride ions, 3-mercapto-1-propanesulfonate (MPSA), polyethylene glycol (PEG), and polyvinylpyrrolidone (PVP) are introduced into the electrodeposition process in order to provide improved conformity and adhesion of the copper to the substrate. The present study focuses on investigating the optimal parameters of electrodeposition of copper such as the concentration of each of the additives, the effects of additive aging, and the electrodeposition parameters of deposition voltage and its corresponding current density.

Electrochemical methods such as cyclic voltammetry and controlled potential coulometry probe the mechanism of both the specific effects of additives and the interplay between additives. Optical profilometry and four-point probe sheet-resistivity measurements are used as characterization tools to map the surface topography and sheet resistances of the deposited films. Combining with these tools with electrochemical methods, optimized parameters for electrodeposition of copper are obtained and desired fabrication methods for metamaterials are achieved in this study.
Does the micro-RNA binding protein HuR play a role in causing airway inflammation?

Asthma is an airway inflammatory disease that effects over 25 million people in the United States. Because the airway between the lungs and mouth is inflamed, this can make it hard for individuals to breath. A cure for asthma has not been found yet, although there are many treatment options to lessen the effects of the disease. Research has shown that the RNA binding protein HuR could be important in the formation of airway inflammation. Cytokines, which are important for cell signaling in the Th2 cells are regulated by HuR. Further research has been conducted to determine that both HuR and the cytokines such as IL-2 could be essential in the formation of asthma because both are closely related to one another.

My lab and I have hypothesized that HuR interacts with the cytokines in Th2 cells. To see if HuR is in fact a part of airway inflammation, 3 groups of mice were injected with either aluminum and magnesium hydroxide or OVA. The 3 groups of mice are the HuR knockout, OTII ROSA HuR fl/fl (HA-HuR transgenic) and wild type black B6 mice. Alum is important for immune system response and OVA is chicken egg whites. After 7 days, each mice will be injected with an IP booster. After Day 16, all mice had a tracheostomy performed so the airway hyperresponsiveness measurements could be taken. Some mice had a bronchoalveolar lavage performed to see if the experiment worked. Spleen and lymph nodes were taken for further analysis.
The genetic architecture underlying the complex trait controlling soybean seed pigmentation

Rachel Combs and Kristin Bilyeu

Soybean is a crop that produces high quality oil and protein. Yellow seed coats in soybeans account for most modern high yielding cultivars; however, a wide variety of seed coat and hilum pigmnetations also exist, including diverse colors such as black, brown, imperfect black, red brown, red buff, gray, green, buff, as well as clear, which is the absence of pigmentation. Several mechanisms that make up the blueprint for the spectrum of pigmentation are multiple independent loci that interact such as the Inhibitor gene, the Tawny pubescence gene, the R gene, and the W1 gene for flower color. It is important to note that derivatives from a phenylpropanoid biochemical pathway are considered key factors in the pigmentation of soybeans. Our objective is to confirm the molecular basis and broaden our understanding of the components of this complex trait for seed coat pigmentation. Using genome-wide association, we were able to identify genes and the associated SNPs from unknown seed coloration lines. At the genomic locations we were then able to test for accuracy of these alleles to predict their phenotypes. For instance, in gray seed coat lines, we were able to find a SNP that correlates to the Inhibitor gene, and for red buff, a region containing SNPs on Chromosome 14 was identified that is linked to the w3/W3 allele that controls flower color pigmentation. In conclusion, we were able to determine the loci controlling the phenotypes for the pigmentation trait of several unknown soybean seed coats and hila.
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Faculty Mentor: Dr. David Braun, Biological Sciences
Funding Source: National Science Foundation Grant to D. Braun

Characterization of carbohydrate partitioning defective

Kyle R. Conner, Christopher Ricciardi, Robert F. Baker, Tanner Buschmann, Kristen A. Leach, Mark Lubkowitz, and David M. Braun

Carbon fixation assimilates inorganic carbon into carbohydrates, which provide energy for plant growth and development. Consequently, the plant needs to transport soluble sugars, largely in the form of sucrose, from photosynthetic source tissues (leaves), to non-photosynthetic sink tissues (roots, seeds, fruits, etc.). When carbohydrate partitioning, the distribution of fixed carbon throughout the plant, is disrupted it results in an increase of sugars and starch within leaves. We performed genetic screens for plants displaying leaf chlorosis, anthocyanin and starch accumulation in leaves, and overall decreased plant growth to identify carbohydrate partitioning defective (cpd) mutants. One such mutant, Cpd2, is a semi-dominant mutant that exhibits these phenotypes. The mutant was initially mapped to the short arm of chromosome four. Fine-mapping is currently being used to narrow the position of the mutation responsible for these phenotypes. Identification and characterization of the causative mutation will give insight into the gene’s role in carbohydrate partitioning. Understanding this crucial transport pathway will help guide genetic improvements for C4 grasses, and enhance our knowledge of metabolic pathways.
Consumer discrimination in professional sport: An examination of digital fan interest

Brad Copeland, Tyler Krantz, and Nicholas Watanabe

Seminal work by economist Gary Becker (1971, 1975) theorized the existence of economic discrimination and how certain individuals and organizations may display bias in their decision making, including purchasing goods and hiring individuals. From this work, the economic literature (Kahn, 1991; Nardinelli & Simon, 1990) has developed empirical and theoretical examination of three different forms of economics discrimination: employer, employee, and consumer-based discrimination. Specific to the context of this research is consumer discrimination, the case where individuals display a preference based on certain characteristics, and thus are willing to pay a premium for products that fall in line with their inclinations.

Within the sport literature, discrimination by consumers is primarily considered through using econometric methods to analyze the price of player memorabilia (Kanazawa & Funk, 2001; Primm, Piquero, Regoli, Piquero, 2010; Regoli, 1991; Smith, Primm, Piquero, Piquero, & Regoli, 2012). However, because the market and data for memorabilia such as trading cards is rather limited in scope, the results from this line of sport consumer discrimination research provides mixed results. This project attempts to advance the empirical examination and theoretical understanding of consumer discrimination in sport by considering fan interest in players that are not as limited in their scope. Specifically, this research follows initial work by Depken and Ford (2006) which examined All-Star voting by fans. In the case of this research, we will analyze how sport fans have behaved in the digital realm by examining online voting for all-stars in the National Basketball Association, as well as their following on the Twitter social media platform. Results from this research will not only provide enhanced theoretical knowledge on the behaviors of sport fans in a digital context, but also develops a better understanding of the existence of consumer discrimination in our everyday lives.
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Omission bias in surrogate decision makers: How age affects decisions for treatment over stabilizing care

James Cousett and Victoria Shaffer

Introduction: As surrogate decision makers, a sizable minority of mothers chooses not to vaccinate their children, even though it reduces their mortality rate for specific diseases. Previous work has suggested that part of this decision is driven by feelings of responsibility and a sense of anticipated guilt if the child were to experience a negative outcome from the vaccination (Asch, et al., 1994). This preference for inaction over action even in the face of greater possible consequences has been termed the omission bias. Research has also shown that in the cases where an action has led to a negative outcome, it is likely to be judged as far more immoral than in the case of inaction (Carnes & Janoff-Bulman, 2012). This is likely due to an underlying sense of responsibility that comes when a person chooses to act; consequences are dependent upon the actions that lead to them. However, no research has examined whether patient age impacts susceptibility to the omission bias. Therefore, the purpose of this study is to understand how age of a patient will influence preference for inaction over action in a surrogate decision making task.

Methods: Participants (N=100), from introductory level psychology courses at a Midwestern University, receiving course credit for their participation, will read two vignettes about patients with life threatening illnesses that require a decision between invasive treatment (act of commission) or comfort care (act of omission). The age of the patient will vary between the two scenarios, with one scenario involving a pediatric patient (5 years) and one scenario involving a geriatric patient (70 years). Participants will take the role of the surrogate decision maker indicating their preferred treatment for each scenario and completing several Likert-scale items about their attitudes toward care; example item, “It would be my responsibility if the treatment failed to save the patient’s life”. Participants will also be asked to rate their emotions associated with their decision (e.g. guilt, regret, responsibility and confidence) for each scenario on a series of Likert-scales.

Hypothesis and Expected Conclusions: It is hypothesized that participants will differ in their decisions and emotions between the two conditions. The results of this study can inform future research about the omission bias, surrogate decision making, and age.

This project was completed to fulfill a Capstone requirement.
Accuracy of allele prediction and SNP association of genomic locations for pod shatter in soybeans

Carolyn Culp and Kristin Bilyeu

Soybean can be an important economic crop because of its low cost and high protein content. Soybean was domesticated in east Asia, and diverse soybean accessions are currently curated by the USDA National Plant Germplasm System (NPGS). While soybeans in the NPGS collection are made available for research and breeding for their positive traits, many accessions also contain undesirable traits. The pods often shatter early in soybeans originally from Japan and Korea, resulting in a drop in harvest. Recently, a soybean gene was identified on chromosome 16 that contributes to pod shatter. US soybean varieties are fixed for shatter resistance, but the shatter allele is prevalent in landraces and Asian cultivars. The objective of this research is to develop tools and resources to improve breeding for pod shatter resistance in breeding programs targeting high yield and needing access to the genetic diversity and positive traits from Asian soybean accessions. We are using association analyses (GWAS) to find the most significantly associated SNP from a set of 50K SNP data that predicts the shatter or resistant allele of the gene on chromosome 16. We will assess the accuracy of the associated 50K SNP and determine the magnitude of the phenotypic effect. In addition, we will use GWAS to identify additional genomic locations of genes controlling pod shatter. We aim to provide the predicted shatter potential for each of the soybean accessions in the NPGS. This research will allow better soybean breeding to reduce pod shatter when utilizing soybeans from NPGS.
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Funding Source: College of Engineering Undergraduate Research Option

Analysis of 3 dimensional printed material for use with structural engineering programs and sustainable housing

Isaac Cundiff and Zhen Chen

Recent advances in 3D-printing have been increasing the possible use of 3D-printed material for Structural Engineering applications. 3D-printing technology is becoming increasingly more affordable and adaptable. As the limitations of 3D-printing begin to drop away the possibility arises that the microstructures of structural materials may be fine-tuned, shapes may be designed for specific application, and a variety of other steps may be taken to improve the behavior of the overall structural member. In preparation for the time at which 3D-printing surpasses the current state of its use, studies should be started to observe how well 3D-printing may be applied to the production of structural members as well as how well current structural analysis programs will adapt to the new material properties available.

There have also been innovations in the field of 3D-printed sustainable structures overseas. One such project is being completed in Italy and due to the fact that structures are being made, the response of these structures to various loading types will need to be observed. The material is primarily mud and clay based and because the work is already being done, a new sand filter design is to be coupled with the fabricated structure in order to address a lack of potable water. Researchers hope to prove that 3D-printed structures and the wall interior sand filter (WISF) will have sufficient strength to withstand the loading cases to which they are likely to be subjected.
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Faculty Mentor: Dr. John Tanner, Biochemistry  
Funding Source: Honors College Discovery Fellowship

**Crystallographic studies of two flavoenzymes**

Christopher Dade and John Tanner

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Pharmacological inhibition of myostatin increases skeletal muscle mass and function in wild type and Osteogenesis Imperfecta model mice (*oim/oim*)

Salah Daghlas, Youngjae Jeong, and Charlotte Phillips

Osteogenesis Imperfecta (OI) is a clinically heterogeneous disease that is characterized by compromised bone strength and quality. This is due to impaired production and/or modification of type I collagen, a major constituent of bone. Treatments in OI are currently limited to surgical insertion of rods and use of anti-resorption drugs, which are accompanied with adverse side-effects, such as device failure and potentially harmful side effects. Thus, novel pharmacological treatments are being investigated as alternatives. In the following study, we investigated the effect of myostatin receptor blocking agent (RAP-031; Acceleron Pharma, Inc). The inhibition of the myostatin pathway induces enlargement of muscle, increasing loading force on bone. Increased load on bone is known to improve bone integrity due to its mechanosensitive properties. We administered RAP-031 to an OI mouse model (*oim/oim*) and wild-type (WT) mice. RAP-031 treated mice exhibited increase in body weight, hind limb skeletal muscle wet weights, and absolute contractile generating capacity regardless of genotypes. However, muscle contractile force was diminished when normalized to muscle cross sectional area and weight in RAP-031 treated WT mice, while *oim/oim* mice maintained equivalent levels between TBS (vehicle) and RAP-031 treatment. This suggests muscle weight gain with RAP-031 may not associate with concomitant increase in specific function of muscle fibers, and further investigation is still required to evaluate the effectiveness in improving bone quality.
Determining the selectivity of a new $\text{P}_2\text{Y}$ receptor antagonist, AR-C118925XX, a potential therapeutic drug for treating inflammatory diseases

Rokeith Daley, Jean Camden, and Gary Weisman

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
A comparison of the accelerated aging degradation rates of various poly(lactic acid) composite materials

Blake Darkow and Hao Li

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
To defend against herbivory, plants produce chemicals that can deter insect feeding. More of these chemicals are produced when plants detect attack. The level of induction can depend on the extent of damage. Jasmonate is a plant hormone produced in greater amounts when a plant experiences wounding and herbivory. It causes reduced growth, delayed flowering and defense responses. Its ability to induce defense responses when applied externally has given rise to its nickname as the ‘wound hormone’. A reporter of jasmonate biosynthesis could serve as a rapid screening tool to identify stimuli involved in defense induction. We used a stably transformed Arabidopsis thaliana line developed by the Koo lab that contains a yellow fluorescent protein fused to a promoter of the JA biosynthetic enzyme OPR3 (OPR3 YFP-PTS1). Thus, YFP fluorescence of this line reports the transcription of OPR3 and could be used as a proxy for induction of jasmonate biosynthesis. In this experiment, we asked whether wounding with application of methyl-jasmonate would induce the production of jasmonate in the OPR3 YFP-PTS1 mutants. Half of the plants had three leaves damaged with a pattern wheel and 20 uL (0.2 mM) of MeJA were pipetted into the wound. The other half of the plants were left untouched as controls. A set of wild type plants (Col) were treated similarly as additional controls. We hypothesized that the OPR3 plants which received wounding and MeJA would show a higher level of YFP compared to the controls. OPR3 YFP-PTS1 plants that received wounding and MeJA had much higher levels of YFP than undamaged OPR3 and wild type plants. This confirms the suitability of the mutant for use in initial screens for defense responses induced by feeding vibrations, a focus of my lab.
Leslie A. Day, Kara B. De León, Hannah L. Linnenbringer, and Judy D. Wall

Desulfovibrio vulgaris Hildenborough (DvH) is a sulfate-reducing bacterium found in heavy-metal contaminated sites and oil pipelines. This bacterium is beneficial to the environment due to its ability to precipitate heavy metals to a less soluble form; however, it has a negative effect in the oil pipelines because it causes corrosion. DvH is sensitive to nitrate, which often co-occurs with heavy metals at contaminated sites and is added to oil wells by the petroleum industry to limit DvH growth. Previous genome-wide analysis in our laboratory, by Hannah Korte, discovered genes that, when interrupted by a transposon, resulted in nitrate resistance. Thus, these genes encode proteins that cause the cell to be nitrate sensitive. After a lag in growth in the presence of nitrate, DvH was able to overcome the inhibition and to achieve a normal growth rate. and the culture retained nitrate resistance in subsequent transfers. This indicated that a mutation was occurring which caused nitrate resistance. My goal is to identify the spontaneous mutations that resulted in nitrate resistance. Following genome sequencing of six nitrate-resistant cultures, single nucleotide polymorphisms (SNPs) were identified in DVU0248 and DVU0251. I constructed a DVU0251 deletion mutant through electroporation of a marker-exchange deletion plasmid and confirmed the construct by Southern blotting. The mutant was resistant to the presence of nitrate. Through further analysis of DVU0251 sequences, five candidate SNPs possibly causing nitrate resistance were identified. I have constructed plasmids for the insertion of the SNPs in to a nitrate sensitive strain. The SNPs will be confirmed by restriction digest and sequencing. The effect of the SNP insertions will be analyzed through growth studies. This study will further the understanding of the effect of naturally-occurring SNPs on the behavior of DvH in the environment.
The effect of viscosity on the morphology of particles regarding cathode materials in Li-Ion batteries

Austin Degitz and Yangchuan Xing

For our research we are measuring the viscosity of various precursors at varying temperatures and observing the effect that viscosity has on the morphology of the particles formed after reacting due to microwave heating. These particles are to be used as a cathode material in lithium-ion batteries. Our goal is to get consistently sized small particles, around 10 nanometers. Having a larger surface area to volume ratio will theoretically help with the efficiency of our batteries. Heating via microwave radiation is allowing us to have a purely kinetic reaction and have the entire solution heat simultaneously, which we’re hoping will provide more consistently in the size of the particles compared to conventional heating methods. We believe that having a low viscosity will cause particles to form faster, and thus larger, while a high viscosity will cause particles to form slower, and thus smaller. Hopefully our research will bring results and we will be able to improve the efficiency of li-ion batteries.
A comparative epigenetic study in canine and human acute lymphoblastic leukemia

Clayton Del Pico, Alex Stuckel, and Kristen Taylor

Precursor B-cell acute lymphoblastic leukemia (ALL) is a malignancy that occurs in both canines and humans. The presence of analogous epigenetic modifications in each species is important, as it may indicate a similar mechanism of ALL pathogenesis. Our overall hypothesis is that methylation plays a role in the pathogenesis of ALL by regulating the expression of genes that provide a selective growth advantage to leukemic cells and that the genes involved will be consistent across species. To gain insight into the methylation status of ALL in both species, MIRA-seq was performed on dog ALL, and compared with MIRA-seq data previously generated in the Taylor laboratory for human ALL. Methylation peaks were identified in the dog sample using HOMER annotation and the BIOSTAR Gene Conversion tool and were compared to regions that were hypermethylated in the human studies. 120 genes were identified that were associated with regions of hypermethylation in both the human and canine samples. To determine the regulatory potential of the observed hypermethylation, previously generated gene expression data was utilized comparing normal precursor B-cell samples with human ALL samples. Three genes, PTPRO, GLIPR1L2, and FOXR1 were hypermethylated in human and canine samples and were also downregulated in human ALL samples. PTPRO and GLIPR1L2 function as tumor suppressor genes, whereas FOXR1 is an important transcription factor. The results of this study, while preliminary, highlight the utility of comparative epigenomics in discovering novel genes which may play functional roles in the pathogenesis of ALL.
Ryan Delbert
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Faculty Mentor: Dr. Enos Inniss, Civil & Environmental Engineering

**Water treatment: Providing quality drinking water to the public**

Ryan Delbert and Enos Inniss

A drinking water treatment facility in Missouri with approximately 17,000 citizens fell out of compliance with EPA regulations in 2014. Their drinking water system tested high for multiple disinfectant byproducts (DBPs), namely HaloAcetic Acids (HAA5) and Total TriHaloMethanes (TTHM). The objectives of this project include evaluating how the system operates from raw (source) water to finished product, testing treatment alternatives, and communicating options to the facility which may help them regain compliance. The challenges explored during this project include overcoming low organic content in the source water, responding to fluctuating water quality from a surface water source (river), and long water age in the distribution system.
Organic horizon depth and mass are related to distance from shortleaf pines

David Dick, Benjamin Knapp, and John Kabrick

Rationale: The organic soil horizon is a reserve for nutrients and sequestered carbon on a landscape. Needle senescence and bark slough cause litter buildup in the organic horizon under Shortleaf pine (Pinus Echinata Mill.) in Missouri Ozark forests.

Objectives: This study was conducted to describe the accumulation of litter and the variation in thickness and mass of the organic (O) soil horizon with distance from the stem.

Methods: Thicknesses of organic subordinate horizons, mass of organic residues, relative concentration of litter constituents, underlying A horizon characteristics, and the variation of those factors with distance from the base of a tree were examined at the Sinkin Experimental Forest, MO.

Results: O horizon thicknesses decreased with distance from the tree as follows: 8.53 cm. at 0 m. from the tree, 5.15 cm. at 1 m., 4.48 cm. at 2 m., and 4.25 cm. at 3 m. on average. Buildup was most apparent within 2 m. from the stem, and the Oa subordinate horizon contributed the greatest thickness. The oven-dry mass of organic residues collected from the site followed a similar distribution: 872.28 g. at 0 m. from the tree, 553.32 g. at 1 m., 395.09 g. at 2 m., and 376.66 g. at 3 m. on average. A model estimating biomass given the thickness of the residues was also developed.

Conclusions: Litter buildup decreases dramatically within a relatively short distance from the stem of Shortleaf pine trees. O horizon thickness can be used to estimate biomass in the field.
Wade Dismukes
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Faculty Mentor: Dr. J. Chris Pires, Biological Sciences
Funding Source: National Science Foundation Grant to J.C. Pires

Interrogating the phylogenomics of the Cleomaceae using transcriptomic data

Wade Dismukes, Patrick Edger, Jocelyn Hall, Jacob Washburn, and Chris Pires

Recent improvements in the identification of homology and orthology of genes has allowed for next generation sequencing datasets to be utilized to improve phylogenetic resolution and elucidate genome evolution among plant families. To improve our understanding of the phylogenomics of the Cleomaceae, we sequenced 20 transcriptomes and performed genome survey sequencing across Cleomaceae, Capparaceae, and Brassicaceae. We then used a sequence similarity and phylogenetic approach as well as a genome guided approach to identify orthologs and paralogs. We then used a large single-copy gene list to infer a species tree of the Cleomaceae with Capparaceae and Brassicaceae as outgroups. These approaches allowed us to examine and identify the phylogenetic placement of a whole genome triplication that is known to have occurred within the Cleomaceae. We were then able to explore patterns of gene retention and loss and their implications following this genome triplication.

This project was completed to fulfill a Capstone requirement.
The role of the Rnf complex of *Desulfovibrio vulgaris* Hildenborough

Anita Donner, Thomas R. Juba, and Judy D. Wall

*Desulfovibrio vulgaris* Hildenborough (DvH) is a sulfate reducing bacterium (SRB) in the delta-Proteobacteria phylum of eubacteria. These SRB cause industrial problems from metabolic accumulation of corrosive sulfide and organic acids. These end products cause localized pitting or anaerobic corrosion of metals and oil souring. To support energy conversion, SRB use electrons from hydrogen or organic acids, such as lactate, to reduce sulfate. The cells generate an electrochemical gradient by proton translocation across the inner membrane to the periplasm. The resulting proton motive force drives synthesis of ATP via the ATPase. The Rnf complex, an ion-pumping ferredoxin:NADH oxidoreductase, may contribute to the electrochemical gradient. Previously we constructed a strain with a markerless deletion of *rnfAB*. From that mutant we learned that growth with formate or hydrogen as the electron donor was hindered since these donors are limited to respiratory mechanism of energy conversion not substrate-level phosphorylation. With the deletion of *rnfAB*, the mutant also was no longer able to fix atmospheric nitrogen. Since cells were still able to grow on organic acids, though at lower growth rates, we have decided to look at the combination of the deletion of *rnfAB* along with deletions of genes that encode hydrogenases. Hydrogenases are located in the cytoplasm as well as the periplasm. They catalyze the reversible conversion of protons and electrons into hydrogen gas, a gas that readily diffuses across the inner cell membrane. Once in periplasm, other hydrogenases convert the gas back to protons and electrons. The protons can then be used by the ATPase contributing to the electrochemical gradient. With the previous data from hydrogenase mutants, we have designed mutants containing both hydrogenase and *rnfAB* deletions to further understand the energy conversion processes.
The purpose of this project is to provide a repair decision tool to handle broken military aircraft parts for The Boeing Company. When an aircraft part breaks at a military base, it is often more affordable to send it to a depot to be repaired than to replace it with a brand new part. However, due to budget and capacity limitations, not every repairable part can be repaired. Repair costs, lead times, and criticality for flight availability vary by part. Thus, in order to maximize the amount of aircraft available to fly, it is important that the most critical parts are repaired. Currently, asset managers at Boeing rely on experience to eyeball which broken parts to send to repair. This method is subjective, lacks standardization, and does not take advantage of available data. Therefore, this team is building a software tool that will provide an ordered list of recommended parts to repair in order to maximize aircraft availability. Given budget, capacity, and time constraints, the tool utilizes linear programming to find the optimal recommendation list of repairs.
Optimization of random walks over various geometric figures

Michael Dotzel and Carlo Morpurgo

Random walks are paths consisting of a sequence of random steps, defined on sets of vertices and edges. For any edge we can assign a probability, representing the likelihood of traversing this path from an adjacent vertex. It is natural to ask what the probabilities the edges of a particular graph are assigned such that likelihood of starting at a vertex V, traversing a path of length n, and ending at V is minimized. We find that for the classes of cyclic graphs and totally complete graphs, these such probabilities are all equal to 1/D, with D = the number of edges adjacent to any vertex in the graph G. In doing so, we develop a general method of matrix/vector optimization. We also explore other particular classes of regular graphs and their characteristics which yield similar results. These results have applications in engineering, physics, game theory, and probabilistic systems.
Identification and characterization of essential genes involved in regulation of peptidoglycan synthesis in *Agrobacterium tumefaciens*

Caroline Dunn, Wanda Figueroa-Cuilan, Jeremy J. Daniel, and Pamela Brown

The bacterial plant pathogen, *Agrobacterium tumefaciens*, restricts new cell wall biogenesis to the cell pole during elongation and to the mid-cell during cell division. We hypothesize that some of the genes involved in the regulation of cell wall biogenesis will be essential for cell survival. In this study, we focus on 26 proteins encoded by essential genes with domains predicted to interact with cell wall or which are annotated as hypothetical proteins. Phenotypic characterization of the overexpression strains in the presence and absence of inducer includes growth curve data analysis and viable plate counts. These experiments are conducted in varying NaCl concentrations to determine if mutant strains are sensitive to osmotic pressure. Epifluorescence microscopy is used to monitor cell morphology, DNA structure, and sites of cell wall biogenesis in the mutants. Thus far, 5 overexpression mutants have been constructed and subject to preliminary characterization. Two possible candidates for genes involved in the regulation of cell wall biogenesis have been identified thus far based on salt sensitivity observed in growth curves and unusual cell morphologies. Future work will involve the construction of depletion strains to observe the impact of removing these essential genes on cell wall biogenesis in *A. tumefaciens*. 
Seclusion and restraint events in child and adolescent inpatient psychiatric population

Jessica Edgar, Brooke Lappe, and Ravi Shankar

Objective and rationale: The objective of this study was to analyze our data for any trends regarding seclusion and restraint in children and adolescents. There is a limited amount of research in the area of seclusion and restraints especially in children and adolescents. Most research analyzes patient characteristics as precursors or predictors of restrictive interventions, but many studies conclude that additional research is necessary to support the findings. Rationale for the study was to provide more data in child and adolescent patients regarding use of seclusion and restraints and see if this is consistent with what is presented in the adult literature.

Methods and Results: The study documented 394 cases of seclusion and/or restraint among 154 patients over the span of 3.5 years from July 2009 to December 2012 at the Missouri Psychiatric Center. After getting IRB approval, data was entered from packets (CBADS) into an excel database. This excel database is a comprehensive list of the information gathered from patient records by previous research assistants. The data included various background information including age, diagnosis, previous suicide or self-harm attempts, medical history, family history, etc. Additionally, every seclusion and restraint incident was documented with a cause, type of restrictive measure(s), length of time, and any medications that were administered. Data analysis is still in progress but we expect to see trends in the factors that may increase risk for seclusion and restraint episodes as well as an average of 2 or more episodes per patient.

Conclusion: Since there is limited research and data available regarding restrictive interventions, more research is necessary to determine whether the trends we observe are universally applicable.
Insight on the pathogenesis of diabetic peripheral neuropathy

Reginald Edwards, Eric Villalon, Connie Wong, Maria Jones, Victoria Vande Griend, and Michael Garcia

Diabetes is a very common disease involving alterations in insulin levels. Because of this alteration in insulin the body begins to accumulate an abundance of glucose within the blood, referred to as hyperglycemia. This elevated blood glucose level can cause various forms of neuropathy, with the most common form being peripheral neuropathy. Peripheral neuropathy includes axonal degeneration and demyelination, which results in the decrease of nerve conduction velocity. To provide insight into the potential mechanisms leading to peripheral neuropathy, we analyzed sciatic nerves of the db/db model of type II diabetes. Through western blotting, we concluded neurofilament subunit protein expression was unaltered in both the sciatic nerve and spinal cord of 9-week-old and 21-week-old diabetic mice compared to wild type mice. Our teased fiber analysis suggested that there was an increase in internode length between 9-week-old diabetic and 9-week-old wild type mice. Myelin basic protein western blots showed a large reduction in myelin basic protein expression within the 9-week-old diabetic mice, followed by a statistically significant increase in expression within the 21-week-old diabetic mice relative to wild type expression levels. Increased internode length would reduce nerve conduction velocity. Altered myelin basic protein expression can negatively impact axonal diameter and myelin thickness, which are both crucial to nerve conduction velocity. Our data suggests that accumulation of neurofilament subunit proteins does not contribute to diabetic induced peripheral neuropathy; however, early alterations in internode length and myelin basic protein expression could contribute to diabetic peripheral neuropathy.
Belquis Elhadi
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Faculty Mentor: Dr. Tola Pearce, Sociology
Funding Source: McNair Scholars Program

Muslim and American: An intersectional analysis of Muslim identity enactment in a Midwestern town

Belquis Elhadi and Tola Pearce

That way that Muslim Americans enact their Muslim identities – making it known that they are Muslim or not, and how – is explored in this study. In-depth interviews with 12 Muslims are performed to understand how choices and actions are impacted by dominant attitudes and representations of Muslims in America, post-9/11. Four women that wear hijab, 4 women that do not, and 4 men's responses are explored within the framework of intersectionality to consider how each subject’s gendered and racialized positions impact the choices they make in respect of their Muslim identities. Perceptions of threat and feelings of representational responsibility are considered causal agents that prompt Muslim Americans to make particular choices about how they act, and shapes their feelings associated with those choices. This study extracts the concept of passing and applies it beyond the black and white paradigm to reframe the way we think about race within the context of Muslim American racialization based on cultural artifacts and signifiers like the hijab, cultural garb, language, names, or beliefs.
Properties of nanomaterials and dental composites

Joe Elledge and Hao Li

The nanomaterials which we work with are generally too small to observe, make models of, or do tests on alone. We can only do tests on the finished product, the dental composite. Our goal for this composite is to find the optimum recipe which would result in maximum durability. We measure the properties of the composites through many various tests, such as the three-point-bending and the compression tests for strength, comparative (via naked eye) and explicit (via machine) color matching tests, shelf life tests, and water absorption tests. In each new batch of dental composite that we manufacture, we change one material, or one manufacturing method. There are many variables, so we keep close track of each change and each detail of each unique recipe and manufacturing method, this way we know from the test results how each change affected the product. We use the results of each test to form, alter, or confirm a proposed hypothesis, then use the resulting information to alter a previous, less desirable recipe so that we may discover a recipe which conforms to our desired goal. Although it is somewhat resource and time consuming, this method has yielded exceptional results.
Singing from the choir: The cultural affects of the black church on LGBTQIA black individuals

Delan Ellington and Mary Shenk

Looking at the cultural affects of the black church as an institution on LGBTQIA black individuals was the main focus of this study. This was studied because of the lack of research having been done on the Black LGBTQ’s relationship with the church but almost exclusively from the side of the straight cisgender pastors or non-LGBTQ members of the church. But not how church doctrine and the attitudes has effected the individuals that are targeted by it. Being in a unique position to emic study this population in regards to the church it was decided that qualitative methods were best to accomplish exploratory goals in the research. The study’s methodology included getting exempt IRB approval for in-depth audio recorded semi-structured interviews with 10 Columbia area participants. These interviews where then transcribed and run through Textual analysis software Atlas TI coding for commonalities in the answers provided. Each participant was black and identified somewhere in the LGBTQIA community while there were trans participants and college and non college aged participants all of the experiences where unique to the individual but all had been effected by the Black Church in some capacity.
Synthesis of magnetic nanoparticles for future diagnostic applications

Kacey Ellwein and Raghuraman Kannan

In the 2016 year alone, there will be an estimated 1,685,000 new cases of cancer that have to be diagnosed, and over nearly 600,000 of them will pass away from the disease. Thus, there exists a tremendous demand for diagnostic sensors and magnetic nanoparticles (MNP) have shown remarkable applicability in this area. MNPs exhibit smaller dimensions, high surface to volume ratio and magnetic attraction that have enabled their usage in different applications such as targeting molecules as well as capturing cells. Recent studies have shown MNPs with anisotropic shapes exhibit higher magnetic moment and bimetallic nanoparticles have the highest saturation magnetization, making them an attractive choice for sensors. However, synthesizing and functionalizing such MNPs have been challenging. In this study we report on synthesis of cubic cobalt-iron nanoparticles (CoFeNP) and explore their applications towards cancer research. We have synthesized 25-50 nm CoFeNP using a polyol process combined with thermal decomposition. This process forms nanocrystals which can be grown in to anisotropic shapes making their crystal structure highly uniform. Nanoparticles properties such as hydrodynamic radius, zeta potential, and light absorption characteristics, which affect their behaviors in solvent environment, were investigated using Zetasizer and UV visible spectroscopy. Further, their lattice structure was visualized using electron microscopy. Subsequently, these particles will be tested for surface functionalization capabilities by conjugating various antibodies using EDC–NHS coupling technique. Attaching antibodies will enable antigen targeting and these MNPs can be implemented for a diagnostic application in the near future.
Measuring heritability of fecundity and lifespan on different diets in *Drosophila melanogaster*

Osvaldo Enriquez and Elizabeth King

The diet of an organism is very important for how energy will be allocated to do certain tasks. In our experiment we are looking at how the allocation of resources differs due to variance in genetic factors for the tasks of lifespan and lifetime fecundity using *Drosophila melanogaster*. This will be done by using a half sibling design that will then be split into three separate diets, a high sugar, dietary restricted and standard food source. These will be monitored for the entire life of the flies. Then we will estimate the genetic variance found between the different types of food using narrow sense heritability. We will also quantify how much genotypic variation is due to the different types of diets. This will give us a better understanding into how an organism’s genotype and environment can effect its phenotype’s that are closely related to fitness, and allow us to make predictions into how these traits may change and evolve overtime when put into different dietary conditions.

*This project was completed to fulfill a Capstone requirement.*
Faculty Mentor: Dr. Carlos Sun, Civil & Environmental Engineering
Funding Source: College of Engineering Undergraduate Research Option; University Transportation Centers program of the USDOT

**Alternative ways of using right of way to fund transportation**

Nicholas Eschbacher and Carlos Sun

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
3-D printing of copper powder to build 3-D porous structures

Xiao Fan and Chanwoo Park

3-D printing is an additive manufacturing technology to create complex 3-D geometry structures. Although this technology becomes popular in recent years for many industrial manufacturing and biological applications, the 3-D printing materials are still limited to plastics like ABS, PLA and a few metals like steel and bronze. Porous surfaces made out of Copper powder has been used to enhance phase change heat transfer (boiling). The 3-D printing of Copper powder can greatly improve the manufacturing productivity and design flexibility of phase change systems. Paste injection as one of 3-D printing technologies was explored in this undergraduate research, which uses a paste of a binder and copper particles and injects it to print 3-D structures using CAD models. For this study, a Do-It-Yourself 3-D printer was purchased, assembled and modified for the 3-D printing of Copper powder. A good recipe for the copper-powder paste was found from trial-and-error. 3-D printing samples were processed in a high temperature tube furnace to sinter (diffusion-bond) the copper particles in the original 3-D shape. From the visual observation of the 3D samples using a microscope, the bonding between the copper particles was found to be strong enough to make 3-D porous structures.
Optimization of capacitor bank size and location in IEEE 32-bus test system using Powerworld

Bryan Fay, Naadaa Zakiyyan, and Robert O'Connell

The IEEE 32-bus distribution test system with optimal switch configuration has four radial lines at a base voltage of 12.66 kV everywhere and a base apparent power for the system of 10 MVA. A problem of the standard IEEE 32-bus test system is power loss and voltage drops due to long radials with loads at each bus. This can be remedied by placing capacitor banks of appropriate size at appropriate locations. The purpose of this poster is to describe Powerworld-based simulations of the 32-bus system with two capacitor banks of various sizes and at various locations, with the purpose of optimizing system performance defined by power losses and voltage profiles. Powerworld is an interactive program used to simulate power systems as one line diagrams to view various parameters such as bus voltage levels, bus loads, current through branches, power losses, and various other data useful for power system reliability. As it happens, the base values of apparent power and voltage for the test system and the corresponding default values in Powerworld are not identical, thus requiring some initializations. With the optimal switch configuration built and simulated in the software, a voltage profile was created. Since a number of busses still had inadequate voltage levels, capacitor banks were incorporated in order to obtain a voltage level of between 0.95 and 1.0 per unit on all busses. Furthermore, varying configurations of two capacitor banks were tested on the 32-bus system and compared using their voltage profiles to determine the ideal placement and rating. As a result, after simulating capacitor banks at various busses on the system, it was clear that bus 15 and bus 30 were the optimal locations to add capacitor banks in the sizes of 0.8 Mvar and 1.8 Mvar, respectively.
Sources of variation in the lifespan versus reproduction trade-off in Drosophila melanogaster

Wilton Fidelis-Nwaefulu, Enoch Ng’oma, and Elizabeth King

Reproduction and maintenance of somatic tissues are linked through their reliance on a common pool of energetic resources. Differences among individuals in the resources allocated to these traits are attributed to both genetic factors and environmental factors such as dietary intake. Previous research across various organismal models (e.g. fruit flies, mice, & humans) suggests that dietary restriction contributes to increased resource allocation towards lifespan (i.e. somatic maintenance), with reduced allocation to reproduction.

In this study, I examine the sources of variation in the resource allocation trade-off between reproduction and lifespan in Drosophila melanogaster. I measured both lifespan and fecundity in 14 inbred lines that are the progenitors of an established genetic mapping population of D. melanogaster. Replicated samples of 4 female and 4 male flies were observed over the entire lifetime, with fecundity recorded daily along with age at death for each individual. Eggs were counted from images of filtered eggs using ImageJ. Through my results and data analysis, I will discuss the effects of line (genetics) and diet on the trade-off relationship.
Frogs are one of the most diverse and widespread groups of vertebrates with a worldwide distribution of ~6600 species. This diversity gives rise to an array of locomotor behaviors such as swimming, walking, jumping, climbing, and gliding. The nature of the sacro-iliac articulation and the range of motion at this joint in the frog pelvis are posited to correlate with primary locomotor mode in frogs. This may be because the sacrum and pelvis play an integral part in transferring hind limb take-off forces to the frog body as well as to provide a rigid axis upon which the hind limbs can retract just before landing. Previous work has shown that the morphology of the sacrum and the sagittal-hinge movement of the pelvis under the sacrum is different in terrestrial jumping frogs compared to those that walk, hop, swim, or climb. In an effort to understand the roles that pelvic muscles play during jump take-off and landing in terrestrial frogs, we estimated force production capability of a few muscles that attach to the sacrum, ilium, and urostyle with the use of micro-CT imaging and 3D-reconstruction of Southern Leopard Frog (Lithobates sphenocephalus) bones and muscles. This is the first study to model the muscle-forces produced within the frog pelvis. Our results provide the framework for developing future comparisons of the frog-pelvis musculoskeletal system across different pelvic morphologies and locomotor modes.
Faculty Mentor: Dr. David Mendoza-Cózatl, Plant Sciences
Funding Source: Life Sciences Undergraduate Research Opportunity Program

Mapping amino acid residues critical for metal specificity in ZIP-type Arabidopsis transporters

Raschély Flint, Norma Castro-Guerrero, Mather Khan, and David Mendoza-Cózatl

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Spinal Muscular Atrophy (SMA) is the second most common autosomal recessive disorder with an incidence of ~1:6000 and a carrier frequency of ~1:35. SMA is caused by the loss of the Survival Motor Neuron (SMN1) gene. However, only in humans a nearly identical copy of SMN1 exists called SMN2. This gene is present in all SMA patients. SMN2 gene only partially compensates for the lack of SMN1. SMN2 produces low full-length levels and alternatively spliced product that lacks exon 7. Additionally, several intronic regions within SMN2 have been identified that act as splicing repressors. Previously, an intronic region called Element 1 (E1) was characterized as an inhibitor of SMN2 exon7 inclusion. Our lab developed a morpholino-based ASO sequence against E1, resulting in prevention of repressor function and significant phenotypic improvements in mouse models of SMA. Our previous work has shown promising results with delivering specific morpholino modified ASOs targeting the E1 repressor. In order to optimize inhibition of E1, we have designed multiple morpholino ASOs specifically targeting various lengths and segments of the Element 1 repressor region. In this study, we have developed twelve variants of the original ASO sequence to determine which ones have the most effective impact on the SMA phenotype. We delivered these ASOs to newborn mouse SMA animal models (mSmn⁻/⁻; hSMN2+/+; SMNΔ7+/+) via intracerebroventricular (ICV) injections. We observed different degrees of phenotypic differences after delivery of these ASO variants. Molecules that block or inhibit the repressive activity of Element 1 could be envisioned as potential therapies for SMA if they relieve the repression and allow for high levels of full-length SMN expression from the SMN2 gene.
The Right to Speech: An analysis of free speech on college campuses

Samantha Franks and Carli Conklin

The First Amendment enshrined the freedom of speech into American law. The Founding Fathers were intent upon shifting a paradigm in which monarchs punished verbal disobedience, but even in the 1700s, speech remained contentious. The very first Congress passed the Alien and Sedition Acts in 1789, banning public disagreement with the government. The act set into motion centuries of argument. The Supreme Court has spent much of our history defining and distinguishing what kinds of speech should be protected. Still, though, there are questions that must be answered in the modern world. As public universities adapt to an environment largely ruled by social media, the freedom of to speak is more contentious than ever.

My research question, then, is this: Given the complicated legal ground of public colleges, what speech are students guaranteed? Student Conduct Codes serve as a mechanism to control campus climate, but when they control students’ expressions of opinion, are their First Amendment rights violated? At schools across the country, students are suing their administrations over the use of Free Speech Zones and overly stringent Conduct Codes. The legal results remain varied.

After the University of Missouri’s historic year, it became clear that freedom of speech is an issue at this school is well. Three categories of speech are particularly interesting. They include: speech in public spaces, speech made online, and speech by University officials. This project uses examples of when these categories were prevalent at Mizzou in order to identify major issues of free speech in the modern university. It then uses the legal precedent set by the Supreme Court to analyze what can be done to help regulate schools in a way that is both legal and educationally appropriate.

*This project was completed to fulfill a Capstone requirement.*
Design of maintainable drains for earth retaining structures

Kyle Friedman, Ronald Roustio, Eric Koenig, Samuel Runge, and Andrew Boeckmann

Retaining walls and sheet pile walls all across the country have normal pvc drains cut into them to allow the release of excess pore pressures that build up behind the walls due to seasonal weather and water levels. These drains alleviate extra loading on the walls that when not released can cause failure and collapse of the structure. Jet Filter System has revolutionized the drain market with 2-inch, 4-inch, and 6-inch drains that can be post-installed into walls and have filters to keep them working properly. One may ask if all these sizes are necessary and which one would I choose? The focus of this research was to analyze the pore pressure mitigation effects of the drains on a compacted sandy-loam to maximize the efficiency with the size of the drain to see which drain is the most cost-effective to manufacture and produce for the consumer.

A model was constructed inside the bed of a dump truck for each drain where soil was compacted into lifts approximately 6 to 10-inches in height with a push roller and tamper until it reached approximately 4.5 feet tall with a slope of 2:1 (Horizontal: Vertical) with water filled behind the soil wall to a height of approximately 4 feet. Probes were placed strategically in each lift to monitor negative pore pressure values throughout the life of the model. Once all of the soil is saturated in the model the probes will all be reading zero and now the test can begin by unblocking the drain and measuring the amount of water put into it and the amount of water that comes out. Once the models are complete for all the different drain sizes a computer program will be used to help determine the most effective drain layout which can be used in future wall designs and how this system compares to the use of traditional pvc weep holes.
The juggernaut of the one size fits all school construct

Samantha Fullington and Melissa Stormont

Children’s social and emotional readiness for Kindergarten is predictive of how they will perform later in their school years. Teacher perceptions of social and emotional readiness are an important factor to assess as they may understand specific skills based on their experiences with kindergarteners. This study includes teacher ratings of children’s overall readiness for kindergarten and they rated their students based on their social and emotional readiness after entering Kindergarten. Children with higher overall ratings for kindergarten also had higher mean scores on specific social emotional readiness skills. A past study found this readiness item was also associated with reading performance. Specific demographic variables were also analyzed and results indicated that boys were less ready than girls and children who did not receive free and reduced rate lunch also had higher ratings of readiness. This poster will discuss the specific skills that were associated with lower readiness ratings. If teachers and other professionals could target such skills early, children who enter school with less readiness can be supported in learning skills that are beneficial to school success.
The gap between teachers’ goals and practices in the flipped classroom

Nicole Fyten, Abigail Heffern, Salih Birisci, Zandra de Araujo, and Samuel Otten

Whether an innovative success or an educational disadvantage to our students, the outcome of flipped instruction does not always align with a teacher’s expectations. This research study examines the difference between teachers’ expectations for their flipped instruction and the enactment of those ideas both in and out of the flipped classroom. Teachers have increasingly taken to flipped instruction as an “innovative use of technology…[that] makes flipping possible and motivating for students and teachers” (Gojak, 2012). Flipped classrooms commonly include the use of videos or online applications as a core support for lesson plans and classroom curriculum, with students watching instructional videos at home prior to working in class. Albanese and Bush suggested that transitioning to flipped instruction makes sense because “students [are] already accessing videos for homework help, why not flip the method of how students learn…?” (Albanese and Bush, 2015). This study helps examine gaps between teacher practice and their goals. Three teachers voluntarily chose to participate in our study. Using classroom observations, interviews, recordings, and analysis of at-home and in-class materials, we have identified several variables that relate to the success of teachers’ expectations in comparison to their success in a flipped classroom.
Molecular dynamics simulation of thermal conductivity of low dimensional carbon allotropes based on ReaxFF potential

Martha Gahl, Yuan Dong, and Jian Lin

Thermal conductivity of low dimensional carbon allotropes, such as carbon nanotubes and graphene, shows intriguing behaviors. The thermal conductivity can be ultrahigh compared with other bulk allotropes as well as size dependent. Much research has been done to investigate the mechanism of such special behavior and the method to modulate them by nano-engineering. In this work, we perform the molecular dynamics (MD) simulation with a recently developed potential, i.e. ReaxFF potential for carbon condensed phases [J. Phys. Chem. A 2015, 119, 571–580]. The thermal conductivity of carbon nanotubes and graphene based on this new potential will be obtained and compared with results based on other MD potentials. The size dependent behavior of thermal conductivity and the effect of heat bath region length will be also investigated.
T’Keaya Gaines, Victoria J. Vieira-Potter, Nathan C. Winn, Michelle L. Gastecki, Rebecca J. Welly, Terese M. Zidon, Makenzie L. Woodford, Natalia G. Karasseva, Harold S. Sacks, and Jaume Padilla

Uncoupling protein 1 (UCP1), the characteristic protein of brown (B) adipose tissue (AT) is present in white (W) AT during “browning.” BAT activity and W AT browning inversely associate with insulin resistance (IR) in rodents and humans. W AT inflammation predicts IR, W AT browning may decrease inflammation. We hypothesize UCP1 improves IR due to a decrease in inflammation via a decrease in AT oxidative stress. Reasoning female mice null for UCP1 would have an increase in susceptibility to Western diet (WD)-induced AT inflammation and IR. UCP1-/- (KO) and wild-type (WT) mice (age, 6 wks) fed WD or control diet (CD) for 28 wks were compared for food intake, weight gain, adiposity, energy expenditure (EE) and fuel oxidation, physical activity (beam breaks), IR (estimated via glucose tolerance test AUC (GTT) and fasting insulin), W AT and BAT inflammation (gene expression), and indicators of W AT and BAT mitochondrial function and oxidative stress (gene and protein expression, TBARS). Despite no differences in food intake, EE, activity, or weight gain, KO developed IR, exacerbated by WD (GTT: diet, genotype, both P<0.01; fasting insulin: genotype x diet (int), P=0.04). Despite no W AT mass differences, KO W AT had greater inflammatory gene expression (~385% increase in IL6, P=0.014; ~200% increase in MCP1, P=0.027; ~100% increase in TNFα, P=0.05) and an increase in susceptibility to WD-induced oxidative stress via TBARS (int, P=0.05). BAT, a striking 500% increase in mass was observed only in KO/WD (int, P<0.01) along with increased leptin mRNA (int, P<0.02), both suggestive of WD-induced BAT “whitening.” Paralleling, remarkable gene expression differences were observed such that KO BAT had an increase in MCP-1 (int, P=0.01), macrophage (CD68, P<0.01; ITGAM, P<0.01; CD11c, P=0.04), and ER/oxidative stress (p22phox, P<0.01; p47phox, P<0.01; HSPA5, P<0.01; DDIT3, P<0.01) mRNA and a decrease in BAT mitochondrial subunit protein expression (COX I, II, IV; all P<0.05). Our findings uncovers unrecognized role for UCP1 protecting against IR via mechanism independent of total adiposity.
An investigation of bacterial mechanisms for herbicide degradation

William Galvin, Joy Bailey, and Brian Thompson

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Carly Garrow, Wentzville, MO

Faculty Mentor: Dr. Satish Nair, Electrical & Computer Engineering
Funding Source: College of Engineering Undergraduate Research Option

Creation of a computer model of the rodent micturition circuit

Carly Garrow, Christopher Sinks, David Goodman, and Satish Nair

**Background:** The micturition neural circuit controls the filling and voiding processes of urination. This circuit involves input from sympathetic, parasympathetic, and somatic neurons, making the control process very complicated to understand and to model. It is unique because the process begins as an involuntary action, and unlike other involuntary processes, such as heart beating or digestion, it is eventually controlled voluntarily. This particular neural circuit has not been relatively well-studied, and it is still not fully understood how this change from involuntary to voluntary takes place within the neural network.

**Purpose:** Spinal cord injury can cause the micturition circuit to revert back to its involuntary control state, leading to incontinence in adults. A better understanding of the interactions within this neural network and a working computer model of the circuit would allow for the exploration of solutions that could be applied in order to give sufferers of spinal cord injury the ability to control their micturition again.

**Problem Statement/Thesis:** A model of the micturition circuit in rodents will be created in order to provide a basis for future, more complicated models of mammals and eventually humans. Creating a working model of the circuit will allow spinal cord injury to be simulated and solutions to be tested.

**Materials, Methods, and Subjects:** Literature detailing the morphology and electrophysiology of the hypogastric, pelvic, and pudendal ganglia in rodents were identified and used for creation of the model. Individual neuron models and the final model will be coded and run in the NEURON program.

**Results and Conclusions:** These will be presented at the Forum.
Food consumption mapping to assist niche marketers of protein

Candace Gatson and Joseph Parcell

USDA data from the Food and Agricultural Commodity Consumption in The United States study suggests that quantity and type of food demanded is linked to demographic variables such as age, gender, income, and geographical region. This data was used to estimate demand for proteins in Missouri counties to create a tool to help producers determine local levels of demand. To determine if there was varying levels of demand by county, the demographic data was gathered for each Missouri county to match the same demographic categories used in the USDA study. The estimated coefficients from the USDA study were then applied to the collected data to estimate the number of pounds of pork, beef, fish, and poultry demanded per person per year in each Missouri county. A mapping software was then used to create a visual tool for producers to utilize in production decision making. As predicted, the estimated demand varied by county, based on the demographic makeup of the county. Suburban and rural counties differed in their demand for type of protein, with suburban counties demanding higher amounts of pork and beef than rural areas and rural areas demanding more fish and poultry than suburban counties.
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Faculty Mentor: Dr. William Jacoby, Bioengineering; Chemical Engineering
Funding Source: College of Engineering Undergraduate Research Option

SMART filters for electrostatically-enhanced photocatalytic air treatment

Matthew Geiser and William Jacoby

SMART filters are:
Self -Sterilizing, Self-Cleaning
Multi-Layer, Multi-functional
Active Removal and Destruction of Particles and VOC's
Reusable, Field Regenerable
Treatment Systems for Air Filtration

Air treatment is vital in industrial processes and enhancement of indoor air quality. Two types of pollutants are found in air: Those in solution and those in suspension. This work focuses on pollutants in suspension (bioaerosols such as bacteria and viruses), but the technique can also be effective for removing pollutants dissolved in air (e.g. volatile organic compounds).

Photocatalysis is a process by which carbonaceous materials are oxidized at room temperature. When titanium dioxide photocatalyst is irradiated with sufficiently energetic photons (< 360 nm), electrons are promoted from the valence band to the conduction band. This electron-hole pair reacts with air and atmospheric water vapor to create surface-bound reactive oxygen species (e.g. hydroxyl radicals). These reactive oxygen species oxidize surface-bound carbonaceous materials. Bioaerosols are first killed, then oxidized to carbon dioxide and water vapor. Volatile organic compounds are converted to carbon dioxide and water vapor. Photocatalysis is the basis of the self-sterilizing and self-cleaning attributes of SMART filters.

Electrostatic precipitation and electrostatically-enhanced filtration are highly efficient methods for actively removing particles, including bioaerosols, from air streams. They work by ionizing particles in the air via electric coronal discharge: A high voltage is applied to primary electrodes, which then induces negative charges on the particles. The particles then move in the electric field toward positively-charged secondary electrodes, such as metal plates of filter media, where they are immobilized.

Photocatalysis and electrostatic precipitation can be combined by coating the secondary electrodes with titanium dioxide and irradiating them. With the electrostatic precipitation, the bioaerosols have essentially infinite residence time, resulting in their death and oxidation. Volatile organic compounds, however, do not ionize and are not immobilized indefinitely on the secondary electrodes. They still undergo photocatalytic oxidation, but with lower conversion efficiencies. That is why SMART filters also include activated carbon-based adsorption modules. However, these will not be included in this work.
Implementation of formal training regarding ethical technology and social media usage on study abroad programs

Yumiko Gely, Trevor Karasek, and Carolyn Orbann

In recent years, there has been a substantial increase in international travel among college students participating in study abroad programs (Stroud, 2010). Concurrently, there has been a simultaneous increase in technology use in forms of photography, blogging, and social media applications among this same age population (Duggan & Brenner, 2013). As the result, undergraduate students are using technology and social media to share their experiences abroad. Noticeably, students receive little to no training regarding ethical technological or social media usage and universities rarely have easily accessible public policies regarding social media use while on study abroad trips.

This study focuses on the quantity and quality of pre-departure ethical training regarding social media and technology usage while abroad among undergraduate, health science students. It explores the question of how much, and if so, what quality of training are undergraduate students receiving prior to participating in health related study abroad programs and how this is affecting their experiential learning abroad. The goal of the study is to a) identify potential models for photography and social media use policies in place for study abroad trips at peer institutions and b) create and test an intervention strategy.

A community based qualitative study has been conducted, in which students participating in a health science study abroad program at the University of Missouri were given a semi-structured survey and interview regarding their knowledge of ethical social media and technology guidelines while studying abroad. Eight participants have been interviewed about their study abroad experiences and their use of social media while on the trip. Data analysis is currently underway; however, preliminary data indicates the pre-departure curriculum provided structure through which students could process their cultural learning. Final results, analysis and conclusions will be presented at the Forum.
Speech variation and gender expression

Lydia Ghuman and Matthew Gordon

For decades, sociolinguistic researchers have explored the relationship between gender and language. Much of the existing scholarship assumes a binary division between males and females even while acknowledging that gender is much more complex. My research builds on this tradition by examining how variations in speech patterns can be used to analyze and identify gender expression, but I consider the speech patterns of people representing a range of gender and sexual identities. The general goal is to analyze variable patterns across individuals to understand how speech patterns figure into gender expression, as part of the broader societal construction of gender. I analyze the speech of participants with particular attention to pronunciation variables that past research has proven to be indicative of gender expression, such as the pronunciation of the consonant /s/ and vocal inflection. The study samples speech from members of the LBGTQIA community as well as cisgender people. Participants’ speech is recorded in interviews where questions of gender identity and expression are also discussed. Acoustic analysis is used to precisely measure distinctions not easily heard auditorially. Results are interpreted in light of prior research from sociolinguists and feminist theorists. This research is important because the idea of gender identity, gender fluidity, and sexual orientations that align with the LBGTQIA community are constantly challenged. Analyzing how gender expression and sexual orientation is tied to something as subtle as everyday speech patterns highlights the complexities of gender identity and may have implications for advocates seeking to validate these identities and provide an explanation for the basis of these identities, as well as sexual and gender identities that are already accepted in society.
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Funding Source: Coulter Foundation - Translational Partnership Program; MU College of Engineering Undergraduate Research Program

Panacea’s Cloud: Mobile cloud framework for communication in mass casualty disaster triage

John Gillis, Olivia Apperson, Patrick Smith, and Prasad Calyam

In a disaster situation, communication and coordination between first responders and incident commanders is imperative. In today’s world, this vital aspect is often overlooked, leading to mis-triage and morbidity. In cases such as the 2011 Joplin Tornado where infrastructure is destroyed, it becomes extremely difficult to both triage a large volume of patients and allocate supplies properly. Furthermore, the current technology used in emergency scenarios has become outdated, as radios and paper triage tags are no longer as effective in these situations.

Our research presents a solution to these situations. Over the past two years, our lab has been working on Panacea’s Cloud, a platform for communicating and coordinating in disaster situations. Panacea’s Cloud provides first responders and incident commanders with real-time information about the current situation at hand, allowing for proper instruction and planning. This infrastructure-independent platform is comprised of an Intelligent Dashboard, heads-up displays, and Internet of Things technologies. First Responders can utilize heads-up displays, such as the Recon Jet or Google Glass, to send live video streams of the current situation to the Intelligent Dashboard, allowing the incident responder at the hospital to effectively coordinate. Additionally, Panacea’s Cloud’s Intelligent Dashboard contains real-time mapping capabilities, along with patient and first responder profiles, providing the incident commander with the locations of first responders and the locations and statuses of patients in the field. This GPS tracking is conducted through the use of Virtual Beacons and heads-up displays. By providing incident commanders with an abundance of information, we strive to provide emergency services with an effective platform to utilize during these dire situations. Our goal is to present a technology that allows for better triage, coordination, and communication among all emergency services involved.
Loss of the native plasmid in *Desulfovibrio vulgaris* Hildenborough does not affect biofilm formation

Caroline D. Gjerstad, Kara B. De León, and Judy D. Wall

*Desulfovibrio vulgaris* Hildenborough (DvH) is a gram-negative, sulfate-reducing bacterium, using sulfate instead of oxygen as a terminal electron acceptor and producing hydrogen sulfide. It is commonly found in water-saturated soil and is linked to negative effects on the environment, such as corrosion of iron and concrete pipelines. This bacterium is commonly found attached as a biofilm in natural habitats and our goal is to determine the mechanism(s) of biofilm formation in DvH. Previous work with an evolved DvH strain that had lost the native plasmid, suggested that the plasmid was necessary in the formation of biofilm. To test that the plasmid and not an unidentified mutation in the chromosome caused biofilm deficiency, we have deleted the 202-kb native plasmid, from pDV1 from our parental strain JWT700. This was done by first introducing a cassette that encoded a kanamycin- resistance enzyme and uracil-phosphoribosyltransferase (conferring 5-fluorouracil sensitivity) into the strain containing the native plasmid. This was followed by electroporation and selection of 5-FU resistance for the loss of the plasmid. This plasmid-less mutant was confirmed through a series of testing, which included a catalase test, growth curves, and multiple PCRs. Analysis of biofilm formation was performed in Hungate tubes containing glass slides in growth medium. This test indicated that the loss of the plasmid does not affect biofilm formation. This will be confirmed in a biofilm chemostat. With these tests, all genes on the plasmid can be eliminated as having a major influence on DvH biofilm formation.
Timothy Glanvill
Columbia, MO

Faculty Mentor: Dr. C. Pazia Mannella, Art

Untitled

Timothy Glanvill and C. Pazia Mannella

My artwork takes critical views on the abuse animals have endured throughout the years. My work leads the viewer to think about their impact on other lives by taking a look at factory farming, the “sport” of hunting, and over consumption. I use wool felt, a material that comes from animals. Skulls cage the brain, what separates humans from other invertebrates.
Fabrication and characterization of an electrospun PCL and soy lecithin composite material

Jonathan Gootee, Sheila Grant, and David Grant

Introduction: Soy Lecithin is a natural blend of phospholipids and neutrals lipids. It is amphipathic, containing both polar and nonpolar groups. It has been shown to play a critical role in cell signaling and cellular membrane structure. In addition, due to its soy source, it has been shown to be biocompatible. Previous studies have demonstrated that lecithin can modify resorbable polymers (PLLA) to improve their hydrophilicity and cytocompatibility while preserving their mechanical strength and stiffness [1]. As a result, soy lecithin could improve the biocompatibility of tissue engineered constructs. We have electrospun and characterized a composite material composed of soy lecithin and the polymer polycaprolactone (PCL) as a possible soft tissue construct.

Methods: To determine the ideal parameters for fiber formation, solutions with varying concentrations of PCL and lecithin were electrospun at different flow rates, working distances, and voltages. The amount of lecithin mixed with PCL varied from 30 weight % up to 50 weight %. This mixture was then added to the solvent (7:3 ratio of CHCl3: DMF) at various weight/volume % ratios. See Table 1. Scanning electron microscopy (SEM) was utilized to examine fiber morphology. The mechanical and chemical properties of the scaffolds were analyzed via tensile mechanical tests, Fourier Transform Infrared Spectroscopy (FTIR), and Differential Scanning Calorimetry (DSC). Cell viability was measured using a WST-1 Assay. ANOVA statistical analysis was used to quantitatively compare solution formulations via Graph Pad.

Results: Optimization of the electrospinning parameters resulted in successful formation of PCL/Lecithin scaffolds as confirmed by SEM (See Fig 1) and FTIR. Scaffolds with compositions of 30% Solute in 30% Solvent (30:30) and 40% Solute in 40% Solvent (40:40) yielded the most ideal fiber formation. Statistical analysis between the lecithin -PCL constructs and the pristine PCL (no lecithin) constructs revealed no statistical significant difference in the physiomechanical properties of the scaffolds. DSC melt temperatures were statically insignificant at ~ 53°C; uniaxial stresses at failure were within the 1.1-1.5 MPa range, the moduli were ~30 MPa, and uniaxial strains were 18-20% with no significant difference between 30-30, 40-40, and pristine PCL compositions. WST-1 assay revealed a statistically significant increase in cellular viability on the 30% solute 30% lecithin scaffold as compared to the PCL constructs alone. Contact angle measurements showed that the PCL/Lecithin scaffolds were extremely hydrophilic.

Conclusions: This study demonstrated that it is possible to successfully electrospin a lecithin - polycaprolactone construct with various solution concentrations. Statistical analysis of the thermal (DSC) and mechanical scaffold data demonstrated that incorporation of lecithin into the PCL scaffolds did not alter its characteristics from that of the pristine PCL. This is ideal because PCL demonstrates accepted mechanical properties, biocompatibility and stability (slow degradation) when implanted within the body. However the increased cell viability and growth on the lecithin blended scaffolds may be ideal for tissue engineering constructs.
Abigail C. Graham, Bailee N. Kain, Kyle M. Stiers, and Lesa J. Beamer

Phosphoglucomutase 1 (PGM1) is an important human enzyme that regulates glycogen storage and utilization. Recently, patients with mutations in the PGM1 gene have been identified with a metabolic disorder called PGM1 deficiency. These individuals show multiple clinical phenotypes that may include hepatopathy, exercise intolerance, developmental and endocrine abnormalities, and cardiac problems. To gain a better understanding of how these mutants alter the function of PGM1, the Beamer lab has been characterizing the 3D structure of selected missense variants using X-ray crystallography. Crystals were grown from purified samples of the mutant proteins, and X-ray diffraction data collected for structure determination. The 3D structures of the mutants were compared with wild-type enzyme to better understand how the mutations may affect the function of the protein. We have recently collected X-ray datasets for wild-type human PGM1 to 1.75 Å resolution, and for the G121R and G291R missense variants, to 2.2 and 2.6 Å resolution, respectively. From this data, it could be seen that G121R and G291R both affect key active site loops of PGM1, in particular by inducing regions of structural disorder. Other structural rearrangements include changes in the conformations of loops and side chains, some of which are located more than 20 Å away from the site of the mutation. These crystal structures provide the first insights into the structural basis of enzyme dysfunction, and thus molecular pathogenesis, in PGM1 deficiency. These structural insights may help in understanding prognosis and treatment options for people who have inherited this metabolic disorder.
Novel polymer synthesis

Biodegradable polymers can be used for the slow release of molecules for biological applications. The Biomodulatory Materials Engineering Laboratory seeks to specifically synthesize novel polymers to deliver signaling molecules designed to induce stem cell differentiation. Synthetic organic chemistry techniques are being explored to create these unique polymers with a significant focus on polyesters created from diols and diacids. Most research conducted by BioMEL has focused on using melt polycondensation under vacuum (10 mm Hg) and heat (80 °C) using a catalyst (e.g. triflimide). Reactions conducted with diols like pentane-1,5-diol to propane-1,2-diol and five-carbon diacids like glutaric acid and glutamic acid has shown successful polymerization up to 500,000 molecular weight. Interestingly, five-carbon diacids are quite hydrophilic and yield polymers that possess low melting points. This phenomenon is currently being investigated further using differential scanning calorimetry and varying monomer content and polymer molecular weight. After a suite of interesting polymers has been created, research will shift towards investigating their degradation properties and bioactivity.
Active heat control: Vapor chamber design and testing experiment

Jordan Groezinger, Minwoo Lee, and Chanwoo Park

With electronic components becoming simultaneously smaller and more powerful, a significant amount of heat is being generating over a small, localized area. The capacity to cool such components has become the limiting factor in creating more effective microscale computer devices, thus there has arisen a need to create more effective heat removal methods. Previously, passive heat removal methods – such as heat pipes – have been used in temperature regulation applications, however more complex active heat removal methods are becoming necessary to study. Past experiments regarding active heat control have been conducted using an intricately fabricated vapor chamber to remove heat from a localized source and transfer it to a cooler region. This project serves to gain insight from these previous research projects by fabricating this type of system and expanding upon the concepts to improve efficiency and capability.

This project requires thorough design of each element with a notable emphasis on affordability without sacrificing component effectiveness. Experimental set-up consists of a localized heat source, vapor chamber, cold plate, and a clamp to hold the components together. A small block of 110 Copper will be used to fabricate the heater block, which will be a machined copper block with insert holes for cylindrical heater cartridges. This heater block will serve as the localized heat source and will simulate heat generation from electronic components for future applications. Additionally, the experiment requires a cooling block to act as a condenser and will be produced from a slab of aluminum with carefully drilled channels to allow for internal cold-water flow when connected to a water chiller. Finally, the vapor chamber will consist of micro-fabricated sintered copper particles housed within a rectangular copper shell to create an enclosed region which to allow internal evaporation and condensation of a contained liquid. This internal fluid circulation will promote high heat exchange rates from the heater block to the cold plate and will be experimentally tested and optimized.

The experiment is currently in the design phase with multiple alternative designs having been considered and core components analyzed in heat modeling software to optimize the effectiveness of the overall design. Due to this, results and conclusions are not currently available and will be presented at the Forum.
Molecular dynamics simulation of defects generation and doping via ion bombarding on graphene layer

Melinda Groves, Yuan Dong, and Jian Lin

Ion bombarding is a popular method to create holes, defects and heteroatoms doping on graphene layers. The defective and doped graphene layers may have unique mechanical, thermal and electrochemical properties. In this work, we perform the molecular dynamics simulation with the reactive potential, ReaxFF, to study the process of ion bombarding on graphene layers. Both oxygen and nitrogen ions are investigated. The effects of ion density, system temperature, and energy flux on the defects formation and the geometry feature of defects and dopants will be illustrated.
Impact of word type on overall intelligibility of nonnative English speakers

Anna Marie Guilkey and Dana R. Fritz

Since 2006, undergraduate student clinicians in the Department of Communication Science and Disorders work with nonnative English speakers in the MU Accent Modification and Pronunciation Program (AMP) to improve their American English pronunciation and intonation in order to increase the participants’ overall intelligibility. In this context, intelligibility is defined as the percentage of the nonnative speaker’s speech an unfamiliar listener is able to understand in a structured speaking task. To measure intelligibility and monitor change, a Sentence Intelligibility Test (SIT) is administered at the beginning and end of the semester. For this test, participants read a series of unpredictable sentences that increase in length while the clinician records them. Three unfamiliar listeners then transcribe what they are able to understand from the recording. Intelligibility is the average percent of words in sentences understood by three unfamiliar listeners. Using baseline and endline SIT results from the Fall 2015 semester, this study examined whether unfamiliar listeners understood more function words or more content words in the participants’ utterances and considered the impact this had on overall intelligibility. On average, listeners understood more function words than content words in both baseline and endline SIT recordings. This may mean that communication difficulties between nonnative speakers and native speakers of American English occur in part because native speakers are not understanding the meaning-carrying words (i.e., content words) in the language learner’s utterances, even if they are understanding most of the grammatical, connecting words (i.e., function words).
Evolution of multispecies interfaces of coflow jets

Qiwen Guo and Jacob A. McFarland

When a shock wave passes through the interface of two different fluids, any perturbation on the interface will grow nonlinearly with respect to time, and eventually induce a fully turbulent flow. This phenomenon is referred as Richtmyer-Meshkov instability (RMI). The RMI is observed and used in various natural and industrial processes such as supernovae explosions, the mixing of fuel and oxidizer in supersonic and hypersonic air-breathing engines, and in inertial confinement fusion power.

In this project we explored different geometries and boundary conditions to generate a dynamically stable fluid interface. The goal is to set up a platform for subsequent research on the RMI for a multiphase system. In order to find a favorable interface condition, an understanding of the fluid interface evolution is crucial. The problem is first addressed by numerical methods, and the Reynolds averaged Navier-Stokes (RANS) equation is solved using the commercial CFD code Fluent and the open source CFD code OpenFOAM. The fluid interface is simulated by interpenetrating multispecies models. Several conventional jets are compared with respect to their evolution rates. In addition, a novel sine-shape jet is designed. This special geometry leads to a new interface with periodic curves. This work will guide our future experimental work, where a full-size shock tube will be built with the sine-shape jet. A small scale experiment has been built to verify the simulation results. For visualization of this experiment, the gas to one of the jets is mixed with liquid particles, generated by a fog machine. The velocity field of flow is then tracked by particle image velocimetry (PIV). The results from experiments are recorded by a high resolution camera. By statistical analysis of the photos and simulation results, we demonstrated a good match of our numerical and experimental results.
Simulating the effect of the quadrupole moment on the adsorption of nitrogen in Zeolite A

Cannon Hackett, M. C. de Almeida Monteiro, and Karl D. Hammond

Nitrogen adsorption is the de facto standard in physical adsorption for the purposes of catalyst characterization for both surface area and porosity. However, high-resolution adsorption isotherms (low-pressure adsorption) of nitrogen on microporous materials such as zeolites show that the micropores fill with adsorbate at approximately ten times lower pressure for nitrogen than they do for argon, despite the smaller molecular diameter of argon compared to nitrogen. The lower pressure of micropore filling for nitrogen relative to argon is typically explained by the fact that nitrogen possesses a quadrupole moment, whereas argon is closer to a perfect sphere. We investigate this “standard” explanation by simulating the adsorption of nitrogen gas on siliceous Zeolite A (LTA) using Grand Canonical Monte Carlo simulations. The potential energy model uses point charges to represent the quadrupole moment of nitrogen and its interaction with the framework atoms; the distance between the charges in the nitrogen molecule can be varied as a way to study the effect of the magnitude of the quadrupole moment on the chemical potential of adsorbed nitrogen.
The State of Desire

Elizabeth Hagens and Joseph Erb

My animation The State of Desire is centered on a poem I wrote.

He says he lives in a state of desire,

Desire beyond his eyes can see

He wants money, a lot of it.

He wants clothes, cars, houses, friends…

Friends.

He looks at his life and says

“I aint got none”

And he obviously wants some.

He goes left, he goes right he goes up side side down.

He goes searching and searching because he believes…

“I aint got none”

He wants a lot yes, too much to ask for!

But what he really wants is to be loved.

I drew this character specifically to show his obvious confidence issues. He is too afraid to show his own face, so he wears a mask. He is too afraid to tell his desires so I, the narrator, complete it for him. I believe everyone is in a constant state of desire. We have a job to get this and save money for that. But you never realize it until you don't have “it”.

But what's worse than being in a state of desire is having no control over what you can actually obtain. The character in the animation is not only in a constant state of desire but is in a situation where he cannot get anything. This is because he is afraid to show the world who he really is and what he really wants.
Paulina Hampel
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Faculty Mentor: Dr. Denice Adkins, Information Science & Learning Technologies

Midwestern Latino immigrant needs

Paulina Hampel and Denice Adkins

This study involved examining research and existing data centered on the information needs of Midwestern Latino Immigrants. Focused on the information and education needs of Latino youth and their families, the research aims to answer questions surrounding the information needs of Midwestern Latino immigrants. Researchers used a content analysis approach to examine different studies about Latino immigrants. Participants varied within each study, generally consisting of Midwestern Latino immigrant population with varied respondents of 10-100 people. Our results showed a variety of different information, educational, and health related needs that are not met within the Latino community. These needs include language needs within communities and education systems, which may lead to disproportionate college enrollment among Latino immigrant students. Other needs such as a lack of information available to Latino immigrants about sexual health and dietary health were prevalent in several studies. Researchers concluded that there are a variety of informational needs, as well as language, educational, healthcare, and communication needs that are not met within Midwestern Latino immigrant populations. One possible reason for the gap in needs within this population may be due to the focus of government funding. Further research and content analysis is needed to determine the effects of information, education, and health needs on Latino immigrant communities.
Sex doesn’t matter! Preservation of sex ratios through the postfledging period in Passerine birds

Mikenzie Hart, Julianna M. A. Jenkins, Lori S. Eggert, and John Faaborg

Population sex ratios and mortality rates are essential for informative population models. Sex ratio at hatch is usually close to 50:50 in most songbirds, while adult sex ratios often differ. This change could be attributed to differences in adult behavior leading to divergent mortality rates or to differences in juvenile survival. While postfledging studies have shown very high mortality rates, none have explored sex-biased mortality during this period. We monitored the sex ratio and behavior of the Ovenbird (*Seiurus aurocapilla*), a Neotropical migrant passerine, across the periods of greatest juvenile mortality, nesting and postfledging, in order to identify the degree to which pre-migratory mortality alters sex ratio. Ovenbird nests were located and monitored in two mature Oak-Hickory forests in Central Missouri. Pinfeathers were collected from 33 nestlings from 18 broods. Radio transmitters were attached to 1-2 individuals from each brood (n=19) and tracked until radio failure or long-distance movement from study site. Sex of individuals was determined via molecular sexing methods. Our initial results suggest there is no significant difference in the survival of male (n=8) and female (n=11) fledglings, suggesting that sex does not influence postfledgling mortality rates. This knowledge can be used to better understand postfledging ecology and improve population models concerning Neotropical migrants. For future research, I suggest a more expansive census, which can be completed with relatively minimal additional effort in conjunction with other monitoring projects.

This project was completed to fulfill a Capstone requirement.
In recent years, income inequality has become a prominent topic of discussion and debate in the United States. The main arguments surrounding the topic have been how large the income gap is and whether or not it is growing. A significant amount of research has been done by scholars, research agencies, and think tanks regarding these topics. The objective data produced by these studies, concerning distribution, suggests that the income and wealth gap is significantly large and that it has been growing substantially over recent decades. To help illustrate the degree of these changes, these data are commonly portrayed in the form of graphs and other figures. The objective data from these studies are also easily accessible. As a result, news outlets can compile these data and create their own unique graphs and figures to help facilitate information to their audience as well as the general public. However, based on the type of data set utilized, the measures portrayed, and the style of graphs used, the news media could potentially emphasize or deemphasize the changes pertaining to income and wealth distribution. This paper uses two popular mainstream news outlets: The New York Times and The Wall Street Journal to examine the ways in which each portray income and wealth distribution data and if, and how, their portrayals differ. I find that, between the two news outlets, The New York Times makes use of graphs portraying cross national and socioeconomic status comparisons that emphasize the income gap while The Wall Street Journal utilizes graphs portraying single measurements, like median household income, to refrain from making socioeconomic comparisons and thus, deemphasizing the income gap.

This project was completed to fulfill a Capstone requirement.
**Associations between IL-10, psychophysiological stress response, and gastrointestinal symptoms in autism spectrum disorder**

Kaitlyn Hartnett and David Beversdorf

Autism spectrum disorder (ASD) is characterized by impairments in social communication and abnormal repetitive behavior patterns. Recent studies have shown a strong association between ASD and gastrointestinal (GI) symptomatology. GI symptoms have been linked with abnormally deficient concentrations of immune system cytokine, interleukin 10 (IL-10), as well as increased stress reactivity. Research has shown a positive correlation between atypical immune response and ASD, suggesting that stress, immune response, and GI symptoms could be interconnected in people with ASD. Given the fact that children with ASD are likely to have higher stress reactivity to environmental stimuli, increased GI problems, and abnormal immunological response and the fact that GI dysfunction is associated with stress reactivity and abnormal immune response, it is possible that children with ASD who have high stress reactivity to sensory stimulation coupled with irregular gastrointestinal symptomatology likely have an abnormal immunological stress response and decreased levels of IL-10. Exploring the relationship between stress reactivity, GI dysfunction, and anti-inflammatory cytokine levels could allow for clinical application of anti-anxiolytics to subdue these symptoms associated with ASD.
Inhibition of CYP11B1 11β-Hydroxylation by *Sutherlandia frutescens*

Casey Hawkins, Kaitlyn Chetney, and Rainer Glaser

The body responds to stress by hydroxylation of the C11 position of 11-deoxycorticosterone (DOC) and 11-deoxycortisol (cortodoxone) by the cytochrome P450 enzyme CYP11B1 to form corticosterone and cortisol, respectively. Stress management aims to inhibit this synthesis, and it has been hypothesized that extracts of the South African plant *Sutherlandia frutescens* lower the levels of cortisol and corticosterone (Sergeant and Folk, 2011) and the phytochemical sutherlandioside B (SU1) is a possible inhibitor. It is the goal of our research to explore this hypothesis with molecular modeling techniques. We employ different theoretical levels for various parts of the active site. The iron-oxo system and SU1 require electron-correlated methods of ab initio theory while the important residues of the protein will be modeled with density functional theory.

By far the most complicated part of the active site is the iron-oxo system and we have been studying the systems \([(\text{Por}^{2-})(\text{Fe}^{3+})\text{O}(\text{L}^-)]^{1-n}\) (1, \(\text{L}^- = \text{thiolate} ; 2, \text{L}^0 = \text{imidazole}\)) in detail. There are questions about the nature of the bonds between iron and oxygen and between iron and the ligand that tethers the complex to the protein via a side chain thiolate (cysteine) or imidazole (histidine), the overall spin multiplicity (doublet, quartet, sextet), and the distribution of the unpaired electrons. We have performed analyses of these complicated spin systems to address these questions. We will show that the quartet state is preferred and that the distribution of the spin depends greatly on the nature of the tether. In the imidazole system, the three unpaired spins are distributed over Fe, O, and within the π-system of the (dideprotonated) porphin ligand. Remarkably, in the thiolate system the three unpaired spins are distributed over Fe, O, and the almost neutral SR ligand. Results of quantitative electron and spin population analyses will be reported.
**The gap between teachers’ goals and practices in the flipped classroom**

Abigail Heffern, Nicole Fyten, Salih Birisci, Zandra de Araujo, and Samuel Otten

Whether an innovative success or an educational disadvantage to our students, the outcome of flipped instruction does not always align with a teacher’s expectations. This research study examines the difference between teachers’ expectations for their flipped instruction and the enactment of those ideas both in and out of the flipped classroom. Teachers have increasingly taken to flipped instruction as an “innovative use of technology…[that] makes flipping possible and motivating for students and teachers” (Gojak, 2012). Flipped classrooms commonly include the use of videos or online applications as a core support for lesson plans and classroom curriculum, with students watching instructional videos at home prior to working in class. Albanese and Bush suggested that transitioning to flipped instruction makes sense because “students [are] already accessing videos for homework help, why not flip the method of how students learn…?” (Albanese and Bush, 2015). This study helps examine gaps between teacher practice and their goals. Three teachers voluntarily chose to participate in our study. Using classroom observations, interviews, recordings, and analysis of at-home and in-class materials, we have identified several variables that relate to the success of teachers’ expectations in comparison to their success in the flipped classroom.
Thomas Jefferson and Nature’s God

Paige Hemmersmeier and Justin Dyer

The Declaration of Independence evokes the elusive phrase “the Laws of Nature and of Nature’s God” as the foundation of America’s obligation for revolution. For much of history, “Nature’s God” has been presumed to mean the God of Abraham—the God of the Judeo-Christian tradition that was prominent in Revolutionary America. Yet, what if the use of Nature’s God is not meant to invoke the God of Abraham, but is a calculated misdirect by our founding fathers to garner the support of an early nation? The following research zooms in on the Declaration’s writer, Thomas Jefferson, in an effort to discern Jefferson’s understanding of the significance of the phrase Nature’s God as he used it in the Declaration of Independence.

Currently, two schools of thought exist to the meaning of Nature’s God—a theistic understanding rooted in Judeo-Christian doctrine and a deistic understanding rooted in the doctrine of nature. This research argues that to deduce Nature’s God into either of the preceding categories, it is not necessary to understand Jefferson’s holistic religious convictions, but merely his convictions on creation doctrine. Thus, the prevailing purpose of this research is to determine whether Jefferson’s convictions are compatible with the Judeo-Christian doctrine of creation ex nihilo or the eternal matter doctrine of Deism. The resulting compatibility testifies to Jefferson’s understanding of the significance in using the phrase Nature’s God.

This project was completed to fulfill a Capstone requirement.
Genetic diversity and population structure of shortleaf pine *Pinus echinata* in the Missouri Ozarks

Ben Hendrickson, Michelle Anderson, Jeff Koppelman, and Lori Eggert

Shortleaf Pine (*Pinus echinata*), Missouri’s only native pine species, experienced intense logging from the 1880s to 1920s during the post-Civil War Ozark lumber boom. Shortleaf pine timber saw extensive use in both general and railroad construction, leading to the rapid depletion of the resource by largely unregulated harvesting practices and inhibiting reseeding. Recently, efforts have been made to reestablish shortleaf populations on both private and government land. In this study, we examine the level of historic genetic diversity and population structure of Missouri’s shortleaf pines in order to determine if seed stock used for restoration efforts needs to be compartmentalized geographically to preserve genetically unique stands.

We extracted DNA from tree core samples obtained from shortleaf pines (DBH ≥ 15 inches) from 8 counties in the Missouri Ozarks for use in microsatellite analysis. Overall, Missouri’s shortleaf populations exhibited relatively low rates of inbreeding and high levels of genetic diversity. We failed to observe distinguishable population structure across the statewide distribution. These results could be due to the long-range, wind-facilitated pollen dispersal patterns exhibited by shortleaf pine. Our findings suggest that seed compartmentalization by county is unnecessary in order to proceed with shortleaf restoration across the state and we recommend that seed stock used reflect the high level of historic genetic diversity available.

*This project was completed to fulfill a Capstone requirement.*
Social skills instruction to reduce bullying involvement among middle school youth

Mikaela Henke, Lindsay Beachner, Jennifer Buehler, Kirsten Zemke and Chad Rose

Bullying has become a pervasive problem among school aged youth. According to recent data approximately 1 in 4 students report being victimized within American schools. Two of the most common predictors among youth that experience prolonged victimization are social and communication skills deficits. This is especially true for students with disabilities, who are disproportionately involved within the bullying dynamic. Therefore, it’s critical to examine the relationship between social skills instruction and youth who have been identified with low social skills.

The current study used existing data collected by the partner schools’ school climate survey coupled with their social behavioral screener to assess the individualized needs of youth. Students identified by their teachers as having low social skills at the beginning of the 2015-2016 academic year were eligible for involvement in the study. Each school identified approximately 20% of their total population who would benefit from Tier 2 social skills instruction. Of the 20%, a total of 55 students returned parental consent allowing them to enroll in the study. Once enrolled, students received weekly, targeted social skills instruction in ten critical areas. These areas include: Listen to Others, Follow the Steps, Follow the Rules, Take Pride in Your Work, Ask for Help, Conversations, Working with Peers, Self-Management, Do the Right Thing, and Respect Others. Each student received approximately 10 hours of social skills instruction.

These students have demonstrated increased self-awareness, group participation, confidence, peer relationships, and engagement in organized social activities. All of these skills are critical for adolescent development as well as reducing bullying involvement. While the results of this study are preliminary, the improvements are promising and have direct implication in curricular development and implementation. These data suggest that schools should consider implementing targeted interventions to improve the social and behavioral outcome of middle school youth.
Maintenance of traffic for innovative geometric design work zones

Gabrial Henks, Henry Brown, Carlos Sun, Timothy Cope, AmirHossein Khezerzadeh, and Praveen Edara

New geometric intersection designs have provided solutions to several modern transportation challenges such as increasing traffic congestion and limited funding. Initial studies have found that these designs increase traffic efficiency and safety while costing less to implement than traditional intersection designs. Since these concepts are still in the early phases of their development in the United States, there is a need for guidance for the maintenance of traffic (MOT) during the construction and maintenance of innovative intersection designs. This research synthesizes information obtained from literature, the experiences and opinions of several transportation professionals, and example project plans to develop guidelines for MOT strategies involving the construction and maintenance of the roundabout, single point urban interchange (SPUI), diverging diamond interchange (DDI), restricted crossing U-turn (RCUT) intersection, median U-turn (MUT) intersection, and displaced left-turn (DLT) intersection.
Developing a clinical tool for early detection and monitoring of speech and swallowing deficits

Elise Henn, Amanda Smith, Whitney Thomlinson, Renata Muenks, Kate July, Joshua Erich, Peiyu Wu, Zhihai He, Mili Kuruvilla, and Teresa Lever

Background: Our lab previously collected data on 162 healthy participants, ages 20-90 years old, using a battery of four simple behavioral tests of speech and swallowing function that elicit distinct acoustic waveforms. We hypothesized alterations in these waveforms would indicate speech and swallowing dysfunction as a consequence of normal aging. While data collection is quick to perform, manual data analysis is labor intensive and impractical for a clinical environment. To overcome this barrier, we are developing algorithms to permit automation of data analysis.

Methods: Manual analysis of acoustic data revealed two of the four tests have the highest inter-rater reliability: tongue tick and diadochokinetic speech rates. Performance on these tasks significantly declines with age, providing rationale for their inclusion in our automation efforts. Using Matlab and Java programs, the waves are compiled into an array, and then run through various algorithms to calculate values that would be impossible to find manually. Values obtained through manual and automated methods are being compared to establish accuracy before proceeding to automate the remaining behavioral tasks.

Results: Spectrographic analysis revealed distinct acoustic waveforms between the two behaviors that predominantly involve tongue movements. While performance of both behaviors declined with advancing age, tongue tick rate was significantly more affected than diadochokinetic speech rate. Initial automation attempts and manual calculations produced similar results, but in some instances the automated results were greater than the manual results. These can be attributed to differences in counting methods between humans and the algorithms.

Conclusions: Initial automation attempts were successful. We are currently identifying additional clinically relevant outcome measures that are unfeasible to quantify through manual analysis methods. We envision our automation efforts will culminate in a clinical tool for use by speech-language pathologists to permit early detection and monitoring of speech and swallowing deficits in pediatric and adult populations.
Linda Montano and Tehching Hsieh’s Rope Piece Study

Edward Henuber, Rachel Trout, and Alexis Callender

We, Rachel Trout and Edward Henuber, plan to do a 72 hour performance.

We will stay together for 72 hours and never be alone.

We will be in the same room at the same time, when we are inside.

We will be tied together at the waist with an 8 foot rope.

We will never touch each other during the 72 hours.

The performance will begin on April 26, 2016 at 12 A.M. and continue until April 29, 2016 12 A.M.

Our performance is a re-creation of a year long performance done from July 4, 1983 to July 4, 1984 by artists Linda Montano and Tehching Hsieh. Montano and Hsieh are both dedicated to blurring the boundaries of life and art through their work. This collaboration, which we plan to explore through our adaptation of the work, could be understood as an investigation of freedom and entrapment, correspondence and movement or, more suitably, of the universal human condition. Using their conceptual framework, we will live physically connected for three days, negotiating the differences between our habits formed by the networked environment of the University of Missouri. Additionally, we will perform drawings in tandem that explore the connections and impact that binary code and text messaging have on our bodies and relationships.
Teaching the past to look towards the future: Teaching with counter narrative pedagogy

Julia Hickcox, Caitlin Steward, and Lenny Sanchez

With the increase of globalization, schools are pressed with greater responsibility to prepare students to know how to live in a culturally diverse and interdependent world. This includes supporting students knowing how to solve real-world problems and participate in dialogue that improves the human condition both locally and globally. The project utilizes counter narrative pedagogy to inspire fifth grade students to analyze multiple perspectives of historical events, develop historical empathy towards the past, and increase civic mindedness for the present and future. Using student interviews, curriculum analysis, and classroom observations, we examined how elementary school children developed sociocritical perspectives of history through social studies learning in their classroom. This qualitative research study occurred in two fifth grade classrooms and focused on the students, their social studies teacher, the school’s media specialist, and a university researcher. This study has important implications for teachers as schools work to deepen the knowledge and skillsets of students so they can more fully participate in and change an ever-growing diverse world.
Amanda Hicks, Haley Schemmer, and Barbara Mitchell

The participating elementary school in Jefferson City, Missouri implemented Positive Behavior Supports, which is a schoolwide system. After screening students in participating classrooms for outlier behavior, we observed each participating teacher for fifteen minute time increments. During each observation, we collected data regarding the teacher’s classroom management practices. We documented each time a teacher used positive feedback, negative feedback, general praise, negative then positive feedback, and pre corrects. We also tracked the specific type of instruction that was happening: whole class, one-on-one, peer, or small group instruction. After baseline observations, teachers were instructed upon implementing more use of pre corrects, negative then positive feedback, and positive feedback and less negative feedback and general praise in their classroom. We anticipate that upon evaluating data, as teacher’s professional development and implementation of behavior management increased, the occurrences of student problem behaviors decreased.
Developing ice cream with delayed sugar release property in stomach model

Molly Higgins and Bongkosh Vardhanabhuti

In 2014 a reported 29.1 million people in the United States had diabetes. To prevent sharp increases in blood sugar, diabetics monitor the glycemic index (GI) of foods which is the measurement of how carbohydrate containing foods raise blood glucose levels. Low GI foods usually contain fat and/or fiber which prolong digestion and can be beneficial by lowering blood glucose levels. The goal of this research was to develop low GI ice cream by formulating ice cream mixes to form gel during digestion. Formation of intragastric gel could slow the release of sugar and thus potentially delay postprandial glucose response. All mixes contained 3.4% protein, 10.78% fat, and 15% sugar. Five formulations, corresponding to protein types (nonfat dry milk or whey protein isolate), stabilizer (with or without carrageenan), and heating methods (heating protein and carrageenan together before or during pasteurization) were chosen. Digestion properties and viscosity of mixes were determined. Results showed that mixes made from nonfat dry milk (NFDM) or whey protein isolate (WPI) without carrageenan did not form gel in model stomach. Addition of 0.34% carrageenan to either NFDM or WPI led to the formation of intragastric gel; however, the mix made with NFDM and carrageenan was very viscous while the viscosity of those made with WPI and carrageenan were similar to commercial ice cream mix. Interestingly, mix made with heated WPI and carrageenan (e.g., heated together before pasteurization) formed the intragastric gel most resistant to digestion as shown by the smallest change in gel weight. Thus, mix made with heated WPI and carrageenan had the highest potential in producing ice cream with slow sugar release. Future experiments will determine protein digestion rate using gel electrophoresis and sucrose release using HPLC. Finally, selected mixes will be processed into ice cream and evaluated for physical properties and sensory characteristics.
Data mining for associations in glycan structure, binding affinities, and the influenza virus

Justin Hofer, Mike Phinney, and Chi-Ren Shyu

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Kristin Hofstetter
Columbia, MO

Senior
Civil Engineering

Faculty Mentors: Dr. Carlos Sun, Dr. Praveen Edara, and Dr. Henry Brown, Civil & Environmental Engineering
Funding Source: College of Engineering Undergraduate Research Option; University Transportation Centers program of the USDOT

Improving Missouri highway safety via HSM calibration

Kristin Hofstetter, Erin Reinkemeyer, Boris Claros, Amirhossein Khezerzadeh, Praveen Edara, and Carlos Sun

The American Association of State Highway and Transportation Officials (AASHTO) Highway Safety Manual (HSM) is a valuable resource in transportation safety. The HSM provides several empirical methods and processes that are used to predict the frequency and/or severity of a crash. This information is then used to evaluate highway safety. Specifically, the HSM can be used to identify high-crash frequency locations, contributing factors, and potential solutions to correct safety problems. The purpose of this research was to classify crashes in order to calibrate the HSM models to provide more accurate safety analysis and to create a long term calibration process. The calibrations accounted for driver populations, conditions, environments, and local conditions throughout the state of Missouri. Local conditions included, but were not limited to, geometric design, signage, and climate. An iterative process was used to develop the calibration. During the process, predicted crash frequencies determined from the HSM methods were compared with the actual crash frequencies for a location. Data was collected from a total of 11,768 crash reports at 890 randomly selected sites in Missouri. Interchanges from all seven Missouri Department of Transportation (MoDOT) regions were used to develop a variety of geographic sites. The locations included terminal and non-terminal interchanges. Terminal facilities included various designs such as cloverleaf, partial cloverleaf and diamond interchanges. Non-terminal facilities included entrance and exit speed-change lanes and ramps. Three years of crash reports from 2010 to 2012 were categorized based on the physical and functional location of a crash. The physical classification was based off the location where the first physical impact occurred. The functional classification was based on the location where the cause of the crash initiated. The crash locations were then categorized based on facility type, exit or entry, and direction. The three facilities used were speed-change lanes, ramps, and freeway segments. If the crash was not associated with any of the previously listed facilities, but instead was related to the ramp terminal, it was designated with the compass direction relative to the main freeway: north, south, east, and west. Once the crashes were classified, the information was combined to determine the calibration factors for terminals, speed-change lanes, and ramps. A total of 44 calibration values were determined.
Devin Holland
Naperville, IL

Faculty Mentor: Dr. Jonathan Stemmle, Strategic Communication
Funding Source: MOJO Ad, Strategic Communication, Missouri School of Journalism

“In ______ We Trust”: Political attitudes of the U.S. Youth and Young Adult (YAYA) Market

Devin Holland, Megan Strait, Samantha Kintz, and Jonathan Stemmle

Introduction/Background: As researchers for MOJO Ad™, we specialize in the 18- to 24-year-old market which we call the youth and young adult (YAYA™) market. Because the YAYA market represents such a large, outspoken and diverse segment of voters, politicians, campaign managers and the government cannot ignore the possible influence they have on domestic politics.

Purpose of Research: There are 31.5 million YAYA consumers in the United States. Their buying power is sizeable, but for them the American Dream is changing. They no longer want of the material trappings of their parents. YAYA consumers are also racially and ethnically diverse, are motivated, complicated and distinct, and their lifestyles represent a new life stage.

Research Questions/Hypothesis: This study was conducted to uncover the YAYA market’s views on several aspects of politics and political issues including the government, the economy, the environment, and the media.

Methods: Our survey was distributed through Rewards Now and its e-Rewards platform using a sample of members who were between 18-to-24-years-old. In total, 500 YAYA consumers completed the survey.

Results / Conclusions: Party Affiliation and Distrust of Institutions: YAYA consumers are the politically unclaimed generation and their distrust of politicians has led to the rise of candidates who are not seen as members of the political norm.

Political News and Advertising Views: YAYA consumers don’t seek out political news on their own. They are also tired of being pigeonholed into a single category by the media and advertisers.

The Internet as a Soapbox and a Forum: Today, political supporters are creating their own communities to spread information, opinions, and gather support for a candidate.

Still Concerned About Economy: The majority of YAYA consumers agree that today’s job market remains a difficult one.

Environmental Concerns: A large majority of YAYA consumers are concerned about global warming and climate change, and also worry about the health effects of environmental pollution.

Implications for Further Research: For the majority of eligible YAYA voters, the upcoming 2016 Presidential Election will be their first. Whatever candidates emerge from the primaries and go on to be President, it is important for researchers to think critically about the impacts of increased political activism on social media and a shift away from the two party system will have for the political sphere going forward.

This project was completed to fulfill a Capstone requirement.
Ironic effects of attempts to reduce violence in public places

Abigail Hollis and Bruce Bartholow

Previous research suggests the presence of weapons can facilitate increases in aggressive behavior (Berkowitz & LePage, 1967; Turner, Layton, & Simons, 1975). This so-called “weapons effect” has been explained as a result of weapons (especially guns) activating or ‘priming’ thoughts in memory related to aggression and violence (Anderson, Benjamin, & Bartholow, 1998; Bartholow, Anderson, Carnagey, & Benjamin, 2005). The current study is aimed at testing whether similar weapons-priming effects occur from viewing posted signs asking people not to bring guns into public buildings or spaces.

Participants in this study (planned N = 100 undergraduates; half women) are randomly assigned to one of two conditions—one in which a “No Guns” sign is posted on the entrance to the lab and the other in which a “No Cell Phones” sign is posted. After entering the lab participants complete a computerized lexical decision task consisting of aggressive words, nonaggressive words, and non-word letter strings. Their task is to press one of two keys as quickly as possible to indicate whether or not each verbal stimulus is a proper English word. Previous research has shown that gun primes facilitate recognition of aggressive words (Anderson et al., 1998), and therefore the current method aims to extend that finding to incidental exposure to a “No Guns” sign. We expect participants in the “No Guns” condition to more quickly recognize aggressive words than neutral words, whereas participants in the “No Cell Phones” condition are expected to respond equally quickly to aggressive and nonaggressive words.

Quicker responses to aggressive than nonaggressive words in the “No Guns” condition will provide evidence that signs intended to reduce the threat of harm (from concealed guns) could ironically increase the possibility of hostile actions. Cognitive theories of aggression stress that heightened accessibility of aggressive thoughts can shape social perception, leading to more hostile intent being attributed to others’ actions. Thus, if incidental exposure to signs intended to enhance public safety actually prime aggressive thoughts, as predicted here, the current findings could contribute to ongoing discussions about gun safety and public policy. More generally, new understanding about the weapons-priming effect could lead to new preventative measures for violence, as well as new treatment approaches. Showing the priming effects of “No Concealed Weapons” signs could also potentially lead to changes in the way weapons are prohibited. Ultimately, the results from this experiment will add information to the ongoing discussion about human violence.

This project was completed to fulfill a Capstone requirement.
Introduction: Interracial marriages have increased over the last several decades. Approximately 15% of all new marriages in 2010 were between spouses of a different race/ethnicity. Despite this trend, most literature has focused on interracial marriage behaviors. We know less about college students’ attitudes toward interracial dating and marriage. The current study examined college students’ openness to interracial relationships and their experiences of within-group and out-group discrimination. We hypothesize that students who experience more within-group discrimination will be more open to interracially date and marry.

Methods: A sample of self-identifying African American and Latino college students attending the University of Missouri in Fall 2015 were asked to participate in an online weekly diary study (N=91). Participants reported their openness to interracially date and marry, excluding whites. Responses were 1 yes and 0 no. Discrimination was measured using 14 within-group and 18 out-group discrimination questions. Responses ranged from 1 never-5 always.

Results: A series of t-tests were conducted to examine mean-differences of within-group and out-group discrimination between those open and not open to be interracially intimate. Those who were open to date someone outside their race (excluding whites) reported more within-group discrimination (M=1.99, SD= 0.81) than those not open (M=1.19, SD=0.33). Furthermore, those who were open to marry someone outside their race (excluding whites) reported more within-group discrimination (M= 2.01, SD= 0.81) than those not open (M=1.27, SD=0.29).

Discussion: This study focuses on college student’s attitudes towards interracial relationships. By measuring these attitudes we found that participants with higher within-group discrimination were more open to a relationship outside of their race, excluding whites. Our study ultimately shows that within-group discrimination can have a significant effect on one’s attitude towards the potential race of their partner. Thus, when continuing research on discrimination, within-group experiences should be included in order to accurately evaluate discrimination.
An extended family of inspiration: An archival study of Lanford Wilson’s *The Sand Castle*

Leslie Howard and David Crespy

*The Sand Castle*, a 1965 play by American Pulitzer Prize winning playwright Lanford Wilson explores Wilson’s relationship with an artistic family from San Diego, California. The characters, which make up the “Reynolds” family in the play, are based on Wilson’s friends and members of the “Brown” family who served as Wilson’s writing confidants early in his career.

Wilson, who was born in Lebanon Missouri in 1937, donated the archives of his career to The University of Missouri Libraries’ Special Collections and Rare Books sector. The collection allows for the role members of the Brown family, and Wilson’s close friend Tanya Newton, played in the formation of Wilson’s playwriting career. Personal correspondences found in the archives confirm that Tanya Newton and members of the Brown family consistently provided Wilson feedback on his writing even after he left California for New York. This paper explores the relationship between Wilson and his San Diego influence that not only inspired some of the most complex characters of Wilson’s career but also served as a sounding board throughout Wilson’s life.
Virtual Achieve program: Effects of online tutoring

Lauren Huber, Erin Masek, Madison Plunkett, and Stephen Whitney

The Virtual Achieve Program is an online tutoring program between University of Missouri students and an inner city charter school in St. Louis, Missouri. This mixed-method research seeks to determine if online tutoring improves the academic performance of elementary students and to provide program evaluation. Interviews were conducted with MU tutors and 5th grade elementary students who participated in the Virtual Achieve Program. In addition, mathematic standardized gain scores were analyzed for five 5th grade students who participated in the program over the fall semester. All five students participating in the Virtual Achieve Program made gains in their STAR Math scores ranging from 0.2 to 25 months, grade equivalent scores, with an average of 12.4 months in a three month time span. Our interview findings indicated some of the issues with online tutoring included a difficulty in connecting interpersonally and issues with the reliability and effectiveness of the technology. Benefits of the program included; elementary students becoming more confident in their ability to approach math problems, MU tutors gaining experience in developing multiple explanations approaches to teaching and an increase in confidence in their ability to teach. Recommendations to improve the program included starting and ending every session with everyday conversations, utilizing technology that allows screen sharing, increasing the reliability of the technology and having more frequent and shorter tutoring sessions.
Development and characterization of gellan gum and homogenized tissue hydrogels for potential treatment of post-traumatic osteoarthritis

Samantha Huddleston, Colten Snider, and Sheila Grant

Post-traumatic osteoarthritis (PTOA) occurs through a variety of joint injuries or trauma and is characterized by joint pain and swelling due to inflammation, synovial discharge, and intra-articular bleeding. Current therapies control short-term pain, but long-term treatments have been ineffective due to the inflammatory response of PTOA. Incorporating anti-inflammatory hydrogels have the potential of decreasing this response and the further development of PTOA. Specifically, gellan gum and homogenized porcine diaphragm were used to determine biocompatibility, viscosity, injectability, heat capacity, and degradation mechanisms to support its use to regulate the immune response in PTOA. Gellan gum was created by combining Phytagel™ and DI water at concentrations of 1 and 1.5% Phytagel to DI water. The different gellan gum concentrations were then mixed with homogenized porcine diaphragm in PBS at concentrations of 3, 5, and 10% gellan gum to homogenized tissue. WST-1 cell viability assay for 3, 7, and 10 days and rheological studies were performed on all samples, a total of nine experimental groups. Injectability studies, differential scanning calorimetry (DSC), and thermogravimetric analysis (TGA) have yet to be performed, but will indicate the stability of the hydrogel. The 3-day WST-1 graph indicated that the gellan gum did not promote cell viability as well as other combinations of gellan gum and homogenized tissue. The 7-day and 10-day WST-1 graphs indicated an increased amount of cell viability, with the greatest viability residing in the 1.5% gellan gum to homogenized tissue combinations. Rheological data showed low viscosity for all samples, which supports its use as an injectable material. Further testing will narrow down the most effective sample combinations for an anti-inflammatory hydrogel.
Evaluation of knee stability following injury and reconstruction of the anterolateral ligament

Marcus Hurtado, Dustin Johnson, and Ferris Pfeiffer

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Exploring the light-tissue interaction of Airy beam for biomedical imaging applications

Romanus Hutchins and Ping Yu

Gaussian beams have been extensively used in biomedical imaging since they can be focused into micrometer-sized spots to achieve desirable image resolutions. However, there is an intrinsic drawback of using Gaussian beams in biomedical coherent domain imaging because of their limited depth-of-field. We believe that Airy beams will overcome this drawback. The Airy beam is a new type of light beam that shows a special Airy pattern during propagation. The main lobe of Airy beam takes a majority of energy of the beam and extends to a long distance without diffraction. This means that the depth-of-field is improved when using the Airy beam in biomedical imaging. The purpose of this research is to study the difference of optical scattering between the Airy beam and the Gaussian beam. Experimental data is acquired from the optical scattering of different turbid media, and the scattering property of the Airy beam is determined by analyzing the speckle size as a function of the density of the scatters in the turbid media. We found that the speckle size in the scattering regime of thin turbid media has a larger difference between the Gaussian beam and the Airy beam. We also observed the self-healing effect of the Airy beam during different points of its propagation when the beam was blocked by a static object. In this experiment we found that the recovery distance of the Airy beam is shorter when a large percentage of it is being blocked than when smaller portions of the beam are being blocked. A better understanding of the scattering capabilities and the self-healing effect of the Airy beam is a very important step toward clinical applications for this beam.
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Faculty Mentor: Dr. Wayne Brekhus, Sociology
Funding Source: McNair Scholars Program

An ethnographic exploration supported by semi-structured interviews of how gender affects work and power in a restaurant

Andrew Hutchinson and Wayne Brekhus

Order Up: Documenting Restaurant Culture is a combination of participant observation field notes and semi-structured interviews that seek to shed light on the power dynamics of restaurant culture and how gender affects work. Interviews and personal experience focus on the experience of a server and how they employ emotional labor to navigate a workplace culture that devalues their work and uses them as a dumping point for occupational frustration. Servers employ various tactics to save face, compete for tips and subtly maintain control over their occupational territory and independence in the face of normalized violence and expressions of hegemonic masculinity. Cooks and management unconsciously maintain a culture of hyper-masculinity and domination that leads to the devaluing of emotional labor despite the fact that servers typically make more than their superiors and coworkers in the kitchen. This study rests upon the sociological tradition of examining the restaurant through a dramaturgical lens but differs in that it focuses on the experiences of servers and their prime importance in the mediation between consumer and cook and their integral role in creating the illusion of organization and experience of the restaurant.
Phenolic induction in *brassica napus*

Keiran Hyte, Clayton Coffman, and Heidi Appel

Plants induce chemical defenses in response to herbivore feeding. These chemical defenses take many forms, such as volatiles, phenolics, and glucosinolates. My lab has previously shown that *Arabidopsis* plants can selectively respond to vibrations from caterpillar chewing by increasing chemical defenses in their leaves when subsequently attacked. It is unknown whether other kinds of plants exhibit similar defense responses to vibrations. I am focusing on the agriculturally important species *Brassica napus* L. cv Westar also known as oil rapeseed or canola, another member of the *Brassicaceae* family. Oil rapeseed leaves are consumed in Asia as a vegetable and its seeds are the source of canola oil. My long term goal is to determine whether *B. napus* increases chemical defenses in response to herbivore vibrations, and if so what specific features of the vibration are important to the response. To do this, I need to first characterize a defense response of *B. napus* to herbivory. I used wounding and methyl jasmonate (MeJA), an elicitor of plant responses typical of herbivory, to characterize the induction of phenolic defenses in *B. napus*. (Tytgat et al., 2013) In this experiment, I treated plants (n=15) with wounding and MeJA and measured their production of total phenolics, anthocyanins, and flavonoids compared to those of control plants that didn’t receive wounding and MeJA. Although I have yet to complete the analysis, my results will be ready in time for the Forum.
Faculty Mentor: Dr. Brenda Peculis, Biochemistry
Funding Source: NIH Initiative for Maximizing Student Diversity (IMSD-EXPRESS)

**Analyzing U8 gene expression in *xenopus laevis***

Joshua Idachaba and Brenda Peculis

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
The goal of this research project is to build a network of sensors that will be used to monitor various aspects of algae cultivation and biofuel production using wastewater. As a team, we plan to monitor the temperature, light intensity, dissolved oxygen, dissolved carbon dioxide, pH, nitrate intensity of algae growth and investigate optimal sensor node tasking to minimize network resource consumption and system complexity. The main goal is to increase the algal biomass productivity while minimizing operating costs, capital, and land. A raspberry pi will be used as the heart of the sensor network. The data collected from the sensors will be displayed on the web. Research will need to be done to find sensors that are compatible to the raspberry pi and measure the specific environmental variables we need to measure.
An articulatory kinematic study of clear speech in talkers with ALS

Abby Isabelle and Mili Kuruvilla-Dugdale

Amyotrophic lateral sclerosis (ALS) is a progressive neurodegenerative disease that causes substantial declines in speech intelligibility. As speech begins to deteriorate, patients are often instructed to use clear speech (i.e. exaggerated articulatory movements) as a strategy to improve intelligibility. Clear speech is a global treatment technique where adjustment of a single variable, for e.g. articulatory movement, can result in significant improvements in intelligibility. Because individuals with ALS are prone to fatigue, less intensive global techniques that improve speech intelligibility while minimizing fatigue are especially effective. Currently, there are limited Phase I studies to determine the efficacy of clear speech in talkers with ALS. The objective of this study is to evaluate clear speech effects at a physiologic level, specifically, on tongue motor control because of the direct impact clear or exaggerated speech can have on tongue movements. We hypothesize that tongue movements will be more stable (demonstrating improved motor control) for clear speech compared to typical speech in talkers with ALS. To test the hypothesis, we recruited six subjects with ALS and six age- and gender-matched healthy controls. Participants were asked to repeat the sentence ‘I owe you a yoyo’ 10 times using both typical and clear speech while an electromagnetic articulograph tracked their tongue tip, mid, and back movements. For the clear condition, subjects were asked to hyper- or over-articulate the sentence. To assess tongue motor control, the pattern of vertical tongue movements and the stability of that pattern over 10 repetitions of the sentence will be captured using the spatiotemporal variability index (STI; Smith & Zelaznik, 1995). High STI values indicate low movement stability while low STI indicates high movement stability. Such investigations into the effects of speech strategies on articulatory motor control will provide a stronger scientific basis for widely used clinical techniques recommended to ALS speakers.
Teodor Ivanov
Buffalo Grove, IL

Faculty Mentor: Dong Xu, Computer Science
Funding Source: College of Engineering Undergraduate Research Option

MU Operations

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Our research is a project founded and mentored by MU Operations. The project is called “MU Operations”, which is about reconstructing all of University of Missouri official websites that are out-of-date and connecting them together. Currently the websites being reconstructed are: MU Police, Staff Council, MU Printer Service, Campus Facility, MU Operation, Parking Service, etc. The project aims to be finished by the end of April. We then plan to publish the official sites after a few months of testing.

“MU Operations” is built upon Drupal 8. We use a Content Management System, based on our departments requests. Drupal 8 enables each department to modify content more conveniently and more efficiently based on their needs. We selected Drupal 8 as our Content Management System because it is the newest version of Drupal, so we don’t expect major updates to Drupal in a few years. Thus this promotes efficiency in maintenance towards inexperienced users. Also Drupal has many features that highly simplify our project’s goal. Drupal is designed to handle large websites, which helps us handle around one thousand web pages in total for “MU Operation”. This allows security to be handled on one platform too.
Crayfish form social dominance hierarchies following agonistic encounters with conspecifics. For instance, once a dominant-subordinate relationship is established, subordinate crayfish display overt behavioral changes, including a prone posture, and increased numbers of escape tail-flips in response to encounters with dominants. Prior studies have shown that the social status of subjects with established dominant/subordinate relationships can be reversed by the introduction of an ‘intruder’ male. Our hypothesis is that an established dominant/subordinate relationship can be reversed by exposure to water conditioned by a dominant animal (a test of whether conditioned water contains pheromones that can communicate social status). In studies presented here, we tested whether the dominant/subordinate relationship of two crayfish was reversed after being exposed to the conditioned water. First, we replicated a previous study showing an intruder crayfish can lead to reversals in the established social statuses of previously paired crayfish. This showed that half of the time an intruder caused social roles to reverse. In our new experiments, we tested whether conditioned water alone elicited a role reversal in pairs of crayfish, in the absence of an intruder crayfish. Two control experiments were also performed. In one control the paired crayfish were exposed to untreated water (i.e., neural water). In a second control, the paired crayfish were left in the test arena and no water change was performed. The latter control was to test whether the crayfish reversed social status on their own over the time frame (without any experimental manipulations). Preliminary results suggest that treated water alone can elicit role reversals in paired crayfish without the presence of an intruder crayfish. This suggests that dominant crayfish release a pheromone(s) into the water that communicates social status and that the pheromone can disrupt a previously established social hierarchy established between two different subjects. In future studies, we will test social hierarchy changes when paired crayfish are introduced into water conditioned by subordinate crayfish.

This project was completed to fulfill a Capstone requirement.
RNA binding: Fluorescent RNA binding analysis

We are interested in the ways in which RNA can foreshadow contemporary living systems. The RNA world theory proposes that RNA, as a self-replicating catalyst, was a precursor to today’s genetic systems. RNA both stored genetic information and catalyzed the chemical reactions in primitive cells. Specifically, interacting RNA structures can form a scale free network, which is characterized by a distribution function where there are a few “hub” RNAs that interact with many partners. RNAs in the network are linked through these hubs. This kind of distribution is common to many biological systems. Our lab studies the structures of RNA binding as well as the properties that cause some hubs to have higher binding affinities than others. We use the unit of measurement reads per million (RPM) to measure binding to the baits. We used three well-characterized RNA loop motifs as baits and selected a population of RNAs that were able to bind each of these motifs, GAGA, UGAGAU, and UUCG. A sequence from the library of the baits was used to test the accuracy of binding between the baits and the sequences. We hypothesized that the tetraloop GAGA would have better binding properties due to the frequency of appearance of GAGA in an RNA library.

In previous experiments we used Weblogo to identify the best binder through identifying the conserved nucleotides in the binding population. Through this data we found GAGA to have a higher affinity for binding, with the highest bits value. In current experiments we use fluorescent anisotropy to verify the rate of binding between the baits and the RNA sequences that were found to have low, medium, and high reads per million. The initial test consists of only the GAGA bait being bound to the low and high RNA binders. Results of the experiment showed no correlation to the expected hypothesis, and the experimental procedures are being evaluated.

Introduction: Interracial marriages have increased over the last several decades. Approximately 15% of all new marriages in 2010 were between spouses of a different race/ethnicity. Despite this trend, most literature has focused on interracial marriage behaviors. We know less about college students’ attitudes toward interracial dating and marriage. The current study examined college students’ openness to interracial relationships and their experiences of within-group and out-group discrimination. We hypothesize that students who experience more within-group discrimination will be more open to interracially date and marry.

Methods: A sample of self-identifying African American and Latino college students attending the University of Missouri in Fall 2015 were asked to participate in an online weekly diary study (N=91). Participants reported their openness to interracially date and marry, excluding whites. Responses were 1 yes and 0 no. Discrimination was measured using 14 within-group and 18 out-group discrimination questions. Responses ranged from 1 never-5 always.

Results: A series of t-tests were conducted to examine mean-differences of within-group and out-group discrimination between those open and not open to be interracially intimate. Those who were open to date someone outside their race (excluding whites) reported more within-group discrimination (M=1.99, SD= 0.81) than those not open (M=1.19, SD=0.33). Furthermore, those who were open to marry someone outside their race (excluding whites) reported more within-group discrimination (M= 2.01, SD= 0.81) than those not open (M=1.27, SD=0.29).

Discussion: This study focuses on college student’s attitudes towards interracial relationships. By measuring these attitudes we found that participants with higher within-group discrimination were more open to a relationship outside of their race, excluding whites. Our study ultimately shows that within-group discrimination can have a significant effect on one’s attitude towards the potential race of their partner. Thus, when continuing research on discrimination, within-group experiences should be included in order to accurately evaluate discrimination.
From the Bible to *Harry Potter*: Updating an ancient myth into modern fantasy

Rachel Jelinek and Johanna Kramer

This paper argues that *Harry Potter and the Deathly Hallows* not only becomes an updated version of the Bible, but also completes the story of the Bible. As an updated Bible version, *Harry Potter* allows readers to explore spiritual questions that help them make sense of today's world while also showing them how it all ends rather than only alluding to what will one day come.

The aim of my larger project is to investigate and identify the thematic and symbolic parallels between the seventh *Harry Potter* book and the New Testament (King James Version). Previous scholars have compared the two, but most research to date remains either too superficial or focuses too heavily on the controversy over the novels by Christian fundamentalists. In contrast to existing scholarship, I am interested in performing a literary critical analysis of the two texts that leaves religious controversy aside and focuses instead on the literary significance of the links between these two popular texts and the question of what modern, secular readers gain from a narrative with clear Christian Gospel echoes.

An example of a literary parallel is the theme of the battle between good and evil. In the seventh book, the final battle between Harry and Voldemort occurs, much like the expected final battle between Christ and Satan when “the beast, and the kings of the earth, and their armies, gathered together to make war against him that sat on the horse, and against his army” (Rev. 19:19). The two battles parallel one another, but they differ in that the Bible only prophesizes the final battle, whereas *Harry Potter* plays out the final battle at Hogwarts. Thus, *Harry Potter* completes the Bible’s narrative. This completion provides readers the imaginative space to explore complex and universal philosophical questions from a secular perspective.

*This project was completed to fulfill a Capstone requirement.*
Optimization of electric field enhancement for aluminum plasmonic gratings

Ximeng Jia and Shubhra Gangopadhyay

Plasmonic gratings have drawn increasing attention of many researchers in the past few decades. The enhanced electromagnetic field produced by the surface plasmon, in the presence of metal nanostructures, can achieve signal enhancement via confining light to small volumes on the nano-scale. Plasmonic gratings, as novel plasmonic structures, are often used as platforms to provide very efficient and extreme light concentration.

In this study, instead of traditional expensive process of making plasmonic grating nanostructures such as electron beam lithography, we are using HDDVDs and Blue-rays as molds to make aluminum plasmonic gratings, because HDDVDs and Blu-rays have periodic gratings in the form of tracks. The cost of producing plasmonic gratings by this way is a lot cheaper due to the commercially available discs. Mass finite difference time domain (FDTD) simulations have been performed in order to optimize aluminum plasmonic grating structures. By analyzing the electric field distribution, we are able to find the most effective situation with a highest electric field enhancement. Several factors have been taken into consideration, including thickness and patterns of the grating, and configurations when imaging under a microscope. We tested gratings ranging from 10 nm to 120 nm with an increment of 10 nm to find the best thickness that can achieve a maximum electric field enhancement. HDDVD gratings with a 400 nm grating period and Blu-ray gratings with a 320 nm grating period are investigated respectively and compared with each other. We also tried both top illumination and bottom illumination to verify different cases due to the configuration of imaging. Finally we draw the conclusion that Blu-rays obtains a greater electric field enhancement in the most situations regardless of other factors, while the optimal thickness varies from case to case.
Impact of the shape of membership functions on the truth values of linguistic protoform summaries

Tianqi Jiang, Jain Akshay, and James Keller

Linguistic protoform summary provide a promise to summarize the raw data in the short sentence. In the recent past, a lot of work has been done on Linguistic Protoform Summaries (LPS). Much of this work focuses on improvement of the ways to compute truth values of LPS as well as on development of different protoforms. However, almost all of the systems using LPS use trapezoidal membership functions. This work investigates the effects of using triangular and pi shaped membership functions and compare their performance when using trapezoids. We start with an experiment using synthetic data and then compare the behavior of the three types of membership functions using real data which is obtained from an eldercare setting.
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Funding Source: College of Engineering Undergraduate Research Option

Evaluation of knee stability following injury and reconstruction of the anterolateral ligament

Dustin Johnson, Marcus Hurtado, and Ferris Pfeiffer

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
A microassay system to investigate malignant tumor cell proliferation

Gabrielle Johnson, Stephanie L. K. Bowers, and George Davis

It is not clear whether the growth of malignant tumor cells is dependent on endogenous growth factors and signals versus their dependence on exogenous growth factors. To investigate such questions, we have set up an assay system using HT1080 fibrosarcoma cells that have been grown in two dimensions under serum-free conditions. In the assay we add growth factors exogenously with a single growth factor, growth factors in pairs and in triplet combinations. Interestingly, HT1080 cells can grow under these serum free conditions even without the presence of growth factors \textit{in vitro}. Experiments have shown that the presence of endogenous factors sparks growth to a significant level with the percent difference being over 400% when the original seed cell count is compared to the cell count after three days which was significant at \( p < .01 \). We hypothesize that the addition of combinations of growth factors will increase growth of the HT1080 cells to a significant level where \( p < .05 \). In early experiments, the exogenous addition of growth factors shows significance when compared to the control with \( p < .05 \), but the effect is not as pronounced as that of the endogenous growth factors. Our early data shows that the endogenous growth factors, mutations or both play a primary role in the growth of these cells which goes against our original hypothesis that the addition of exogenous growth factors will increase growth to a more significant level than what the endogenous growth curve shows. If we find that this characteristic is common among various cancer cell types we will investigate which endogenous regulators control the proliferation response. If we are able to find endogenous growth factors then we will be able to try and block the receptors that the growth factors bind to, thus stopping growth of the cell. Ultimately, if we are able to stop tumor growth we will try and transfer this system \textit{in vivo} using a quail model for human tumor growth. This work might identify new approaches for cancer treatment.
Activators and inhibitors of JCV replication

Kirtan Joshi, Alexander Kenzior, and William Folk

John Cunningham polyomavirus (JCV) causes a neurodegenerative disorder called progressive multifocal leukoencephalopathy (PML) in patients that have weakened immunity, caused by HIV infection or autoimmune disorders such as multiple sclerosis. JCV causes myelin degeneration which results in motor deficits, altered consciousness, unsteady and staggering gait and visual symptoms. Currently there are no means to efficiently and selectively block JCV replication and the consequent pathology.

In our current studies of JCV replication, we use a sensitive light emitting reporter assay system in which DNA sequences containing the viral replication origin are inserted into cells and assessed by luminometry. This is a very sensitive and robust assay that allows us to search for inhibitors of JCV replication and identify their targets.

Our results show a dependence of JCV replication on several viral and cellular proteins, which sets the stage for high throughput screening of combinatorial chemical libraries for potential inhibitors of viral replication machinery. We are currently collaborating with a group from Germany and Japan to explore several strong candidates. Preliminary results are very encouraging. Blocking JCV replication will allow treatment options for immunocompromised patients and better their quality of life.
Biomodulatory Hydrogels

Mary Josselet, Emily Cheng, Sidney McMillan, and Brett Ulery

Hydrogels are of great interest for the treatment of osteoporosis due to their potential as non-invasive drug delivery carriers. The hydrogel components can be injected into an osteoporotic fracture site where they will combine to form the water swollen network in situ. Ionic crosslinking is one method that can be used to form hydrogels for which ions can be chosen that have potent biochemical properties. Of particular interest are phosphates which are known to induce bone pro-forming effects. Ionic crosslinking alone, however, has resulted in mechanically weak hydrogels. To mitigate this issue, covalent crosslinking using genipin was carried out and its impact on hydrogel mechanical properties was studied using rheology.

This project focuses on studying the effect phosphate ions and genipin have on chitosan hydrogel crosslinking time and mechanical properties. Chitosan is used as the biopolymer because of its biodegradable and biocompatible characteristics. A number of experiments were conducted varying the concentrations of both phosphate ions and genipin. Using the inversion test, uniform gelation is witnessed around four minutes; however, the hydrogel continues to further gelate over the next twenty-four hours. Rheology was also performed on the crosslinked hydrogels to measure their mechanical properties. This process was repeated with bicarbonate ions, which have no bioactive properties and serve as a control. By determining the effect of phosphate and genipin solutions on crosslinking time and the physical properties of the hydrogels, these parameters can be tuned to produce a range of hydrogels capable of treating a variety of osteoporosis-related injuries including vertebral compression fractures and long bone pathological fractures which require different mechanical properties and gradients of biological repair cues. Also, by changing the bioactive crosslinker used, the hydrogel technology can serve as a regenerative engineering platform in the treatment of post-traumatic osteoarthritis and peripheral nerve damage.
Water-soluble inhibitor ameliorates motor functions against brain damage after severe traumatic brain injury in mice


Traumatic brain injury (TBI) affects 1.7 million individuals in the United States. While the primary causes of TBI are immensely broad, studies point to the gelatinase MMP-9 as a key factor in the pathogenesis of TBI secondary injury, which results in neuroinflammation, edema, blood-brain barrier (BBB) breakdown, and apoptosis. SB-3CT (1) is a selective gelatinase (MMP-2 and MMP-9) inhibitor, which effectively reduces brain damage after severe TBI in mice. However, SB-3CT is poorly water-soluble and is metabolized primarily to a more potent inhibitor, p-hydroxy SB-3CT (2). We examined the effects of the O-phosphate prodrug (3) of p-hydroxy SB-3CT on motor functions and histological changes in C57Bl/6J mice with TBI. Prodrug 3, an inactive MMP inhibitor, has enhanced water solubility by more than 2000-fold and is readily hydrolyzed to the active metabolite 2 in human blood. Pharmacokinetics showed that metabolite 2 achieved therapeutic concentrations in the brain. Mice were divided into three groups: sham, vehicle, and prodrug 3/metabolite 2. Prodrug 3 was administered intravenously at 7.8 mg/kg at 30 minutes after TBI, followed by subcutaneous injections of p-hydroxy SB-3CT at 25 mg/kg 1 hour after TBI and daily for the next 3 or 6 days. SNAP and beam-walking tests were performed to assess neurological impairment; cresyl violet staining was used to assess brain lesion. SNAP results for sham were the lowest, as expected, followed in increasing order by 7-day treatment, 3-day treatment and vehicle. While foot faults for sham and 3-day treatment stayed relatively constant over time, the average number of foot faults in 7-day treatment mice decreased, indicating greater motor control. Our results suggest prodrug 3/metabolite 2 treatment over seven days improves motor functions and decreases neuronal damage. These findings indicate that selective inhibition of MMP-9 by a water-soluble inhibitor is a promising therapy for treatment of severe TBI.
Determining optimal safety stock calculations

Caroline Junker and Ronald McGarvey

Most inventory reorder points are determined using a standard safety stock calculation that takes into account the standard deviation of the demand and of the lead time along with the demand and the average lead time assuming a normal distribution for all data. A new method being explored is that of quantile forecasting; it focuses on finding the distribution for each individual data set. From this, theoretically a more accurate safety stock calculation could be determined for each product.

The method to determine if this could be an effective alternative involves finding the already used safety stock using the normal distribution and analyze each product to find the optimal distribution. Then the new safety stock calculation should be calculated and compared to the original calculation. However, this cannot be so easily done. Some factors that will need to be considered are cycle times, fulfillment by different distribution centers, seasonal variations, and constantly changing products. The new algorithm will be tested by using a large dataset showing all demands over a three year period.
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**Water tracking pro**

Emily Kahanic and Maria Fidalgo

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Do reticulospinal neurons in the lamprey regenerate their axons following chronic spinal injury?

Megan Keller and Andrew McClellan

Research abstract withheld at the request of the faculty mentor for proprietary purposes.

This project was completed to fulfill a Capstone requirement.
Amber Kellum and Antoinette Landor

The romantic relationships of African Americans are often characterized by conflict, instability, and dissatisfaction (Kogan et al., 2013). Those who do marry experience high divorce rates and lower marital quality, which makes it important to research these factors in order to identify the difficulties that are experienced within African American relationships. Not only that, there has been an increase in reluctance to marry among the African American population due to the change in attitudes and negative schemes or experiences in racial discrimination, family instability, and violence (R. L. Simons, Simons, Lei, & Landor, 2012). Due to these factors, a significant amount of evidence indicates that maintaining happy, satisfying, and enduring relationships within African American romantic relationships is a challenging task. There have been several studies that highlight the importance of early childhood and adolescent experiences which contributes to the development of negative schemas created within these children at an early age (L. G. Simons, Simons, Landor, Bryant, & Beach, 2014). For example, there have been many studies that examine the effects that parental-child relationships have on later marital and relationship quality (Nicholson, 2006). There has also been research linking financial strain and socioeconomic status with marriage and divorce rates as well as cohabitation among African American couples (Lincoln & Chae, 2010). Racial discrimination and early on experiences during ones childhood has also been a major factor within African American couples that reduces relationship quality and satisfaction (Allen, 2015).
Impact of beta-bactam antibiotics on localization of penicillin-binding protein in *Agrobacterium tumefaciens*

Colleen Kennedy, Michelle Williams, and Pamela Brown

The cell wall is absolutely vital for bacterial cell survival. Composed of a thin layer of peptidoglycan (PG), the gram negative cell wall in *A. tumefaciens* provides support and protection while ensuring the homeostasis of osmotic pressure between internal and external environments. Penicillin-binding proteins (PBPs) synthesize new cell wall material and we have used green fluorescent protein (GFP) fusions to observe the localization patterns of PBPs in *A. tumefaciens*. We observed that the proteins localize either at the cell poles or midcell in *A. tumefaciens*. We employed two β-lactam antibiotics, ampicillin and cephalexin, to combat growth by targeting bacterial cell walls; specifically, β-lactam antibiotics directly bind to PBPs to inhibit the synthesis of cell wall material. Antibiotics that inhibit growth of the cell wall cause the cell to experience osmotic imbalances, which can lead to autolysis or viable bacteria with morphological alterations. In past experiments following treatment of *A. tumefaciens* with ampicillin and cephalexin, we discovered altered phenotypes, including cellular branching, midcell elongation, and rounded cell formation. The changes in cell morphology were visible within 4 hours of incubated growth in higher antibiotic concentrations; morphological alterations also appeared in lower antibiotic concentrations at extended time points. After analyzing the impacts of varying concentrations of the two β-lactam antibiotics on cell morphology and viability, we investigated the influence of the same concentrations on localization of PBP-GFP fusions. We expect that the morphological changes induced by the two β-lactam antibiotics will disrupt typical PBP localization patterns during cell division and elongation.

*This project was completed to fulfill a Capstone requirement.*
A comparison of the extent of template removal accomplished via chemical extraction, thermal calcination, and oxygen plasma in hexagonal mesoporous silica

Lauren Kesselring and Heather Hunt

Mesoporous silica (MPS) is a porous material that can be used in many biomedical applications that require high surface area, including implant coatings, drug delivery systems, and biosensors. However, before MPS can be utilized for these applications, the removal of the organic template, which was used to create the network of pores, from the surrounding molecular framework is necessary. This is typically accomplished via thermal degradation (i.e., calcination). However, partial collapse of the structure may occur during high-temperature calcination. A frequently used alternative technique that is less likely to impact the structure is chemical extraction, which allows the surfactant to be removed intact from the pore network and then potentially recycled. The primary disadvantage of chemical extraction, and chemical removal methods in general, is that they may result in the incomplete removal of the template. Ideally, template removal should completely remove the template in a minimum amount of time, while leaving intact the ideal structural and surface properties of the inorganic framework. However, very little work has been done to fully compare the extent of template removal across the standard removal techniques, and the extent of template removal for MPS materials used in biomedical applications is rarely presented in literature. Given the importance of this synthetic step, it would be beneficial to explore the extent of template removal across chemical and thermal degradation methods. Here, the extent of template removal accomplished via chemical extraction, thermal calcination and oxygen plasma is compared for 2D-hexagonal mesoporous silica, using cetyltrimethylammonium bromide (CTAB) as the organic templating agent.
Ser Mapuche: Does identifying as Mapuche influence motivation and effort in Chilean schools?

Paige Kiehl and David Bergin

This qualitative research investigated high school student motivation in Chilean schools. A secondary purpose was to compare motivation between Mapuche and non-Mapuche students and the impact of constructed ethnic minority identities within a culture (Merino & Tileaga 2011). The Mapuche are an indigenous group in Chile that has experienced discrimination and appropriation of land. Using single, semi-constructed interviews, Dr. David Bergin conducted interviews in Spanish with male and female, high and low achievers, Mapuche and non-Mapuche students from three schools that target low-income students. The interviews followed scripted questions and used follow-up impromptu questions to further explore students’ motivation and classroom experiences. Findings included the following: 1. Students preferred active learning over lecture. In particular, they disliked dictation in which they wrote down what the teacher read. 2. Most interviewed students said that they do not compete for grades; however, they reported comparing grades. 3. Interviewed students did not report teasing of high achievers. 4. Interviewees made widely varied reports regarding discrimination for being Mapuche, but there were some reports of teasing and taunting of youth in public for being Mapuche.
Improving social competence in adolescents with autism

Mikayla Kightlinger and Janine Stichter

Individuals with autism can struggle with interpersonal connection in their daily lives. The conflicts that arise from these social difficulties can often lead to negative outcomes for these individuals in the future. Problems such as obtaining and retaining employment and creating friendships are struggles individuals with autism can face. The SCI-A curriculum was developed to improve the social outcomes of adolescents with higher functioning forms of autism and for youth with similar social competence deficits. The age of participants for this study were between the ages of ten to fifteen years of age who had either been diagnosed with high functioning autism or had social concerns that are in line with those of autism as well as an IQ of 75 and above. The participants received twenty hours of SCI-A curriculum delivered by trained school personnel as part of their educational programming. The effectiveness of this curriculum was evaluated by the General Social Outcome Measure (GSOM) to determine the change in an individual’s level of social competence before and after the curriculum has been taught. The GSOM was administered two weeks prior to curriculum being taught to students and then two weeks after students had completed the SCI-A curriculum. The GSOM looks at sub categories of conversation reciprocity, affect demonstration, recognizing emotions and social problem solving to determine an individual’s social competence performance. The results of the GSOM from the individuals who were exposed to the SCI-A curriculum yielded the result that social competence improved, on average, from the pre to post test. This study has important implications for helping improve the quality of social interactions individuals with high functioning autism and related social needs to better their social outcomes.
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Battery thermal management using thermoelectric heat pump

Joon Woo Kim and Chanwoo Park

Thermoelectric device is a solid-state device which can be used to both heat and cool by simply changing the electrical polarity. In this undergraduate research, the solid-state thermoelectric (TE) device was used as heat pump to cool rechargeable battery during charging and discharging. The experimental setup consists of a TE module, a heat pipe heat spreader, and a liquid cold plate as heat sink. The experiment was performed by changing the coolant flow rate through the cold plate, and the TE voltage to study their effect on cooling of a Lithium–Ion battery cell. The temperature and flow rate of the water in liquid cold plate and the voltage of the TE were measured to calculate the heat transfer rates and the Coefficient of Performance of Cooling (COPc) of the TE heat pump. It was found from the experiment that there was desirable conditions for the TE heat pump to maximize COPc.
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Funding Source: National Science Foundation Grant to H. Appel and R. Cocroft

**Effect of feeding vibrations from *Trichoplusia ni* caterpillars on arabidopsis chemical defense**

Alexis Kollasch, Heidi Appel, and Rex Cocroft

Plants respond to stress in their environment by making defensive chemicals. My lab has studied how the vibrations from insect feeding serve as cues to the plant to make more chemical defenses. Feeding vibrations of caterpillars of the cabbage butterfly (*Pieris rapae*) on the model plant *Arabidopsis thaliana* induce higher levels of glucosinolate and phenolic defenses. In my project I am asking whether feeding vibrations caused by another agricultural pest, the cabbage looper (*Trichoplusia ni*), similarly induce defenses. I have raised *T. ni* caterpillars and recorded the feeding vibrations they cause on Arabidopsis leaves using a laser vibrometer with the capacity to measure the movement of a leaf to 1/10,000 of an inch. Once this library of feeding vibrations from 25 caterpillars was assembled, the recordings were processed and played back to new plants in the absence of caterpillars to determine whether the vibrations altered their production of phenolic defenses. Although I have yet to complete the experiment, my results should be ready in time for the Forum.
Poor math achievement and childhood obesity are topics of national concern. If short bouts of physical activity can be integrated with teaching the number knowledge and skills that predict later math proficiency, there is potential to favorably influence short- and long-term numeracy and physical health. The proposed project aimed to determine if physical activity can be integrated with number learning games to improve preschoolers’ number knowledge and counting skills. We hypothesized that integrating an age-appropriate large motor skill, such as jumping, with an evidence-based number board game, would produce improvements in preschoolers’ numeracy outcomes that are at least equivalent to those from sitting to play the game. A pilot study is underway with 28, 3-year-olds from the Columbia Public Schools Title I Preschool Program. After parents gave consent for their child’s participation, preschoolers were pre-tested (fall 2015). Pre-assessments evaluated participant’s non-symbolic quantity discrimination and symbolic knowledge of counting, numerals, ordinality, and cardinality. After pre-testing, children were randomly assigned to one of two intervention conditions: 1) the original seated number board game; and, 2) a number game that is played by jumping on a game board floor mat. The intervention began in January, 3 months after children were pre-tested. Preschoolers in both conditions met individually with the same experimenter for two, 15- to 20-minute game-playing sessions over a two-week period; post-testing occurred one week after the second intervention session. As of March 15, 2016, 24 children will have completed pre-testing, 2 intervention sessions, and the post-test. Data scoring, entry, and analysis are underway. Our hypothesis will be tested with ordinary least squares regression (OLS). If the proposed study shows that preschoolers’ early numeracy is improved by playing a game that integrates jumping, our next step will be to evaluate the impact of the game on children’s moderate-to-vigorous physical activity (MVPA).
Evolutionary differences between C₃ and C₄ photosynthesis

Satya Kothapalli, Jacob Washburn, and Chris Pires

The majority of plants on earth use C₃ photosynthesis, and this works well in cool, wet climates. Other plants use a different photosynthetic pathway known as C₄ which is well adapted to hot, and arid climates. C₃ and C₄ photosynthesis refers to the various mechanisms these plants utilize to carry out the calvin cycle during photosynthesis. One of the most striking observations about C₄ plants is that they have over 60 independent origins, 20 distinct leaf anatomies, and three classically defined enzymatic subtypes (named: NADP-ME, NAD-ME, and PCK). This project studies the evolutionary differences between the three classical C₄ subtypes using a set of four species from the grass tribe Paniceae. To study these differences, we obtained and sequenced RNA from the mesophyll and bundle sheath cells of each of the four species sing a method known as leaf rolling. The grasses utilized for conducting this experiment include: Panicum hallii, Saccoiopsis indica, Setaria italica, and Urochloa fusca. With the sequencing data from this study, we are able to investigate to what extent each of the enzymatic subtypes of the C₄ are used within our species and how much, if any, C₄ subtype mixing is occurring. Studying how different C₄ subtypes evolve from C₃ can help provide useful information for the improving of photosynthesis within economically important crop plants.
Consumer discrimination in professional sport: An examination of digital fan interest

Tyler Krantz, Brad Copeland, and Nicholas Watanabe

Seminal work by economist Gary Becker (1971, 1975) theorized the existence of economic discrimination and how certain individuals and organizations may display bias in their decision making, including purchasing goods and hiring individuals. From this work, the economic literature (Kahn, 1991; Nardinelli & Simon, 1990) has developed empirical and theoretical examination of three different forms of economics discrimination: employer, employee, and consumer-based discrimination. Specific to the context of this research is consumer discrimination, the case where individuals display a preference based on certain characteristics, and thus are willing to pay a premium for products that fall in line with their inclinations.

Within the sport literature, discrimination by consumers is primarily considered through using econometric methods to analyze the price of player memorabilia (Kanazawa & Funk, 2001; Primm, Piquero, Regoli, Piquero, 2010; Regoli, 1991; Smith, Primm, Piquero, Piquero, & Regoli, 2012). However, because the market and data for memorabilia such as trading cards is rather limited in scope, the results from this line of sport consumer discrimination research provides mixed results. This project attempts to advance the empirical examination and theoretical understanding of consumer discrimination in sport by considering fan interest in players that are not as limited in their scope. Specifically, this research follows initial work by Depken and Ford (2006) which examined All-Star voting by fans. In the case of this research, we will analyze how sport fans have behaved in the digital realm by examining online voting for all-stars in the National Basketball Association, as well as their following on the Twitter social media platform. Results from this research will not only provide enhanced theoretical knowledge on the behaviors of sport fans in a digital context, but also develops a better understanding of the existence of consumer discrimination in our everyday lives.
Understanding the basis for increased toxicity in BoNT/A2 versus BoNT/A1

Daniel Kranz and Michael Baldwin

*Clostridium botulinum* is a Gram-positive, anaerobic bacterium that produces the highly potent neurotoxin, botulinum neurotoxin (BoNT). Through cleavage of a protein (SNAP-25) essential for docking synaptic vesicles to the presynaptic membrane, the toxin prevents neurotransmitter release at the neuromuscular junction, producing a flaccid paralysis known as botulism. Understanding the mechanism in which BoNT binds to and enters neurons is essential. One of the major variants of BoNT in pharmaceutical use is subtype BoNT/A1. A closely related subtype, BoNT/A2 has been shown to enter neurons with greater efficiency than BoNT/A1, resulting in enhanced toxicity. It is possible that differences in membrane (ganglioside or phospholipid) binding contribute to differences in the rate of neuronal entry. By generation of a mutated BoNT/A2A1 chimera protein, it was shown that BoNT/A1 and BoNT/A2 toxins have two different modes of binding to gangliosides-glycosphingolipids essential for the toxin’s binding and entry into neurons. BoNT/A1 binds ganglioside GT1b via hydrogen bonding and hydrophobic stacking interactions mediated by conserved residues located in the C-terminal subunit of the binding domain. In comparison, binding of BoNT/A2 to GT1b appears to be stabilized by additional electrostatic interactions with residues in the N-terminal subunit of the binding domain. Previous experiments created a BoNT/A1 protein with six specific residues in BoNT/A1 binding domain mutated to their respective BoNT/A2 counterparts and tested for binding affinity to ganglioside. The mutated protein bound with much greater affinity to ganglioside than either BoNT/A1 or BoNT/A2. Upon introduction to neurons, however, its rate of entry was lower than BoNT/A2 and showed no significant difference from BoNT/A1. This experiment suggested that the greater efficiency in neuronal entry of BoNT/A2 was independent of ganglioside binding. With differences in ganglioside binding ruled as an unlikely mechanism of increased efficiency of entry into neurons, attention was then turned to the contribution of phospholipids on neuronal entry. Our initial experiments were designed to test binding affinity of BoNT/A1 and BoNT/A2 to different membrane phospholipids (Phosphatidylcholine, Phosphatidylserine, and Phosphatidic acid). Preliminary testing suggests a significant difference in the binding of BoNT/A1 and BoNT/A2 to these phospholipids. Future experiments will test the role of phospholipid binding in the entry of botulinum neurotoxins into neurons.

*This project was completed to fulfill a Capstone requirement.*
Repair prioritization with respect to inventory requirements

Molly Laird, Kyle Dorge, Lauren Himmelberg, and James Noble

The purpose of this project is to provide a repair decision tool to handle broken military aircraft parts for The Boeing Company. When an aircraft part breaks at a military base, it is often more affordable to send it to a depot to be repaired than to replace it with a brand new part. However, due to budget and capacity limitations, not every repairable part can be repaired. Repair costs, lead times, and criticality for flight availability vary by part. Thus, in order to maximize the amount of aircraft available to fly, it is important that the most critical parts are repaired. Currently, asset managers at Boeing rely on experience to eyeball which broken parts to send to repair. This method is subjective, lacks standardization, and does not take advantage of available data. Therefore, this team is building a software tool that will provide an ordered list of recommended parts to repair in order to maximize aircraft availability. Given budget, capacity, and time constraints, the tool utilizes linear programming to find the optimal recommendation list of repairs.
Brooke Lappe  
Farmington, MO  

Faculty Mentor: Dr. Ravi Shankar, Psychiatry

Seclusion and restraint events in child and adolescent inpatient psychiatric population

Brooke Lappe, Jessica Edgar, and Ravi Shankar

Objective and rationale: The objective of this study was to analyze our data for any trends regarding seclusion and restraint in children and adolescents. There is a limited amount of research in the area of seclusion and restraints especially in children and adolescents. Most research analyzes patient characteristics as precursors or predictors of restrictive interventions, but many studies conclude that additional research is necessary to support the findings. Rationale for the study was to provide more data in child and adolescent patients regarding use of seclusion and restraints and see if this is consistent with what is presented in the adult literature.

Methods and Results: The study documented 394 cases of seclusion and/or restraint among 154 patients over the span of 3.5 years from July 2009 to December 2012 at the Missouri Psychiatric Center. After getting IRB approval, data was entered from packets (CBADS) into an excel database. This excel database is a comprehensive list of the information gathered from patient records by previous research assistants. The data included various background information including age, diagnosis, previous suicide or self-harm attempts, medical history, family history, etc. Additionally, every seclusion and restraint incident was documented with a cause, type of restrictive measure(s), length of time, and any medications that were administered. Data analysis is still in progress but we expect to see trends in the factors that may increase risk for seclusion and restraint episodes as well as an average of 2 or more episodes per patient.

Conclusion: Since there is limited research and data available regarding restrictive interventions, more research is necessary to determine whether the trends we observe are universally applicable.
Circumstellar dust shells of the Asymptotic Giant Branch: Modeling stellar spectra

Aylecia Lattimer and Angela Speck

This project explores the effects of stellar dust on emitted stellar and circumstellar spectra, specifically those of Asymptotic Giant Branch (AGB) stars. AGB stars have finished core hydrogen fusion, and have moved off the main sequence (where the majority of a star’s “lifetime” is spent). They are characterized by an inert carbon and oxygen core, surrounded by concentric shells of helium and hydrogen fusion. AGB stars pulsate, which promotes the loss of stellar matter. During these pulsations, newly-formed elements from the H- and He-fusing shells can become mixed with the outer layers of the star, changing the star’s surface composition. The matter at the outermost edge of the star is loosely bound after the star’s expansion into the red giant phase, due to the increase in the stellar radius (following Newton’s law of universal gravitation), allowing matter to escape the star. This ejected matter condenses into dust grains, which form the circumstellar dust shells that are the main study of this project. I used the computer program DUSTY to model the effects of chemical composition of circumstellar dust on the spectrum of the AGB star RX Boo. DUSTY produces models of the star’s spectrum, including a component from the circumstellar shell, according to parameters that are manipulated within the program. These parameters include stellar and dust shell temperatures, dust grain size and distribution, and the chemical composition of the dust grains. The spectra produced by DUSTY were then compared to the spectrum of RX Boo in order to determine which combination of parameters most closely replicated RX Boo’s observed spectrum. The best-fitting DUSTY models suggest that RX Boo has a relatively high carbon to oxygen ratio. Further results, and conclusions drawn from these results, will be presented at the forum, as the interpretation of the data is still ongoing.

This project was completed to fulfill a Capstone requirement.
Simulations of adsorption of natural gas mixtures in graphene nanocells

Drew Lemke, Alexander St. John, Eddie Maldonado, Michael Roth, and Carlos Wexler

The adsorption of natural gas (NG) in graphene nanocells is of significant interest for its potential use for energy storage. In most studies NG is assumed to be comprised of pure methane, its main component. However, this neglects that 10-30% of NG is made-up of as ethane, propane or heavier gases which may preferentially adsorb eventually reducing the storage capacity. In this studies we seek to understand the adsorption of NG mixtures by performing Molecular Dynamics (MD) simulations. Whereas most adsorption simulations are done with the computationally more efficient Grand Canonical Monte Carlo (GCMC) methods, MD offers advantages for the study of larger molecules where internal configurations changes are important. In addition, MD permits studying time-dependent processes such as diffusion, which can help determine the reversibility or irreversibility of the adsorption of the heavier molecules.
Kristin Lenz
St. Louis, MO

Faculty Mentor: Dr. Charlotte Phillips, Biochemistry
Funding Source: CAFNR On Campus Research Internship - Weldon & Winnie Jones; Stroeter Scholarship Fund

Inhibition of myostatin *in utero*: A potential strategy to improve muscle in *oim* mice

Kristin Lenz, Arin Oestreich, Youngjae Jeong, Natalia Karasseva, Laura Schulz, and Charlotte Phillips

Osteogenesis imperfecta (OI) is a heritable genetic condition that affects 6-7 people per 100,000 worldwide (OI Foundation). Patients who have OI typically display muscle weakness and skeletal fragility, which persists throughout their lifetime. Current pharmacological treatment, bisphosphonates, can cause undesirable side effects, especially in children. We have focused on strategies that could indirectly improve bone strength through improving muscle mass and strength, such as inhibiting myostatin, a protein in the TGF-β superfamily that negatively regulates muscle mass. In this pilot study, we bred the osteogenesis imperfecta mouse model (*oim*) and transferred the embryos into pseudo-pregnant myostatin deficient mouse model (*mstn*) and *oim* control dams to determine if decreased maternal myostatin would improve the musculature of the offspring. In the adult offspring, we measured the weight of five hind-limb muscles: gastrocnemius, tibialis anterior, plantaris, soleus, and quadriceps. We also measured the contractile generating force and muscle fiber cross sectional area (CSA) of the gastrocnemius and tibialis anterior. Although we observed subtle changes in wet muscle weight and relative muscle weight, we saw greater increases in absolute contractile generating force, contractile generating force relative to muscle weight, contractile generating force relative to CSA, muscle fiber CSA, and muscle fiber CSA relative to muscle weight in adult offspring of *mstn* dams compared to those *oim* dams. Together, these preliminary results suggest myostatin deficiency *in utero* has potential to improve muscle strength and may indirectly improve bone strength of offspring afflicted with osteogenesis imperfecta without some of the side effects that current therapies generate.
Introduction: With concern about childhood obesity over the last decade, increased attention has been given to the amount of SSB consumed by young children. Past research has suggested that dietary practices of parents shape the quality of their child's diet. The purpose of this analysis is to increase our understanding of the relationship between parents' consumption of SSB and their child's consumption of SSB.

Methods: As part of a mixed-methods project on parental collaboration around infant feeding, 24 co-residential biological parents, with children from 6-36 months, were recruited through convenience sampling at two pediatric clinics. The child's mean age was 23.1 months ($SD = 11.4$). Both parents filled out a short survey asking about the frequency with which soda, sports drinks (e.g., Gatorade), 100% fruit juice, and juice drinks (e.g., Sunny Delight) were consumed in their own diet and their child's diet. The scale ranged from 1 – never, 2 – rarely (once a week or less), 3 – sometimes (2-4 times a week), and 4 - daily. Given the exploratory nature, small sample, and number of tests we focus on correlations (Spearman’s rho) with a p-value < .01.

Results: Child’s consumption of juice drinks was associated with mother’s consumption of SSB and there was a strong correlation between mother’s consumption and child’s consumption of fruit juice (Table 1). The only significant correlation for the father, with our criteria, was that father’s consumption of sports drinks was positively associated with child’s consumption of fruit juice (Table 2).

Discussion: The associations between parental SSB consumption and child SSB consumption were more apparent with mothers. This is consistent with previous knowledge that during children’s infancy and toddler years, mothers tend to be the primary managers of food. Limitations include small sample size and limited generalizability.
Weijian Li
Shiyan, China

Senior
Computer Science

Faculty Mentor: Dr. Dong Xu, Computer Science

MU Operations

Weijian Li, Yihan Xu, Jing Su, Ruirui Wang, Yijie Ren, Teodor Ivanov, Tianbo Wang, Hao Mu, and Dong Xu

Our research is a project founded and mentored by MU Operations. The project is called “MU Operations”, which is about reconstructing all of University of Missouri official websites that are out-of-date and connecting them together. Currently the websites being reconstructed are: MU Police, Staff Council, MU Printer Service, Campus Facility, MU Operation, Parking Service, etc. The project aims to be finished by the end of April. We then plan to publish the official sites after a few months of testing.

“MU Operations” is built upon Drupal 8. We use a Content Management System, based on our departments requests. Drupal 8 enables each department to modify content more conveniently and more efficiently based on their needs. We selected Drupal 8 as our Content Management System because it is the newest version of Drupal, so we don’t expect major updates to Drupal in a few years. Thus this promotes efficiency in maintenance towards inexperienced users. Also Drupal has many features that highly simplify our project’s goal. Drupal is designed to handle large websites, which helps us handle around one thousand web pages in total for “MU Operation”. This allows security to be handled on one platform too.
A comprehensive database of protein subcellular localization

Qintai Liu, Xueyan Wu, Yihua Shi, Ning Zhang, and Dong Xu

Most proteins will be trans-located to their appropriate destinations after synthesized in cytosol, meanwhile about half of them would need to go through the targeting process in order to get settled at their correct subcellular locations. Since any mistake in the localization process of proteins might result in metabolic disorders or diseases, correct subcellular localization appears crucial to the maintenance of cell organization and function. The capability of identifying the subcellular localization given any protein has long been a challenge and is especially helpful in the study of the underlying mechanisms of protein targeting.

The goal of this research project is to develop a comprehensive database that stores the subcellular localization information for proteins across species, which is expected to be a valuable resource for biological researchers. The database will be utilized for investigation of the localizations as well as functions of different proteins aiming at different levels of users, by allowing users to perform analysis tasks or searches for detailed information related to a specific protein.

The project also utilized Basic Local Alignment Search Tool (BLAST) and TargetP to predict the subcellular location of eukaryotic proteins. BLAST for Basic Local Alignment Search Tool is an algorithm for comparing primary biological sequence information, such as the amino-acid sequences of different proteins or the nucleotides of DNA sequences. A BLAST search enables a researcher to compare a query sequence with a library or database of sequences, and identify library sequences that resemble the query sequence above a certain threshold. A Module-View-Controller (MVC) architecture is adopted for easier and better maintenance as well.
iTongue: A Combination of Chinese Medicine and Modern Technology

Siyang Liu, Meng Zhang, Chengyi Qu, Houbin Cheng, Yudu Du, Dong Xu, and Ye Duan

iTongue is a cellphone app which employed the Traditional Chinese Medical theory. This app provides a path for users to connect with real TCM doctors. It is convenient for users to discover their own body conditions from the tongue images anytime and anywhere.

The users just need to take a photo of their tongue, and the app would send back the Hot-cold status (not the temperature, but the whole body status based on TCM) including some recommendation lifestyles for reference.

This 2.0 version can be applied not only on iOS, but also the Android system. Currently, we are preparing to publish this 2.0 version on the Apple Store and Google Play. We hope more and more people would focus on the tongues of our own, and then focus more on our body feeling.
Customization of integrative genome viewer for Soybean Knowledge Base (SoyKB)

Xuan Liu and Trupti Joshi

Soybean Knowledge Base (SoyKB) is a comprehensive all-inclusive web resource for soybean. It is designed to handle the storage and integration of the gene, genomics, EST, microarray, transcriptomics, proteomics, metabolomics, pathway and phenotype data. SoyKB team has analyzed resequencing data for 1000+ soybean germplasm lines for SNP and Indel identification and want to provide their users easy ways to visualize the lines and regions of interest. In order to provide users a better visualization and interactive exploration of large, GWAS datasets, we will customize the Integrative Genomics Viewer (IGV) and integrate within SoyKB to achieve that.

IGV supports a wide variety of data types, including array-based and next-generation sequence data, and genomic annotations. Although IGV is often used to view genomic data from public sources, its primary emphasis is to support researchers who wish to visualize and explore their own data sets or those from colleagues. IGV allows users to integrate different data types simultaneously, run it locally on their desktop. To incorporate IGV within SoyKB, we use external control of IGV which creates HTML Links to launch and load data to IGV. Users can visualize a specific region of soybean lines, by choosing lines, chromosome and regions through website user interface. Then SoyKB website would generate a link and direct to IGV by users’ click. In additional, SoyKB also allows users to load multiple lines data into IGV at the same time in just one click.
Design of a non-antibody based test for HIV

Chin Yi Loh, Rich McGhee, Joey O’Brien, Colin Grace, and Mario Pennella

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Phosphorylation of free molecules by evolved RNA enzymes

Melissa Lokugamage, Raghav R. Poudyal, and Donald H. Burke

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Lipopolysaccharide modification of *Yersinia pestis* aids in intracellular survival

Lacey Lopez, Miqdad Dhariwala, and Deborah Anderson

*Yersinia pestis*, the etiological agent of the disease plague, is a zoonotic pathogen which has been the cause for several pandemics throughout history. In its wild-type form, *Y.pestis*, possesses the ability to evade degradation via the phagosome and reside in the *Yersinia* containing vacuole (YCV) of macrophages. Increased survival in macrophages has been shown to aid in the establishment of infection and further development of disease. Inversely, bacterial strains unable to kill macrophages from inside the vacuole provide key insight as to which bacterial components are aiding in intracellular survival. We screened a transposon mutagenesis library to identify genetic variants of the parental strain CO92 pCD1-with decreased cytotoxicity. From this, 59 insertion mutants were recognized to be hypocytotoxic and 14 of the 59 were highly sensitive to the cationic antimicrobial peptide Polymyxin B. Cationic antimicrobial peptides are found within macrophages where they work to control host innate immune defenses in response to infection; therefore, our hypothesis was that sensitivity to Polymyxin B would be associated with decreased bacterial numbers within macrophages. These 14 mutants were then used to infect RAW 264.7 murine macrophages, under typical phagocytosis assay conditions. Thus far, we have successfully identified 3 insertion mutants exhibiting lower amounts of intracellular bacteria when compared to their parental strain. This suggests that these bacteria quickly succumb to the environmental conditions within the macrophage. All of these mutants had interruptions in genes responsible for lipopolysaccharide (LPS) modification. LPS is a cell wall component of Gram-negative bacteria and modification of this component has been linked to evasion of host immune responses and further enhancement of disease progression. Therefore, future studies will examine the hypothesis that LPS modification renders *Y. pestis* resistant to the environmental conditions of phagosomes in both naïve and activated macrophages.
A pilot study of likely crime areas in Mizzou campus using EEG

Wade Lucas and Newton D’Souza

Although there has been a wealth of information about the effect of architecture design on human behavior, new cognitive tools have renewed interest in understanding the emotional aspects of design. This project uses a mind mapping tool using EEG signals to explore emotional responses of people to environmental features. The context of this project is Mizzou campus which has been affected by increased occurrences of crime in the past few years. There is an immediate need to gain insights into environmental crime which has been a major concern at Mizzou and university campuses across the country. For this project we pilot tested two spaces in the Mizzou campus. Crime statistics have shown that East Campus has higher crime rates than West Campus. The hypothesis we tested was that the crime rates on East Campus are higher due to low visual angles/ surveillance, and the issue of spotty lighting.

We used multiple methods to test this hypothesis. First we conducted a detailed documentation of environmental features in these two campuses (tree density, building scale, road width). Then we used a program called Space Syntax which provided us degrees of visibility. The program corroborated our hypothesis in that we found East campus having low degrees of visibility as compared to West Campus. We extended this study into a field experiment. We used a mobile EEG tracker called Neurosky Mindwave as we walked across the campus at night. This provided signals that captured emotional responses of ‘attention’ and ‘meditation.’ Since attention relates to fear and arousal, the hypothesis was that the degree of attention from the user would be higher in East Campus as compared to west campus. We assumed that users will be calmer in low crime areas and hence higher meditation levels. To get more participation, and for safety reasons, instead of having walk alone in the target areas, we extended this study into a lab experiment by using a GOPRO camera to record high quality video of East and West Campus. We ran these two stimuli with volunteers wearing the Neurosky Mindwave. The results of this study is also being analyzed.
Andrew Ludwig
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Faculty Mentor: Dr. Melissa Mitchum, Plant Sciences
Funding Source: Missouri Soybean Merchandising Council and United Soybean Board grants to M.G. Mitchum

**Understanding serine hydroxymethyltransferase function in soybean cyst nematode resistance: A biochemical approach**

Andrew Ludwig, Pramod Kandoth, Amanda Howland, and Melissa Mitchum

Soybean cyst nematode, or SCN, is a parasitic roundworm that infects the roots of soybeans and causes over one billion dollars in yield losses each year. Host resistance is the primary management strategy adopted to combat this pathogen. In soybean cultivar Forrest, serine hydroxymethyltransferase (SHMT) is required for resistance to SCN, but its function in the resistance pathway is poorly understood. The aim of this study is to better characterize the role of SHMT in resistance to SCN through the identification of interacting proteins and an allelic series of SHMT mutants. To identify interacting proteins, SHMT cDNA from a resistant and a susceptible line of soybean were cloned as N-terminal hemagglutinin (HA) tag fusions in binary vectors under the control of the native promoter of SHMT. The constructs were transformed into Agrobacterium rhizogenes and used to generate transgenic soybean hairy roots expressing the SHMT HA-tagged proteins. The transgenic roots are being used in co-immunoprecipitation studies to isolate SHMT protein complexes. SHMT-interacting proteins will be identified by liquid chromatography-tandem mass spectrometry (LC-MS/MS). Identification of proteins that interact with SHMT and any differences in interacting partners between resistant and susceptible version of the protein will aid in our understanding of the function of this enzyme in soybean resistance to SCN. In addition, we are conducting a forward genetic screen of an ethyl methanesulfonate (EMS)-mutagenized population of SCN-resistant soybean to identify mutations in SHMT which can be used to further characterize the function of this enzyme in resistance.
Lithium-ion battery thermal management using solid-state thermoelectric heat pump

Lichao Mai and Chanwoo Park

Lithium-Ion battery became the electrical energy storage technology of choice for hybrid electric vehicles (HEV) and electric vehicles (EV) because of its high energy density. The electrical performance and lifetime of the battery are greatly affected by the thermal management of the internally generated heat in the battery during charging and discharging. Thus, an effective thermal management (cooling and heating) of the battery system within a desirable temperature range (10 ~60°C) is critical to deliver the warranted battery performance and longevity. In this undergraduate honors research, an active battery thermal management system (BTMS) using a solid-state thermoelectric heat pump for Lithium-Ion battery was analyzed using a computational model to investigate its thermal performance under various operating conditions such as thermoelectric voltage, battery heat generation and heat sink temperature. The computational model is capable of calculating the temporal variations of the temperatures of the components (battery and thermoelectric module) of the BTMS. It was found from the simulation results that optimum operating conditions for the thermoelectric heat pump for maximum efficiency (Coefficient of Performance of Cooling, COPc) exist.
Mutagenic potential of 5-hydroxymethyl cytosine (hmC)

Philip Mannino and Kent Gates

Deoxyribonucleic Acid (DNA) serves as the genetic code for all organisms and therefore any damage to DNA has significant biological consequences including the introduction of mutations. In this project, we seek to explain why 5-methylcytosine (5-MeC) residues are mutation hotspots in human genome. 5-methylcytosine can be oxidatively converted to 5-hydroxymethylcytosine (5-hmC) in duplex DNA and we hypothesize that 5-hmC can be selectively covalently modified by aldehydes to form mutagenic lesions. The rationale for this reaction comes from chemical precedents which involve reactions between molecules with very similar functional groups. We will describe the chemical synthesis of the 5-hmC nucleoside and its reactivity towards endogenous and exogenous aldehydes such as formaldehyde, 4-hydroxynonenal, and acetaldehyde. Observation of stable covalent adducts will provide preliminary support for our hypothesis that a reaction of 5-hmC with aldehydes can contribute to mutagenic effects of 5-MeC in genetic material.
Spingosine kinase 2 is critical for suppression of virus-specific T cell proliferation and viral persistence

Tykeemi Manor, Curtis Pritzl, Young-Jin Seo, and Bumsuk Hahm

Research abstract withheld at the request of the faculty mentor for proprietary purposes.

This project was completed to fulfill a Capstone requirement.
Inlet metering project

Levi Manring, Matthew Taylor, and Roger Fales

As undergraduate research assistants, we recently tested an idea related to hydraulic pumps that is rather unique in its fundamental applications. It is common for hydraulic pumps to have control systems composed of actuators and valves to control how the pump behaves, specifically its output flow. The purpose of our testing was to determine the effectiveness of using an area-control valve as the primary control and thus simplify the control scheme for hydraulic pumps.

The principal idea is this: using an area control valve, control flow by closing the area of the inlet to the pump and vaporizing part of the hydraulic fluid. The amount of area we close will determine how much fluid is vaporized. The saturated solution then flows through the pump and is condensed. Before testing was actually started, it was clear that two issues could occur. The first is the issue with getting oil to evaporate, and the possibility that air could come out of solution instead. The second is potential issues with cavitation.

After testing this experiment, it became clear that regardless whether or not the oil was evaporating or air was being taken out of solution, the control mechanism behaved as expected. It is possible that if air was evacuating the solution, that the size of reservoir could become a factor if the oil does not have time to reabsorb air from the atmosphere and continue the cycle. It was determined that cavitation was not a contributing factor to the success of this experiment after careful examination of the pump after disassembly. The test results seem prospective and realistic, but overall efficiencies were at best in the 70-80% range. Slow response check valves on the inlet and outlet of the pistons are the most likely reason for the low efficiencies, and we believe that higher efficiencies could be achieved with a simple redesign of the check valves.
Nargiza Mardanova
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Faculty Mentor: Dr. Laura Schulz, Obstetrics, Gynecology and Women's Health
Funding Source: American Diabetes Association 1-14-BS-181 to L. Schulz

The effects of leptin on hormone sensitive lipase and perilipin A protein activation in adipose tissue of pregnant mice

Nargiza Mardanova, Omonseigho Esangbedo, and Laura Schulz

Research abstract withheld at the request of the faculty mentor for proprietary purposes.

This project was completed to fulfill a Capstone requirement.
Verifying weaknesses in cancer-enabling molecules via atomic force microscopy

Brendan Marsh, Steven R. Van Doren and Gavin King

The tumor-enabling molecule MT1-MMP can destroy our cells’ natural defenses against invading tumor cells. However, biochemists at the University of Missouri theorize that previously unknown states of MT1-MMP exist in which they are vulnerable to attack by pharmaceuticals. If these new states were confirmed, a new way of stopping MT1-MMP and the invasion of healthy cells by tumor cells could exist. Single molecule techniques like atomic force microscopy have emerged as powerful tools for studying molecules such as MT1-MMP in their native conditions with extremely high resolution. In the King Laboratory, the power of atomic force microscopy is combined with new analysis algorithms, leading to new findings regarding MT1-MMP and extending the capabilities of atomic force microscopy.

Combining atomic force microscopy with computer simulations, we identified new states of MT1-MMP. First, new data analysis algorithms were developed to study real images of MT1-MMP produced by an atomic force microscope. These algorithms provide a finer, more detailed description of MT1-MMP that allows us to identify different states of the molecule. Additionally, the known and theoretical states of MT1-MMP were run through computer simulations to provide a reference for the atomic force microscopy data. Comparing real atomic force microscopy data with simulated results, a significant proportion of the MT1-MMP population exists in the newly theorized vulnerable state.

Strong evidence was found to support the existence of a vulnerable state of MT1-MMP, meaning that MT1-MMP is sometimes vulnerable to degradation by prescription pharmaceuticals. Thus a new avenue for stopping MT1-MMP from degrading our cellular defenses has been identified, potentially leading to improvements in cancer treatments, rheumatoid arthritis and other diseases in which MT1-MMP is involved. Beyond pharmaceuticals, the algorithms developed in this study can be generalized for the larger atomic force microscopy community, offering valuable new tools for studying biological molecules.
Auxin Evo-Devo: Reverse genetic approaches to understanding the role of auxin in shoot development

Kiley Marshall, Joseph Struttmann, Qiujie Liu, Diana Roberts Coats, Jacob R. Withee, Simon T. Malcomber, Andrea Gallavotti, and Paula McSteen

The growth hormone, auxin regulates nearly all aspects of plant growth and development. A better understanding of the genes controlling auxin biosynthesis, transport, and perception is therefore fundamentally important to basic plant biology with applications in crop improvement. Previous research has demonstrated both conservation and diversification of the role of auxin in maize and Arabidopsis development. We are using maize vegetative and reproductive development as a model to further understand how auxin regulates development using both forward and reverse genetic approaches.

Phylogenetic analyses of 15 gene families controlling auxin biosynthesis, transport and response illustrates complex relationships amongst monocot and eudicot clades. Reverse genetic analysis has confirmed 85 transposon insertions in 51 genes. Higher order mutant analysis is being guided by both phylogenetic and expression analysis. Results from the vanishing tassel2 (vt2), ZmPIN, ZmTIR/AFB, ZmARF and ZmAux/IAA gene families involved in auxin biosynthesis, transport and perception, respectively will be presented.
Seismic Anisotropy in the Aegean Sea and Eastern Mediterranean Sea

Nicklos Marti, Dylan Lambur, and Eric Sandvol

The subduction of the African Plate beneath the Anatolian plate in the eastern Mediterranean has led to seismically active regions along the Hellenic and Cyprean Arcs. The direction and delay time of the fast and slow polarized waves, interpreted through shear wave splitting, can reflect how the mantle has responded to the retreat of the subducting slabs along the Cyprean and Hellenic arcs. The fast directions help us to determine directions of maximum finite strain in the mantle while the lag times help us to constrain the anisotropic strength and layer thickness. We used the most common approach to measure shear wave splitting that minimizes the corrected tangential component for SKS waves and the second eigenvalue of the covariance matrix for S-waves.

To better understand mantle deformation in convergent plate boundaries, shear wave splitting data was analyzed from stations within the GEOFON, Hellenic, and the Kandilli Observatory seismic networks. Results of our analysis of SKS splitting show a predominant N-S fast polarization direction in the Aegean Sea with delay times at slab stations along the Hellenic Arc significantly greater than those in the back arc. Complexity exists along the eastern Hellenic Arc where the fast direction rotates to a primarily NE-SW orientation with a large range of delay times. This NE-SW anisotropic fabric is seen along the eastern half of the Hellenic Arc system. We observe more complexity along the Cyprean Arc with respect to the anisotropic delay times and more heterogeneous fast directions. Both back arcs in the region show similar results with a general fast polarization direction of N-S and smaller delay times, indicating a thinner layer or weaker anisotropic fabric. Maximum delay times of SKS waves measured at slab stations along both the Hellenic and Cyprean Arcs are approximately the same.
Virtual Achieve Program: Effects of online tutoring

Erin Masek, Lauren Huber, Madison Plunkett, and Stephen Whitney

The Virtual Achieve Program is an online tutoring program between University of Missouri students and an inner city charter school in St. Louis, Missouri. This mixed-method research seeks to determine if online tutoring improves the academic performance of elementary students and to provide program evaluation. Interviews were conducted with MU tutors and 5th grade elementary students who participated in the Virtual Achieve Program. In addition, mathematic standardized gain scores were analyzed for five 5th grade students who participated in the program over the fall semester. All five students participating in the Virtual Achieve Program made gains in their STAR Math scores ranging from 0.2 to 25 months, grade equivalent scores, with an average of 12.4 months in a three month time span. Our interview findings indicated some of the issues with online tutoring included a difficulty in connecting interpersonally and issues with the reliability and effectiveness of the technology. Benefits of the program included; elementary students becoming more confident in their ability to approach math problems, MU tutors gaining experience in developing multiple explanations approaches to teaching and an increase in confidence in their ability to teach. Recommendations to improve the program included starting and ending every session with everyday conversations, utilizing technology that allows screen sharing, increasing the reliability of the technology and having more frequent and shorter tutoring sessions.
Maggie Massey
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Faculty Mentor: Dr. Mike Smith, Animal Science
Funding Source: CAFNR On Campus Research Internship - James Houx Fund

Effect of sexual maturity on early development of parthenogenic porcine embryos

Maggie Massey, Lee Spate, Kevin Wells, and Mike Smith

Oocyte competence has been defined as the ability of an oocyte to resume meiosis, undergo fertilization, and progress through embryonic/fetal development to term. Parthenogenesis can be induced experimentally in mammals; however, mammalian parthenotes will not progress to term. Parthenogenesis is a natural form of reproduction where an embryo can grow and mature without male contribution (fertilization.) Parthenotes are a good model system for examining effects of maternal factors on oocyte competence independent of the mechanisms associated with fertilization. We chose to utilize parthenogenic activation of oocytes to test the hypothesis that sexual maturity can affect the competence of porcine oocytes. The objective was to determine if parthenogenic activation of oocytes collected from prepubertal gilts or mature sows differ in the rate of early embryonic development. Ovaries from prepubertal gilts and mature sows were collected at an abattoir and oocytes were collected by follicular aspiration. Following collection, cumulus-oocyte complexes were placed in maturation media. The maturation rate was 41% and 72% for the oocytes from gilts and sows, respectively. Following selection of matured oocytes they were parthenogenetically activated by electrical activation in medium containing low Ca and then transferred into thimerosol and DTT solutions with hepes washes in-between. Subsequently, they were moved to MU2 embryo culture media. At approximately 48 hours the percentage of oocytes that cleaved were 35% and 87.5% for the gilt and sow oocytes, respectively. The blastocyst rate was 8.3% and 45.7% for gilts and sows, respectively. In conclusion, sexual maturity of the pig may influence the competency of the oocyte to undergo parthenogenic activation. However, these results could be confounded since the gilt and sow oocytes were matured in slightly different media.
The environmental impacts of reducing food waste

Trevion McGhaw and Ronald McGarvey

The proposed project will analyze the impact of current food waste rates, and the potential benefits of future food waste reductions. The goal of this project is to predict future food waste values, set yearly target values for food waste reduction, and provide explanations for how we can reduce the environmental degradation, all while increasing the amount of food available to consumers. This will be done using data provided by The U.S. census, ERS, and State master websites. We will use a modeling software called GAMS (General Algebraic Modeling System) to formulate our problem and analyze the result we receive. We will analyze this problem through the amount of food wasted, amount of land, and amount of greenhouse gases, and nitrogen released per 1 unit of food.
This study examines the relationship between academic engagement and motivation by class and race. The Early Childhood Longitudinal Study (ECLS-K) from National Center for Education Statistics data was used. ECLS-K is a nationally representative sample of students, parents, teachers, and administrators from Kindergarten to 8th grade. The current study utilizes 9,725 students and their teachers in the 3rd and 5th grade. The sample was divided into White, Black, Hispanic, Asian, and Native American and socioeconomic status was divided into quintiles. Within groups multiple linear regressions revealed engagement was a better predictor of reading achievement than motivation. Black and Native American students reported lower engagement, but not lower motivation. Engagement showed a linear relationship with socioeconomic status, but no difference in self-reported motivation was found. The results may indicate that Black and Native American students are equally motivated to read however do not engage in school reading due to a lack of cultural connection with the reading material or the structure of reading within schools. Further research exploring the differences between motivation and engagement within class and race may suggest potential pedagogical changes to increase reading scores for all students.
Biomodulatory hydrogels

Sidney McMillan, Emily Cheng, Mary Josselet, and Bret Ulery

Hydrogels are of great interest for the treatment of osteoporosis due to their potential as non-invasive drug delivery carriers. The hydrogel components can be injected into an osteoporotic fracture site where they will combine to form the water swollen network in situ. Ionic crosslinking is one method that can be used to form hydrogels for which ions can be chosen that have potent biochemical properties. Of particular interest are phosphates which are known to induce bone pro-forming effects. Ionic crosslinking alone, however, has resulted in mechanically weak hydrogels. To mitigate this issue, covalent crosslinking using genipin was carried out and its impact on hydrogel mechanical properties was studied using rheology.

This project focuses on studying the effect phosphate ions and genipin have on chitosan hydrogel crosslinking time and mechanical properties. Chitosan is used as the biopolymer because of its biodegradable and biocompatible characteristics. A number of experiments were conducted varying the concentrations of both phosphate ions and genipin. Using the inversion test, uniform gelation is witnessed around four minutes; however, the hydrogel continues to further gelate over the next twenty-four hours. Rheology was also performed on the crosslinked hydrogels to measure their mechanical properties. This process was repeated with bicarbonate ions, which have no bioactive properties and serve as a control. By determining the effect of phosphate and genipin solutions on crosslinking time and the physical properties of the hydrogels, these parameters can be tuned to produce a range of hydrogels capable of treating a variety of osteoporosis-related injuries including vertebral compression fractures and long bone pathological fractures which require different mechanical properties and gradients of biological repair cues. Also, by changing the bioactive crosslinker used, the hydrogel technology can serve as a regenerative engineering platform in the treatment of post-traumatic osteoarthritis and peripheral nerve damage.
Exploring the Raman emission of Silicalite-1 (MFI), a microporous material

Lydia Mengistu, Alexes Planells, and Heather Hunt

Optical material systems have the opportunity to impact the design, fabrication, and performance metrics of micro- and nano-scale optical devices and systems. Zeolites are nanostructured materials with a crystalline pore structure, which gives them the ability to selectively absorb molecules based on their shape and size. Due to zeolites’ unique relationships among structure and function, they have potentially interesting optical properties that may be leveraged for integrated optical systems. Here, we demonstrate the synthesis of silicalite-1 (MFI) zeolite films via *in situ* crystallization for various synthetic parameters, and characterize their resulting structural and optical properties, including Raman spectroscopy of the calcined samples. We explore the changes in emission based on orientation, thickness and aging time of the crystallized sample. This work demonstrates the Raman spectra of silicalite-1 (MFI) films, which should lead to a better understanding of how to apply these unique material systems to integrated optical devices.
Mackenzie Mertens
Jefferson City, MO

Junior Psychology

Faculty Mentor: Dr. Sara Gable, Nutrition & Exercise Physiology
Funding Source: MU Office of Research, Research Council; The Margaret Flynn Endowment

Integrating physical activity with numeracy in the preschool classroom

Mackenzie Mertens, Alicia Brueggemann, Emily Konecek, Shahrukh Naseer, and Sarah Gable

Poor math achievement and childhood obesity are topics of national concern. If short bouts of physical activity can be integrated with teaching the number knowledge and skills that predict later math proficiency, there is potential to favorably influence short- and long-term numeracy and physical health. The proposed project aimed to determine if physical activity can be integrated with number learning games to improve preschoolers’ number knowledge and counting skills. We hypothesized that integrating an age-appropriate large motor skill, such as jumping, with an evidence-based number board game, would produce improvements in preschoolers’ numeracy outcomes that are at least equivalent to those from sitting to play the game. A pilot study is underway with 28, 3-year-olds from the Columbia Public Schools Title I Preschool Program. After parents gave consent for their child’s participation, preschoolers were pre-tested (fall 2015). Pre-assessments evaluated participant’s non-symbolic quantity discrimination and symbolic knowledge of counting, numerals, ordinality, and cardinality. After pre-testing, children were randomly assigned to one of two intervention conditions: 1) the original seated number board game; and, 2) a number game that is played by jumping on a game board floor mat. The intervention began in January, 3 months after children were pre-tested. Preschoolers in both conditions met individually with the same experimenter for two, 15- to 20-minute game-playing sessions over a two-week period; post-testing occurred one week after the second intervention session. As of March 15, 2016, 24 children will have completed pre-testing, 2 intervention sessions, and the post-test. Data scoring, entry, and analysis are underway. Our hypothesis will be tested with ordinary least squares regression (OLS). If the proposed study shows that preschoolers’ early numeracy is improved by playing a game that integrates jumping, our next step will be to evaluate the impact of the game on children’s moderate-to-vigorous physical activity (MVPA).
The evolution of airport diagrams: improving airfield operations through the development of a safety model

John Perlik, Jeremy Metz, and Carlos Sun

The Federal Aviation Administration (FAA) maintains a set of airport diagrams for America’s airports under its jurisdiction; these diagrams serve as a standard reference material for pilots, as well as airline crews and safety personnel at airports. Contained in these diagrams are figures such as runway length and orientation, taxiway name designation, the location of terminals, and other operational and safety features of the airport. These airports diagrams are updated often by the FAA to account for different airport improvement projects, and the changes in airport diagrams over the last eight years parallel the trends in airport engineering operations and safety. Increasing air traffic creates a demand for more runway facilities in airports. The trends in runway diagrams over eight years show that to be the case, with many examples of new runway construction or existing runway expansion. However, despite the nearly ubiquitous increase in air traffic, some airport diagrams remain largely unchanged; this is often explained by a lack or airport resources, such as land or capital. In many examples of urban airport locations, expansion is simply impossible due to land constraints, or other geographical factors. In these cases, airport expansion is replaced with a more efficient taxiway geometry or NextGen air traffic control improvements. These variables were quantified over eight years in order to be implemented into a safety model; Safety models in airport engineering characterize the effects that these variables have on the safety of airfield operations, and as a result, contribute to ensuring the safest possible operation of an airport.
3D data mapping and real-time experiment control and visualization in brain slices

Michael E. Miller, Marco A. Navarro, Jaime V. K. Hibbard, Tyler W. Nivin, Austin A. Peters, and Lorin S. Milescu

We have designed software that streamlines electrophysiology and imaging experiments in brain slices and enhances data collection and analysis. The experiment is interfaced with a 3D scene viewer, where the rig, the brain slice, and the recorded data are represented to scale. Within this viewer, the user can visualize a live image of the sample and 3D renderings of the recording electrodes, with real-time position feedback. Furthermore, the user can control the instruments and visualize their status in real-time, and can reload previously executed experiments and run simulations. Multiple types of experimental data can be integrated into a spatial and temporal map of the brain slice. These data can consist of low-magnification maps of the entire brain slice, for spatial context, and any other types of high-resolution structural and functional images, together with time-resolved electrical and optical signals. The entire data collection can be visualized within the 3D scene viewer. These ideas can be applied to any other types of experiments where high-resolution data are recorded within a larger sample, at different spatial and temporal coordinates.
Interactive plant phenotype analysis on smartphones

Yuhang Ming, Ke Gao, Tommi White, Michele Warmund, and Filiz Bunyak Ersoy

Mobile handheld devices (such as smartphones and tablets) started to include high-resolution cameras and increasingly powerful processors that enable them to perform image analysis directly on the device. This technology offers promising potential for non-destructive plant phenotype and disease quantification. In this poster, we present our mobile image analysis and quantification app. This app can capture, analyze and quantify plant seed images. Researchers can use the app in the field and upload the images, analysis results, and other sensor data using smartphone's wireless capabilities. The app segments individual seeds within a cluster and calculates shape parameters such as area, perimeter, major and minor axis. Users can manually select/unselect seeds of interest; compute group statistics such as distribution, mean, and standard deviation for computed shape parameters; display the results to the user; and transfer the data to our database. The app is built in Android Studio, programs are written in Java programing language and the interface is in Extensible Markup Language. Additionally, OpenCV library is imported to the app in order to perform efficient image processing.
A systematic review of bullying among students with disabilities

Lindsey Mirielli, June Preast, Anthony Plotner, and Chad Rose

Bullying has become a notable public health concern, especially for youth with disabilities. Over the past several years, scholars have noted the disproportionate representation of students with disabilities within the bullying dynamic. Increasing evidence suggests that students with disabilities are at greater risk for bullying involvement, but the depth to which disability status serves as a risk factor is unknown. Therefore, we systematically evaluate the extant literature to directly address bullying among students with disabilities. Implications and future directions are provided.
Hybrid apps and iOS Research Kit

William Morrison and Yi Shang

Over the last 2 semesters my research has introduced professor Shang’s lab to hybrid and iOS apps through the development of 2 mobile apps.

A hybrid app is an app which can be built once and be made available on both the iOS App Store and the Android Market. I was tasked with researching hybrid apps for my first project. After my research I determined the platform PhoneGap was most appropriate for our lab’s needs. PhoneGap is ideal because it is built on top of Cordova, a massively popular hybrid app platform. PhoneGap not only has all the functionality of Cordova, but it is also easier to use and has great documentation. PhoneGap uses HTML, JavaScript, and CSS as its building blocks. After I researched these hybrid apps, I helped lead a team of graduate students to develop the lab’s first hybrid app. The first hybrid app our lab developed was a bow hunting survey app for the Missouri Department of Conservation.

After I helped build the lab’s first hybrid app I helped build the lab’s first iOS app. The psychology department at the University of Missouri wanted our lab to build an iOS app which utilized Research Kit. Research Kit is an API, or set of tools, Apple gives to its developers to help them make research apps. Research Kit enables scientist to quickly and easily build surveys and other research apps by simplifying the code it takes to develop a User Interface. I familiarized myself with Research Kit, and am currently leading a team of students to build the app for the psychology department. Over the last two semesters I have not only learned a lot about software engineering and new technologies but I have also learned a lot about leading and communicating.
Peptide amphiphile biomaterials

Logan Morton, Julie Nguyen, Rui Zhang, Josiah Smith, and Bret Ulery

Peptide amphiphiles are molecules that contain both hydrophobic and hydrophilic regions (hence, the name “amphiphile”). When these molecules are placed into solution, the hydrophobic and hydrophilic interactions along with intermolecular hydrogen bonding cause the self-assembly of peptide amphiphiles into three-dimensional nanostructures. Through changing the environment (e.g. pH, temperature, solvents, etc.) and selecting a different sequence of amino acids, different three-dimensional nanostructures can be generated. Peptide amphiphiles possess great biocompatibility and can be utilized for many different applications. Peptide amphiphile research conducted in the Biomodulatory Materials Engineering Laboratory (BioMEL) focuses on two general construct types: self-assembled micelles and film deposition. Micelles are fabricated by solubilizing peptide amphiphiles in water which induces interactions between the hydrophobic components to create a nanoparticle core covered by a corona consisting of the hydrophilic components. Currently, BioMEL is studying micelle characteristics in order to make them more suited as a biomaterial-based carrier for vaccines. In addition to micelles, the hydrophobic and hydrophilic domains of peptide amphiphiles can also be used to attach these amphiphiles to other surfaces, creating ordered films. Peptide amphiphile films hold tremendous potential as an inexpensive surface modification and are being specifically studied in the laboratory as antimicrobial coatings for medical products.

One major goal of peptide amphiphile research in BioMEL is to develop micelle design principles so desirable characteristics can be predicted and controlled. By understanding micellar interactions, ideal drug delivery systems can be designed that function as efficacious vaccines. After synthesizing and assessing many peptide amphiphiles by common characterization tools like transmission electron microscopy, circular dichroism, and fluorophore quenching, trends in critical micelle concentration, secondary structure, overall morphology, and stability have been discovered. This research has built a foundation for understanding micellar structure-function relationships that are impacted by several factors including: hydrophobic lipid tail number, linker chemistry, linker location, pH, heat annealing, and peptide sequence. Combining current hypotheses with future work in both in vitro and in vivo studies will allow for the intelligent design of micelles with advantageous physical, chemical, and biological functions.

Peptide amphiphiles can be used to coat surfaces by attaching their hydrophobic tails to a hydrophobic surface. Another major goal of research conducted in BioMEL focuses on studying the antimicrobial capability of peptide coatings applied to endotracheal tubes (ETT). Initial work centers on depositing single layer amphiphile coatings through hydrophobic interactions between amphiphile tails and the ETT surface. Future studies will attempt to determine the optimal peptide concentration needed to convey antimicrobial properties to the surface for which atomic force microscopy will be used to measure the surface distribution of peptide amphiphiles. The end goal of this research aims to provide an inexpensive method to extend the life of endotracheal tubes and keep the patient free of nosocomial (hospital-acquired) infections.
Phosphoglucomutase-1 (PGM1) is a key enzyme in human metabolism that catalyzes the conversion of glucose 1-phosphate and glucose 6-phosphate. Missense mutations causing loss of enzyme function lead to PGM1 deficiency, an inherited metabolic disorder. Affected patients show complex and varying clinical phenotypes, including effects on muscle, liver and heart, as well as endocrine abnormalities. We seek to elucidate a biochemical rationale for these multiple disease phenotypes. Humans have four PGM1 homologs: PGM2, PGM2L1, PGM3, and PGM5. We hypothesize that adaptive changes in the expression of these homologs may compensate, at least in part, for the lack of active enzyme in people with missense variants of PGM1. Compared to PGM1, however, the homologs have not been well studied. Here, we address the multiple cellular homologs of PGM1 using various computational approaches, in order to assess possible functional redundancy between these related enzymes. Using multiple sequence alignments, evolutionary trace analysis, and other computational techniques, we are characterizing similarities and differences among the homologs, including their distributions in the kingdoms of life and divergence during evolution. Transcriptomic and proteomic data from several public databases show profound tissue-specific differences in expression. We are also attempting to correlate homolog-specific amino acid sequence motifs with functional traits, such as substrate specificity. Future directions for the project include recombinant expression and biochemical characterization of these PGM1 homologs.
Faculty Mentor: Dr. Paola Savvidou, Music
Funding Source: A&S Undergraduate Research Mentorship Program

**Movement and wellness training for musicians: A case study report**

Haley Myers and Paola Savvidou

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Ian Naeger
Festus, MO

Faculty Mentor: Dr. Karl Hammond, Chemical Engineering
Funding Source: College of Engineering Undergraduate Research Option

Refinement of visualization of large-scale atomistic simulations of plasma–surface interactions

Ian Naeger and Karl Hammond

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Integrating physical activity with numeracy in the preschool classroom

Shahrukh Naseer, Alicia Brueggemann, Emily Konecek, Mackenzie Mertens, and Sara Gable

Poor math achievement and childhood obesity are topics of national concern. If short bouts of physical activity can be integrated with teaching the number knowledge and skills that predict later math proficiency, there is potential to favorably influence short- and long-term numeracy and physical health. The proposed project aimed to determine if physical activity can be integrated with number learning games to improve preschoolers’ number knowledge and counting skills. We hypothesized that integrating an age-appropriate large motor skill, such as jumping, with an evidence-based number board game, would produce improvements in preschoolers’ numeracy outcomes that are at least equivalent to those from sitting to play the game. A pilot study is underway with 28, 3-year-olds from the Columbia Public Schools Title I Preschool Program. After parents gave consent for their child’s participation, preschoolers were pre-tested (fall 2015). Pre-assessments evaluated participant’s non-symbolic quantity discrimination and symbolic knowledge of counting, numerals, ordinality, and cardinality. After pre-testing, children were randomly assigned to one of two intervention conditions: 1) the original seated number board game; and, 2) a number game that is played by jumping on a game board floor mat. The intervention began in January, 3 months after children were pre-tested. Preschoolers in both conditions met individually with the same experimenter for two, 15- to 20-minute game-playing sessions over a two-week period; post-testing occurred one week after the second intervention session. As of March 15, 2016, 24 children will have completed pre-testing, 2 intervention sessions, and the post-test. Data scoring, entry, and analysis are underway. Our hypothesis will be tested with ordinary least squares regression (OLS). If the proposed study shows that preschoolers’ early numeracy is improved by playing a game that integrates jumping, our next step will be to evaluate the impact of the game on children’s moderate-to-vigorous physical activity (MVPA).
Testing direct repeat containing transgenes as a mechanism for causing chromosome breakage in maize

Transgenes play an important role in genetic engineering. The goal of this project is to utilize a mechanism that uses the Activator/Dissociation (Ac/Ds) transposable element to make chromosome breakage and minichromosome production more predictable. Minichromosome production can serve as a platform to insert new genes on to a chromosome to genetically modify plants. Chromosome breakage depends on how transposase, present in the Activator portion of the transposable element, acts on terminal inverted repeats (TIR) on a transgene. If these TIRs are oriented in opposite direction, transposase will act to transpose the element without breaking the chromosome. For this project, we focus on a transgene containing a Double Dissociation (DrDs) element located on chromosome 4. This DrDs element contains the dominant Su (starchy) allele as well as directly oriented TIRs that, with the presence of Ac, will result in chromosome breakage. We are screening the male, DrDs containing line, via fluorescence in situ hybridization (FISH) to confirm the presence of Ac and DrDs inserts. These will be crossed with female, sugary (su), plants which are responsible for introducing the Ac element. If chromosome breakage occurs in the cross, we expect to observe sugary (su) sectors on the offspring kernels, due to the removal of the starchy (Su) gene. To date, we have found five viable plants to be used to cross.

This project was completed to fulfill a Capstone requirement.
Plants are attacked by a wide variety of herbivorous insects that reduce their ability to survive and reproduce. As a result, plants are equipped with elaborate defense mechanisms that allow them to rapidly identify and respond to their insect attackers. They may make more – or different - chemical defenses in their leaves, some of which are released as volatiles. Plants synthesize a diverse set of volatile chemicals including monoterpenoids, homoterpenes, sesquiterpenes, green leaf volatiles, and benzanoids. In response to insect herbivory, plants release more volatiles that can differ in amount or composition from baseline emissions. These volatiles function as a defense mechanism by attracting predatory insects to the herbivore feeding site and inducing defense responses in adjacent plant parts and even in adjacent plants.

Previous work in our lab has shown that *Arabidopsis thaliana* experiencing feeding by *Pieris rapae* caterpillars releases different volatile profiles than those of undamaged plants. Our lab also recently discovered that plants respond selectively to the vibrations caused by this caterpillar when feeding, even in the absence of the actual caterpillar. Plants experiencing the feeding vibrations produced more chemical defenses in their leaves when subsequently attacked.

In this experiment, we tested whether feeding vibrations caused by *P. rapae* can similarly elicit an increase in volatile release by *A. thaliana*. We captured and measured the amount and variety of compounds emitted using a volatile collection system and GC-MS.
Shing Him Ng
Allen, TX

Faculty Mentor: Dr. Scott Kovaleski, Electrical and Computer Engineering
Funding Source: Mizzou Advantage Undergraduate Research Team

Automation of the phase-contrast x-ray imaging process

Shing Him Ng, Isaac Zachary, and Scott Kovaleski

The study of plant roots has required destructive methods such as excavation in order to perform experimentation. Excavation is time-consuming and the results are frequently inconsistent when comparing different studies. X-ray imaging provides a noninvasive solution that eliminates the various inconsistencies associated with excavation. Phase-contrast x-ray imaging (PCI), a particular modality of x-ray imaging, produces images in which objects of similar densities can be differentiated, an important factor when imaging plant roots in soil. Therefore, it is necessary to create an x-ray imaging system specifically for plant roots. To create a streamlined imaging process, a rastering and rotation system designed to take precisely positioned images used for three-dimensional reconstruction of the plant system was built. A microcontroller handles the output commands, eliminating the possibility for human error while decreasing the imaging time. Thus, we aim to show that by creating a cost-efficient automated imaging process, images can be taken at a faster rate while reducing human error.
Peptide amphiphile biomaterials

Peptide amphiphiles are molecules that contain both hydrophobic and hydrophilic regions (hence, the name “amphiphile”). When these molecules are placed into solution, the hydrophobic and hydrophilic interactions along with intermolecular hydrogen bonding cause the self-assembly of peptide amphiphiles into three-dimensional nanostructures. Through changing the environment (e.g. pH, temperature, solvents, etc.) and selecting a different sequence of amino acids, different three-dimensional nanostructures can be generated. Peptide amphiphiles possess great biocompatibility and can be utilized for many different applications. Peptide amphiphile research conducted in the Biomodulatory Materials Engineering Laboratory (BioMEL) focuses on two general construct types: self-assembled micelles and film deposition. Micelles are fabricated by solubilizing peptide amphiphiles in water which induces interactions between the hydrophobic components to create a nanoparticle core covered by a corona consisting of the hydrophilic components. Currently, BioMEL is studying micelle characteristics in order to make them more suited as a biomaterial-based carrier for vaccines. In addition to micelles, the hydrophobic and hydrophilic domains of peptide amphiphiles can also be used to attach these amphiphiles to other surfaces, creating ordered films. Peptide amphiphile films hold tremendous potential as an inexpensive surface modification and are being specifically studied in the laboratory as antimicrobial coatings for medical products.

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Ideologies supporting capitalist behaviors, institutions, and beliefs have influenced social stratification. Stratification not only continues to guide contemporary social organization, but it also underlies the culture and, consequently, the art produced currently as well as throughout the past century. Thus, literature is a reflection of the cultural locus, reflecting meaning behind signs and symbols. Critical literary analysis of fiction provides a lens through which insight can be gained about American society during the 20th century, and even into the present. I intend to apply this lens to the discourses of 20th century American literature to ultimately uncover the ideologies of elite economic, racial, and sexual control that exist within the works. Rather than critique texts that support capitalism, my focus shall remain on three select works of literary protest: *The Jungle* by Upton Sinclair, *Native Son* by Richard Wright, and *Spartacus* by Howard Fast. As these novels were written with the intent to subvert or foil an aspect of the capitalist, dominant culture, they are all the more suited for identification of oppressive discourses. Additionally, the modes through which the texts have been utilized as commodities can be analyzed for the economic and political effect they have had on society. It follows that a feminist and post-structural literary analysis of oppression within American literature will allow this understanding to be attained. To accomplish this, I will employ *The Dialogic Imagination* by M. M. Bahktin, *History of Sexuality, vol. 1* by Michel Foucault, and *Feminist Theory: From Margin to Center* by bell hooks. Through these theorists, a literary model of the interaction between ideology, culture, and literature, will be synthesized that will fruitfully lead to a traceable trail of capitalism as future culture is outlined, produced, and disseminated.

This project was completed to fulfill a Capstone requirement.
2D VS$_2$-graphene composite anode for sodium-ion batteries

Tyler Nichols, Jinyun Liao, and Yangchuan Xing

Transition metal dichalcogenides (TMDs) like Molybdenum disulfide (MoS$_2$) and Tungsten disulfide (WS$_2$) have been extensively researched in the field of battery applications. The open framework of these TMDs allows the large radii size of Na ions to pass in and out easily, resolving the size problem. In particular, Vanadium disulfide (VS$_2$) has shown promise in being a good candidate for anode material applications as it bears close resemblance to that of MoS$_2$ but retains 2D-nano-sheet sandwich structure morphology, which allows for great intercalation for Na ions. As in this work, the application of graphene to VS$_2$, making it the composite VS$_2$-G, which could significantly improve the capacitance and stability of the battery as it can act as a stabilizing glue to the VS$_2$ nano-sheets. The chemical bond effect in VS$_2$-graphene composite on electrochemical performance will also be investigated.
This World and Others Like It

Drew Nikonowicz and Joe Johnson

*This World and Others Like It* investigates the role of the 21st century explorer by combining computer modeling with analogue photographic processes. Drawing upon the language of 19th Century survey images, I question their relationship with current methods of record making.

Thousands of explorable realities exist through rover and probe based imagery, virtual role-playing, and video game software. Within the contemporary wilderness, robots have replaced photographers as mediators producing images completely dislocated from human experience. This suggests that now the sublime landscape is only accessible through the boundaries of technology.
Tyler Nivin
Arnold, MO

Senior
Computer Science

Faculty Mentor: Dr. Grant Scott, Computer Science
Funding Source: College of Engineering Undergraduate Research Option

Digital curation of satellite imagery training data for deep learning image understanding research

Tyler Nivin and Grant Scott

One actively pursued research area is the usage of deep neural networks to facilitate content-based image retrieval and related image understanding tasks. However, in the satellite imagery domain, there is a staggering shortage of available labelled data suitable for neural network training. Current research has seen some success with using pre-trained neural networks and data augmentation to perform these image understanding tasks, however additional high-quality training data is needed. To this end, my research efforts have been focused on building a tool to automatically collect and catalog satellite imagery data based on information extracted from textual media sources. Using Python and open source libraries I am building a parser which can analyze geospatial information files, such as KML, and use the contained data to acquire images for use in our deep neural networks.
Metabolite of gelatinase inhibitor prodrug attenuates brain damage and improves sensorimotor functions in mouse model of severe TBI

Rasheeq Nizam, Zhenzhou Chen, Brittany Tomlinson, Orr Hadass, Wei Song, Masajiro Ikejiri, María Juárez, Shanyan Chen, Jiankun Cui, Shahriar Mobashery, Mayland Chang, and Zezong Gu

Traumatic brain injury (TBI) is a prevalent condition affecting 1.7 million individuals in the United States. After the initial injury, biochemical processes often lead to a second stage of brain injury that is considered the cause of many neurological dysfunctions. Biochemical, metabolic and cellular changes observed during this secondary injury are often associated with disruption of the blood-brain barrier (BBB), inflammatory responses and infiltration of blood-derived macrophages, edema, and cell death. Studies in our laboratory and others suggest that irregular signaling events seen after a TBI can lead to activation of endopeptidase enzymes called matrix metalloproteinases (MMPs) which can digest the extracellular matrix and tight junction molecules and cause axonal degeneration, resulting in edema, hemorrhage and brain damage. Among the 23 known human MMPs, MMP-9 (gelatinase B) in particular has been correlated with neuroinflammation and white matter damage in the brain. ND-478 is a water-soluble gelatinase inhibitor prodrug which is hydrolyzed into the active MMP-9 inhibitor ND-322. ND-322 is then N-acetylated to ND-364 in the brain and liver. Both ND-322 and ND-364 are capable of crossing the BBB, but only ND-364 achieves therapeutic concentrations in the brain. Thus, we chose to administrate ND-364 at a dose of 28 mg/kg. In this study, we performed a controlled cortical impact TBI model in mice, and subsequently treated them with ND-364 or vehicle injected at 2 and 4 hours after the surgery followed by daily treatment for the next 6 days. Three treatment groups were tested with different routes of administration: (1) subcutaneous injections only; (2) intraperitoneal injection for the first dose, followed by subcutaneous ones; and (3) intraperitoneal injections only. We observed neurological behaviors using beam-walking and a Simple Neuroassessment of Asymmetric imPairment (SNAP) test to evaluate motor, sensory and reflex abilities before surgery, and at 3 and 7 days post-surgery. We then dissected the brains at 7 days post-surgery for coronal sectioning, and stained brain sections with cresyl violet. Microscopic whole-slide image (WSI) analysis revealed that ND-364 was efficacious and significantly reduced cortical lesion percentage in all groups compared to vehicle. ND-364 significantly improved mouse behavior outcomes in groups 1 and 2, but not in group 3. In summary, these findings indicate that selective inhibition of MMP-9 by a second-generation thiirane gelatinase inhibitor is a promising therapy.
Iterative reconstruction of three-dimensional models of human chromosomes from chromosomal contact data

Jackson Nowotny, Sharif Ahmed, Lingfei Xu, Oluwatosin Oluwadare, Hannah Chen, Noelan Hensley, Tuan Trieu, Renzhi Cao, and Jianlin Cheng

The entire collection of human genetic information resides within 23 pairs of chromosomes. These chromosomes have unique 3D structures that control certain genome functions and operations and also contribute to genetic diseases. Therefore, knowing the 3D structures of human chromosomes is important. The general properties of the structure allow for computational modeling. In this study, our research group developed a unique computational approach to construct 3D structures of human chromosomes that will aid in understanding how the genome functions and controls genetic diseases.

Our computational method used a technique known as Growth that built an initial random model. Next, we utilized a technique called Adaptation that randomly altered the model. Then, two optimization algorithms further improved the model's accuracy. Simulated Annealing, the first algorithm, optimized the model through repeated small random changes that found stronger similar solutions. The next optimization algorithm Genetic Algorithm improved the model through natural selection, cross-over, and mutation. Natural selection selected the most accurate models; cross-over merged two potential models; and mutation randomly altered certain parts of the models.

Evaluation of the developed chromosomal structures through scoring functions demonstrated the effective construction from our unique computational approach. In addition, we made comparisons with the competing method Markov chain Monte Carlo 5C (MCMC5C). Our method consistently resulted in higher scores for all chromosomes in comparison to the MCMC5C method. We created a tool to help advance knowledge regarding human chromosome structures, shedding light on important properties of the genome including how it operates and genetic diseases.

Globally, bites from venomous snakes cause a wide variety of health issues, ranging from localized tissue damage to paralysis and death. However, such events are fully preventable with the timely use of anti-venoms. The issue is that the current production of anti-venom is a laborious process causing it to be expensive and in short supply. The goal of the research was to explore a more efficient means of producing an alternative to antivenom, venom inhibitors, which are produced by snakes to prevent their venoms from harming their own cells. A venom and inhibitor combination common to snakes of *Lachesis muta*, a species of pit vipers, was chosen to test the premise. Phospholipase A2 (PLA2) is the toxic enzyme present in the venom that is responsible for disruption of the plasma membrane. To suppress the harmful effects of PLA2, beta-phospholipase inhibitor (βPLI), is expressed to neutralize the toxin. Here we demonstrate the ability to clone both genes into pET expression vectors for recombinant expression in *E. coli*. The project is currently assaying the aptitude of βPLI to inhibit PLA2, *in vitro*, and with positive results could revolutionize the accessibility of treatments to snake bites.
Show-MO carbon storage: An assessment of standing forest carbon by site type in Mid-Missouri

Trevor O’Brien and Benjamin Knapp

Carbon management is an increasingly important objective of foresters and natural resource managers. Understanding the role of carbon storage in forests is important for the mitigation of climate change, and carbon storage has become profitable with the formation of carbon markets. Missouri features a large number of private, absentee land owners, who could benefit from a carbon storage management plan and involvement in a carbon market. This poster looks into the amount of carbon stored across a range of site types at the Basket Wildlife Research and Education Center (BWREC). BWREC features tree species common in eastern deciduous hardwoods. A series of 53 plots, each 1/5 acre plots, was located across different site types at BWREC. In 2005, each tree > 1.5 inches diameter at breast height (DBH) was measured and species was recorded. We published equations to calculate biomass of each tree from DBH and species and converted biomass to estimates of carbon storage. The results presented in this poster are expected to improve the understanding of carbon storage in Missouri for use in a carbon market scheme.
Monitoring factors associated with the risk of herbicide drift

Malynda O’Day, Wyatt Coffman, Mandy Bish, and Kevin Bradley

Agricultural losses in the U.S. due to competition of weeds are estimated at approximately 23 billion dollars annually. Herbicides are chemicals used to control weeds and are estimated to save over 1 billion hours of hand-weeding labor annually in the U.S. Weeds can develop resistance to herbicides that are frequently used and as a result have become problematic in U.S. crop production, particularly in soybean. In the future, two herbicides, 2,4-D and dicamba, which have traditionally been used in corn production, will be available for the first time in 2,4-D- and dicamba-resistant soybean. Historically, 2,4-D and dicamba have been prone to moving from the intended target field to non-target areas, resulting in unintended injury to near-by susceptible crops, gardens, and ornamentals. Availability of 2,4-D- and dicamba-resistant soybean will likely lead to increased use of these herbicides and the increased opportunity for non-target herbicidal injury. This research focuses on monitoring factors associated with the off-target movement of 2,4-D and dicamba. One component of the research is to assess weather patterns known as surface temperature inversions, which are associated with off-target herbicide movement. Little is known about the frequency, duration, and intensity of these inversions; preliminary results from analyzing temperature data indicate these events are common in Missouri during the soybean-growing season. Another component of this research was to survey Missouri pesticide applicators and gain insight into current, real-world pesticide application practices. Preliminary results indicate that most applicators are aware of many but not all factors that contribute to herbicide injury on non-target plants. This research will be useful in the University of Missouri weed science extension efforts to equip herbicide applicators with knowledge to help steward new herbicide technologies.
Analysis of volatile organic compounds released by *Arabidopsis* in response to feeding vibrations

Nicole Odom, William Neer, Chung-Ho Lin, Rex Cocroft, and Heidi Appel

Plants are attacked by a wide variety of herbivorous insects that reduce their ability to survive and reproduce. As a result, plants are equipped with elaborate defense mechanisms that allow them to rapidly identify and respond to their insect attackers. They may make more – or different - chemical defenses in their leaves, some of which are released as volatiles. Plants synthesize a diverse set of volatile chemicals including monoterpenoids, homoterpenes, sesquiterpenes, green leaf volatiles, and benzanoids. In response to insect herbivory, plants release more volatiles that can differ in amount or composition from baseline emissions. These volatiles function as a defense mechanism by attracting predatory insects to the herbivore feeding site and inducing defense responses in adjacent plant parts and even in adjacent plants.

Previous work in our lab has shown that *Arabidopsis thaliana* experiencing feeding by *Pieris rapae* caterpillars releases different volatile profiles than those of undamaged plants. Our lab also recently discovered that plants respond selectively to the vibrations caused by this caterpillar when feeding, even in the absence of the actual caterpillar. Plants experiencing the feeding vibrations produced more chemical defenses in their leaves when subsequently attacked.

In this experiment, we tested whether feeding vibrations caused by *P. rapae* can similarly elicit an increase in volatile release by *A. thaliana*. We captured and measured the amount and variety of compounds emitted using a volatile collection system and GC-MS.
Comparing the virulence effects of the effector proteins HopK1 and AvrRps4 on the Arabidopsis thaliana immune system

Elizabeth Okafor, Morgan Halane, and Walter Gassmann

Similar to other organisms, the plant is exposed to a wide variety of pathogens that can alter its growth patterns leading to cell or plant death. These pathogens introduce effector proteins that increase plant susceptibility to disease by altering the plant immune system. Using Arabidopsis thaliana as our plant model, we are studying the effects of effector proteins AvrRps4 and HopK1 which are secreted by the pathogen Pseudomonas syringae. The literature has demonstrated the N-terminus of AvrRps4 to be essential for virulence in the plant, resulting in a diseased phenotype. Interestingly, little is known about the effector protein HopK1, but sequencing has shown the N-terminus of HopK1 is 75% identical to that of AvrRps4. Surprisingly the C-terminal fragment of the two effectors are distinctly different. We hypothesize hopK1 to have a similar virulence and disease phenotype to that of avrRps4. Currently these constructs of hopK1 (full-length, N-terminus, and C-terminus) are being cloned into a DEX inducible promoter to regulate the expression of the effector protein. Once isolated, the constructs will be introduced into a variety of plant strains ranging in susceptibility by transforming using Agrobacterium tumefaciens. The plants will be analyzed based on severity of disease phenotype, (yellowing of the leaves), bacterial growth assay, and western blotting to determine expression of known plant defense proteins. The results and conclusions of these experiments will be reported upon completion.
Mental illness awareness

Madalynn Olmsted and C. Pazia Mannella

I hope to bring awareness to the importance and prevalence of mental illness in today’s society through the process of making and displaying my artwork. I romanticize mental illness to force my viewers to be immersed in a taboo subject that society tries to ignore. Recently, I have been focusing on the importance of one’s childhood in regards to their adult mental state. I hope to educate the public and reduce the stigmas associated with mental illnesses to promote healthy healing and recovery in today’s stressful world. My artwork takes a critical view of the unimportance placed on good parenting and a stable childhood environment.

In my sculpture, “Nightmare,” I utilize fibers and sculptural processes in order to illustrate the negative side of childhood. Together, the barbed wire pillow, eerie teddy bear, and functionless blanket evoke the feeling of trauma.

My sculpture, “Lost,” is meant to depict a glove lost by a child. This glove represents the process of losing our childhood naivety too early, and the transformation from childhood innocence to a tainted older self. These unfortunate circumstances cause turmoil in a child’s life, causing them to lose their childhood whimsy.

My shrine, “Harmful Home,” contrasts the sense of comfort associated with one’s childhood home with the threat of trauma. There are secrets kept inside, but emotional pain still leaks out into the child’s life.

My book, “Healing,” is a tactile book that documents the healing process of self-harm. Cutting is an unhealthy mechanism that many people develop to cope with mental illness. This book is meant to surprise viewers with its darkness, forcing them to confront tense experiences. “Healing,” is a physical representation of the long lasting emotional pain one can be burdened with for life.
Impact of maternal leptin levels on skeletal bone of adult male and female offspring

Anthony Onuzuruike, Arin Kettle Oestreich, Kathleen A. Pennington, Kelly E. Pollock, Omonseigho Esangbedo, Laura C. Schulz, and Charlotte L. Phillips

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
LPS affected mutants lead to decreased survivability of *Y. pestis* in the flea

Jackson O. Osaghae-Nosa, Miqdad Dhariwala, and Deborah Anderson

*Yersinia pestis*, a Gram-negative rod shaped bacterium, is the causative agent of plague. The bacterium encodes several virulence factors such as an altered Lipid A and no O antigen as part of the lipopolysaccharide. Previously *Y. pestis* strains were randomly mutagenized by transposon Tn5-lacZ to generate a library of 8000 insertion mutants with mutations in various genes throughout the genome of the *Y. pestis* CO92 lineage. These insertion mutants were screened primarily for defects in killing macrophages with the goal to identify bacterial genes required for cytotoxicity. Then further screened for increased sensitivity to Polymyxin B as it might be important to the flea. There is a flea life cycle that has co-evolved with hyper virulence in the mammalian host, which is why we are interested in understanding this relationship and also why we hypothesize that by altering the wildtype LPS synthesis, *Y. pestis* is less able to survive in the flea. During wild-type infection of *X. cheopis* flea, blockage of the flea midgut leads to regurgitation of the bacteria into the wound leading to bubonic infection. Polymyxin B was utilized because it is an antimicrobial peptide produced by the flea to protect against invaders. Four mutants of interest harbor mutations that affect LPS synthesis. LPS contributes to the structural integrity and stability of the outer membrane of gram-negative bacteria. One mutant, EC-51 transfers the second heptose residue to the core oligosaccharide of LPS leading to defects in growth with and without Polymyxin B in liquid broth, and the other mutants behave differently. Our results suggest that these mutations lead to sensitivity to Polymyxin B, however at different capacities depending on the subsequent impact on LPS synthesis. This data suggest that proper formation of LPS may be required for survivability of *Yersinia pestis* in the flea midgut.

This project was completed to fulfill a Capstone requirement.
Transient analysis and transient recovery voltage of a vacuum circuit breaker model during prestrike

Shiyi Pang and Robert O'Connell

In certain power systems, Vacuum Circuit Breakers (VCB’s) may be used to protect circuit components from unwanted transients because they are able to quench high frequency currents. A VCB has many inherent characteristics, some of which are random in nature. A study was done to accurately model and test a VCB on high voltage capacitor banks. Equations that govern VCB behavior, as well as physical VCB parameters, were used in the development of the model. Results of simulations of a realistic scenario will be presented to illustrate model validation.
Horses working in therapeutic riding program: Cortisol and behavior stress indicators

Taryn Parker, Philip Johnson, James Marzoif, Cathy Vogelweid, Jessica Bibbo, and Rebecca Johnson

Therapeutic horseback riding programs have been demonstrated to have many positive outcomes for people, including those with severe physical and mental disabilities, such as military veterans with Post-Traumatic Stress Disorder. With continued growth in the number of horses used for therapeutic riding, it is imperative to consider the stress levels of horses to ensure both health and welfare for the animals. The purpose of this pilot study is to measure the stress levels of horses working in therapeutic horseback riding programs. We hypothesized that the stress levels of horses in these programs should not rise due to an inexperienced rider with disabilities compared to a healthy experienced rider.

The same five horses were used in separate 6-week therapeutic riding classes for a group of military veterans with experienced riders as a control group. Serum cortisol and ACTH levels were the primary stress measurement. The secondary measurement included 2-minute videos of the horses to identify stress behaviors, scored using a nationally standardized equine stress behavior instrument. Both blood samples and video recordings were taken on a resting day, before the lesson, after tacking, and after the lesson on weeks 1, 3 and 6. We expected the stress measurements to show no difference between the experimental and control groups.

Findings demonstrated that horses experienced significantly higher levels of stress with healthy experienced riders. This may be due to expectations that experienced riders imposed on the horses. Growth of these programs, could be potentially beneficial for current horse overpopulation issues.
Improved fluorescence enhancement from nano-structured plasmonic gratings

Samiullah Pathan, Sangho Bok, Aaron Wood, and Shubhra Gangopadhyay

Fluorescence based bio-detection and bio-imaging are two incredibly important tools in the life sciences, however improving the quality and capabilities of these detectors have provided a challenge to industry manufacturers. Nano-structured gratings have immense potential in the above applications as they show significant improvement in the produced electromagnetic field enhancement due to the excitation of surface plasmons.

Recently developed micro-contact printing methods use poly(methylsilsesquioxane) (PMSSQ) as ink for the master mold which is prepared from commercial CD, HD-DVD and Blue-Ray discs. These types of structures have been shown to provide very efficient and extreme light concentration at the nano scale which allows for the excitation of fluorophores in the surrounding environment. Our gratings, which along with being significantly less expensive to produce than traditional lithography techniques, have shown up to 130 times fluorescence enhancement.

To characterize enhancement we use Rhodamine-590 fluorescent dye and compare relative intensity values using the proper microscope and filter. Atomic Force Microscope (AFM) data gave insight into the physical characteristics as well.

This extremely high enhancement points to improved sensitivity and opens the possibility of PMSSQ grating use in bio sensing, plasmonic systems, and many photonic applications.
The influence of temperature on cellular and nuclear size in *H. chrysoscelis*

Karen L. Patterson, Mitchell A. Tucker, and H. Carl Gerhardt

Polyploidy is often associated with novelty and has contributed to the evolutionary history of many organisms; although mechanisms by which it does so are unclear. One possible contributor to phenotypic novelty is the increase in cell size that typically accompanies polyploidy. A previous study investigating phenotypic effects of synthetic polyploidy on treefrog behavior suggested a link between cell size and behavioral change. Polyploid treefrogs were produced from diploid parents; most males produced advertisement-calls with slower pulse-rates than their diploid siblings. However, four polyploid males produced calls with diploid-like pulse-rates and had diploid-like cell size. This suggested that cell size contributed to the slower pulse rates. Cell size is also influenced by a variety of environmental conditions, including temperature. Specifically, development in lower temperatures is often associated with an increase in cell size. In order to assess how developmental temperature influences cell size and treefrog behavior, we raised treefrogs to sexual maturity in three temperature treatments. The cold temperature was set at 18°C, room temperature at 20°C and the warm treatment at 23°C. Using an Olympus Vanox AHBT3 microscope, we measured erythrocytes by examining cellular length and width as well as nuclear length and width as a proxy for global cell size. Large amounts of variation resulted once all data was analyzed together. However, once slides were grouped based on developmental stages at which they were collected, cell size differences were shown to increase with age. Nuclear ratios showed no differences over time between treatments. Future studies will further evaluate cell-size differences across development. The pulse-rate of males’ calls and pulse-rate preferences of females will also be evaluated. This study’s aim is to provide insight about mechanisms by which environmental variation during development and polyploidy can produce phenotypic novelty.

*This project was completed to fulfill a Capstone requirement.*
Faculty Mentors: Dr. James Noble and Dr. Ronald McGarvey, Industrial & Manufacturing Systems Engineering

Funding Source: College of Engineering Undergraduate Research Option

Project SEGway: Global service requirements and spare parts distribution network

Brett Pawlak, R. McGarvey, P. Wutthisirisart, D. Trihastuti, L. Wu, and James Noble

Bayer, a company world renowned for its innovations in the fields of health care and agriculture, is working with the MU Center for Excellence in Logistics and Distribution on a logistics problem concerning their global seed treatment business. Bayer’s CropScience division needed a way to assess different scenarios in order to find the optimal way to distribute spare parts as well as position or send repair technicians. Logically, Bayer wanted to find the best way to do this while prioritizing money and time. It was determined the best way to meet their needs as a company was to develop decision-support tools to assess the overall logistics and supply chain design. In order to do that successfully, data visualization and optimization tools are needed to support the design of a spare part distribution network. This network would consist of DC locations, inventory allocations, repair technician locations, and repair technician allocations. The result will be a set of tools which will support configuration of global service requirements as well as support a spare parts distribution network.
Full characterization of a helical peptide in a lipid bilayer

Ethan Peck, Anahita Zare, and Renee JiJi

It is known that membrane-embedded α-helices are more uniform structurally than their aqueous counterparts. Despite this uniformity, protein dynamics are thought to be common in these proteins in order for them to conduct their cellular tasks. However, how amino acid sequence facilitates these dynamics remains unknown, as methods for investigating structural heterogeneity in transmembrane proteins are limited. Circular dichroism (CD) is often used to characterize the secondary structure of proteins, but its sensitivity to specific non-helical structural configurations is low. Deep-ultraviolet resonance Raman spectroscopy (dUVRR) is a structurally sensitive spectroscopic technique emerging for analyzing membrane protein structure. A set of model leucine-alanine peptides containing the helix breaking residue (HBR) glycine was designed to test its role in promoting helical instability in lipophilic environments. The secondary structure of each peptide was monitored via dUVRR and CD spectroscopies.

This project was completed to fulfill a Capstone requirement.
Gender and masculinity in fraternities: A qualitative analysis about discursive constructions of gender identities

Robert S. Peglow and Astrid Villamil

This qualitative study examines how fraternity men discuss gendered ideals of masculinity, gender equality, feminism, and other gender-related issues. Specifically, this research both highlights the ambiguity surrounding masculinity and labels the common discursive practices used to reproduce the privileges currently found in the fraternal system in order to discuss the ways in which fraternal organizations create, rationalize, and then reproduce discourses around masculinity and gender in general.

The first research question focused around the gendered notion of masculinity and how it was articulated among participants in this study. While the interviewees lacked clear definitions and understandings of masculinity, they possessed a conviction of their own masculinity and relied heavily on stereotypical and shallow masculine tropes and ideals. Through the fraternal culture's unspoken and stereotypical understanding of masculinity, and because of their emphasis placed on maintaining an individual's masculinity, members of the culture produced archaic masculine norms that severely inhibit communication between members.

The second research question examined how fraternity men discursively articulate ideas around gender equality, feminism, and other social problems related to gender. Interviews yielded mostly negative reactions to concepts surrounding feminism and sexual assault, as the respondents tended to downplay the extent and severity of gendered social problems around them. Thematically, the four common tactics employed by the respondents when expressing their opinions were (a) denying the existence of a problem, (b) perpetuating negative connotations around feminism and feminists, (c) using ambiguity to frame ignorance, and (d) resisting responsibility for actions. By employing these four themes, interviewees are able to rely on inherent privileges, found within the culture of their university and the legal system, to create a barrier to resist any potential legal or social repercussions for their actions.

Finally, this study highlights how these gendered notions contribute to dangerous and potentially illegal situations within the fraternal culture and discuss potential solutions. Our research shows that the respondents engage in many dangerous situations that could be avoided with a proper education on the legal definition of rape and sexual assault. By labeling common gendered discourses in the fraternal culture, this research both supports and advances current masculinity research.
Frogs are one of the most diverse and widespread groups of vertebrates with a worldwide distribution of ~6600 species. This diversity gives rise to an array of locomotor behaviors such as swimming, walking, jumping, climbing, and gliding. The nature of the sacro-iliac articulation and the range of motion at this joint in the frog pelvis are posited to correlate with primary locomotor mode in frogs. This may be because the sacrum and pelvis play an integral part in transferring hind limb take-off forces to the frog body as well as to provide a rigid axis upon which the hind limbs can retract just before landing. Previous work has shown that the morphology of the sacrum and the sagittal-hinge movement of the pelvis under the sacrum is different in terrestrial jumping frogs compared to those that walk, hop, swim, or climb. In an effort to understand the roles that pelvic muscles play during jump take-off and landing in terrestrial frogs, we estimated force production capability of a few muscles that attach to the sacrum, ilium, and urostyle with the use of micro-CT imaging and 3D-reconstruction of Southern Leopard Frog (Lithobates sphenocephalus) bones and muscles. This is the first study to model the muscle-forces produced within the frog pelvis. Our results provide the framework for developing future comparisons of the frog-pelvis musculoskeletal system across different pelvic morphologies and locomotor modes.
The evolution of airport diagrams: Improving airfield operations through the development of a safety model

John Perlik, Jeremy Metz, and Carlos Sun

The Federal Aviation Administration (FAA) maintains a set of airport diagrams for America’s airports under its jurisdiction; these diagrams serve as a standard reference material for pilots, as well as airline crews and safety personnel at airports. Contained in these diagrams are figures such as runway length and orientation, taxiway name designation, the location of terminals, and other operational and safety features of the airport. These airports diagrams are updated often by the FAA to account for different airport improvement projects, and the changes in airport diagrams over the last eight years parallel the trends in airport engineering operations and safety. Increasing air traffic creates a demand for more runway facilities in airports. The trends in runway diagrams over eight years show that to be the case, with many examples of new runway construction or existing runway expansion. However, despite the nearly ubiquitous increase in air traffic, some airport diagrams remain largely unchanged; this is often explained by a lack or airport resources, such as land or capital. In many examples of urban airport locations, expansion is simply impossible due to land constraints, or other geographical factors. In these cases, airport expansion is replaced with a more efficient taxiway geometry or NextGen air traffic control improvements. These variables were quantified over eight years in order to be implemented into a safety model; Safety models in airport engineering characterize the effects that these variables have on the safety of airfield operations, and as a result, contribute to ensuring the safest possible operation of an airport.
A large-scale study on the behavior of Palindromic DNA in plant genes

Devin Petersohn, Matt Spencer, Shu-Kai Chang, and Chi-Ren Shyu

Palindromic DNA has many interesting and functional properties, including the ability to form non-canonical DNA structures such as hairpins, cruciforms, and slipped strand structures. Palindromes also serve important roles in binding sites and enzyme activity, and have a strong effect on mutation rates. Even though palindromic DNA is abundant in most genomes, often occurring within coding sequences, in many instances it is still not clear how their presence affects genomic functions. We discuss the preliminary results of a multi-species study on palindromic DNA, focusing on the size, frequency, and distribution of palindromes within genes. Utilizing a Big Data ecosystem enabled us to generate the largest plant palindrome database to date and conduct the largest palindromic DNA study in plants to date. Our study offers new insight into the dynamics of palindromes within gene coding regions and facilitates future investigation.
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Faculty Mentor: Dr. Erin Dannecker, Physical Therapy

Changes in and importance of patient-reported outcomes during long-term therapeutic exercise programs

Rachel Peterson, Pamela Hinton, and Erin Dannecker

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Quantitative gait analysis in a canine model of Duchenne muscular dystrophy

Zachary Pfitzner, Stefan Stover, Gregory Jenkins, John Hu, Chady Hakim, Dongsheng Duan, and Gang Yao

Duchenne muscular dystrophy (DMD) is a muscular disorder that impairs the development of normal muscle tissue throughout the human body, primarily resulting in a visibly uncoordinated and physically exhausting stride in humans. A similar disorder that affects a small percentage of dogs, canine X-linked muscular dystrophy (CXMD), closely mimics the symptoms of Duchenne muscular dystrophy found in humans. Such DMD dogs are important models for testing human DMD therapies.

We investigated in this study whether a wireless motion sensor can be used as a quantitative measure of the abnormal gait in the DMD dogs.

Six dogs were used in this study including three DMD dogs and three control dogs. In each trial, the wireless sensor was securely mounted to a dog's leg. Using Arduino controllers and programming, data from the sensor was sent to a laptop computer where a Matlab-based program was used to examine the data. The dogs were walked at a moderate pace in a straight line over a distance of approximately 10 meters. Video recording was also used to assist the analysis of the canine's gait.

Trials were repeated multiple times, with consistent locations of the sensor across all six dogs. Significant differences in gait pattern were consistently observed between control and DMD dogs when the sensor was mounted close to the front-right paw. The major differences were in the timing of the movement among three orthogonal moving axes. These findings indicate that DMD dogs alter their gait pattern in a consistent and measurable way. The motion sensor can be used to characterize disease progression and monitor therapy outcomes.
Kenya Phillips  
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Faculty Mentor: Dr. Pamela Brown, Biological Sciences  
Funding Source: NIH Initiative for Maximizing Student Diversity (IMSD-EXPRESS)

Using bacteriophages as a biocontrol against crown gall disease of plants

Kenya Phillips, Hedieh Attai, and Pamela Brown

*Agrobacterium tumefaciens* causes crown gall disease, which is dangerous in nursery production of many plants such as stone fruit trees, roses and nuts. Previous biocontrol agents *A. radiobacter* K84 and K1026 have been successful in killing *A. tumefaciens*, but are not effective on all strains of *A. tumefaciens*. Our goal is to search for a better biocontrol by using bacteriophages. We collected 16 water samples from diverse water sources and attempted to isolate phage particles by amplification using *A. tumefaciens* as a host. Out of the 16 samples, 2 had evidence of lytic activity, which we proceeded to characterize. These phages were isolated from plaques that formed in a lawn of *Agrobacterium tumefaciens* strain C58. After phage purification and DNA isolation, restriction digest analysis was conducted to confirm that the phages are unique. To compare the lytic abilities of the new phages, named AP7 and AP8, to the previous phages found in our lab, we did a growth curve and found that AP8 appears to be more lytic than AP7. To further characterize AP7 & AP8, we plan to sequence the phage genomes, and will use transmission electron microscopy to determine the shape and class of the bacteriophages. We plan to conduct specificity testing to determine if the phages kill other strains of *Agrobacterium* and other soil-dwelling bacteria, since an effective biocontrol agent must have a narrow host range. If the phages have a narrow host range, we plan to test the effectiveness of using phage as a biocontrol on plants using a potato disc assay. We expect to find that the phages will kill the *A. tumefaciens* on the potato discs and protect potato discs from infection and tumor formation.
Faculty Mentor: Dr. Hani Salim, Civil & Environmental Engineering
Funding Source: College of Engineering Undergraduate Research Option

Retrofit adobe materials for structural walls

Gabriela Pigg and Hani Salim

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Exploring the Raman emission of Silicalite-1 (MFI), a microporous material

Alexis Planells, Lydia Mengistu, and Heather Hunt

Optical material systems have the opportunity to impact the design, fabrication, and performance metrics of micro- and nano-scale optical devices and systems. Zeolites are nanostructured materials with a crystalline pore structure, which gives them the ability to selectively absorb molecules based on their shape and size. Due to zeolites’ unique relationships among structure and function, they have potentially interesting optical properties that may be leveraged for integrated optical systems. Here, we demonstrate the synthesis of silicalite-1 (MFI) zeolite films via in situ crystallization for various synthetic parameters, and characterize their resulting structural and optical properties, including Raman spectroscopy of the calcined samples. We explore the changes in emission based on orientation, thickness and aging time of the crystallized sample. This work demonstrates the Raman spectra of silicalite-1 (MFI) films, which should lead to a better understanding of how to apply these unique material systems to integrated optical devices.
Virtual Achieve Program: Effects of online tutoring

Madison Plunkett, Lauren Huber, Erin Masek, and Stephen Whitney

The Virtual Achieve Program is an online tutoring program between University of Missouri students and an inner city charter school in St. Louis, Missouri. This mixed-method research seeks to determine if online tutoring improves the academic performance of elementary students and to provide program evaluation. Interviews were conducted with MU tutors and 5th grade elementary students who participated in the Virtual Achieve Program. In addition, mathematic standardized gain scores were analyzed for five 5th grade students who participated in the program over the fall semester. All five students participating in the Virtual Achieve Program made gains in their STAR Math scores ranging from 0.2 to 25 months, grade equivalent scores, with an average of 12.4 months in a three month time span. Our interview findings indicated some of the issues with online tutoring included a difficulty in connecting interpersonally and issues with the reliability and effectiveness of the technology. Benefits of the program included; elementary students becoming more confident in their ability to approach math problems, MU tutors gaining experience in developing multiple explanations approaches to teaching and an increase in confidence in their ability to teach. Recommendations to improve the program included starting and ending every session with everyday conversations, utilizing technology that allows screen sharing, increasing the reliability of the technology and having more frequent and shorter tutoring sessions.
Comparison of human articular cartilage properties in the humeral head of normal and osteoarthritic samples

Andrew Polk, Robert J. Newman, James L. Cook, Matthew J. Smith, Aaron M. Stoker, and Ferris M. Pfeiffer

Osteoarthritis (OA) is a chronic disease characterized by erosion of the protective articular cartilage surface that covers the end of bones. In healthy joints, articular cartilage acts as a smooth lubricated surface which allows the bones to glide over one another with very little friction. In OA patients however, the deterioration in material properties of this tissue can hinder function and serve as a significant source of pain. The purpose of this project is to investigate spatial variation of human humeral head articular cartilage thickness and biomechanical properties (aggregate modulus and permeability) for a range of clinically normal and OA shoulder joints in an effort to better quantify articular cartilage breakdown during early OA.

Articular cartilage thickness was measured across the surface of 9 humeral heads by means of a needle probe test employed at 17 unique locations on each sample. Subsequently, aggregate modulus and permeability were measured at the same locations by means of stress-relaxation testing and Matlab analysis.

The results obtained from this study suggest that there is a predictable natural spatial variation in the material properties of humeral articular cartilage, particularly for samples that would be considered clinically normal. Furthermore, a comparison of these normal samples to those affected by OA, indicate that there may be distinct differences in spatial variation of these properties between diseased and healthy tissue, particularly near the lesion area. Further analysis will be employed to uncover early articular cartilage changes which can be reversible to aid in disease prevention.
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Funding Source: National Science Foundation Grant to S. Kovaleski

Polarization imaging of plasma streamers in liquid

Zachary Porter and Scott Kovaleski

Polarization Imaging can be used to determine the electric field strength and electron density of plasma streamers in various liquids. Plasma is generated from a pin electrode located within an insulated chamber containing a known liquid. Pulsed power, within the range of 10 to 35 kilovolts, is applied to the pin electrode and plasma streamers are produced. The plasma streamer exerts an external electric field onto the liquid which causes polarization dependent changes in the refractive index according to the Kerr effect. Through this effect the induced electric field of the plasma streamer can be determined by measuring the gradient of the refractive index in the liquid. A laser passes through crossed polarizers enabling measurement of the polarization dependent gradient by comparing the beam intensity of the laser after the crossed polarizers to the maximum beam intensity. The diagnostic information about the plasma streamer and liquid interaction is important in various applications ranging from hydrogen reforming for fuel cells to plasma disinfection and treatment of water.
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Faculty Mentor: Dr. Sheila Grant, Bioengineering
Funding Source: Mizzou Advantage Undergraduate Research Team

Ethical Considerations for the Development of Genetic Enhancement

Savannah Pounds and Sheila Grant

Society, especially in America, strives for individuality. As humans, we thrive to be unique. Although we have some control over this individuality in personality and style, a good portion of what makes us unique comes from our DNA. The infamous balance of nature vs. nurture influences our individuality. Micheal J. Sandel in “The Case Against Perfection: Ethics in the Age of Genetic Engineering,” said that the “qualities of children are unpredictable, and here’s a domain of chance where the fact that the domain is governed by chance is morally important.” By taking away the nature aspects of what make up our beings, a portion of unpredictability is abolished. Thus, an ethical question is raised; where do we, as bioengineers, draw the line when using biotechnology for enhancement? This paper introduces important concepts to consider when answering this, such as new technology in this field and its effects on individuality and diversity of a population as well as the evolutionary strain on our species. It’s no question that our species has a strong drive to tamper with the unknown. We seek order on the perceived chaos of nature. It is unsettling for humans to accept the lack of control they have over their fate and the fate of their children. So it is no surprise that we have now tampered enough that today we reach a point where a degree of mastery over the genetic future of our offspring is now in the realm of possibility. With this potential technology in the foreseeable future it becomes important that we implement rules and regulations with ethical considerations now to avoid a human created chaos we try so hard to prevent.
Analysis of transient thermal data

Anna Pozzo and Glenn Washer

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Abyss

Margaret Prather and Jean Parsons

The objective of this project was to design a piece that would be equally artistic as a wearable garment, and also hung on a wall as a piece of art.

In researching objects for inspiration, it was important to the designer to have the overlapping theme of fluidity and movement. In objects that were constantly moving and evolving, one image that came across was an image of an iceberg. This led to the further investigation of the characteristics of icebergs as well as the angles and shapes they provide. In the research, it was found that icebergs are constantly changing. Another intriguing fact about them is the fact that they look one way above the surface of the water, and underneath the surface it is a completely different shape. The shape of the garment is in the shape of an upside down “U”. To create the print for this garment an oil painting was created by the designer. The painting conveyed the blue colors seen in the ocean along with the different colors seen on an iceberg. To make the image more authentic, ice cubes were placed over the painting and melted with a hair dryer, while the designer simultaneously took snapshot pictures of the ice melting over the painting. The ice melting on the painting created different angles and reflections of light that could be taken into Photoshop to make a digital print. This piece is able to be hung on the wall as art, but can also fit to the human body in many different ways, fully conveying my inspiration of the different movements and colors of icebergs. This body of work combines fluidity, geometry, and color in one evolving piece of art.
Using artificial microRNAs to screen for transcription factors mediating iron homeostasis

Samuel Prather and David Mendoza-Cózatl

Plants make up the majority of human diet worldwide; therefore, controlling the nutrient content of plant-based food is of high importance. With global population on the rise, it is critical that we produce enough and nutrition to meet the demand. Essential metals such as iron (Fe) and zinc (Zn) are micronutrients needed for several cellular functions, and without them key metabolic processes in plants, as well as humans, would not be possible. Biofortification is the concept of developing crops of higher nutritional value, and can be done through traditional breeding methods or through transgenic approaches. A precise breeding program could solve problems like anemia, which is caused by a dietary lack of Fe and affects ≈1.62 billion people worldwide. Metal acquisition and storage is a tightly regulated process that includes several cellular components throughout the entire plant. This complexity is required because metals are highly reactive and can easily become toxic. As we begin selecting for enhanced concentrations of trace metals in plant tissues, we require a greater understanding of how plants control and maintain levels of trace metals at optimal non-toxic levels.

One interest of our lab is to identify transcription factors that are involved in the Fe homeostasis network. In this poster I will present a list of genes I’ve identified as putative players in Fe homeostasis. I identified these genes by screening a collection of artificial micro-RNA (amiRNA) mutant Arabidopsis thaliana lines, on metal excessive or deficient medium. And selected the ones with impaired growth thus indicating the genes silenced by the amiRNA had an effect on metal uptake, storage or in use in the plant. These identified genes will lay the ground work for future research that will help our understanding of the intricate pathways that plants use to take up and store essential micronutrients.
Temporal mining on canine veterinary data for outbreak detection

Alexes Presswood, Michael Phinney, and Chi-Ren Shyu

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Cody Price
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Senior
Computer Engineering

Faculty Mentor: Dr. Michela Becchi, Electrical & Computer Engineering
Funding Source: College of Engineering Undergraduate Research Option

GPU power performance analysis of Deep Neural Network parameters through neural network generation and validation

Cody Price, Joshua Walkup, and Michela Becchi

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Filler word use in young school-age children: A preliminary study

Brooke Prigge and Stacy Wagovich

Children and adults use filler words (e.g., “um,” “uh”) frequently in conversation. Clark and Fox Tree (2002) suggested that speakers use these words to signal to the listener that there will be a delay in completing the message. In adults, “uh” tends to signal a shorter delay, and “um” a longer delay. Thus, according to this account, these filler words serve a specific pragmatic function. However, young children may be less aware of their filler use or, if they are aware, may use fillers simply to “buy time” prior to completing an utterance. If young children are using fillers in this way, rather than with specific pragmatic intent, we would not expect a difference in duration between “um” and “uh”. Thus, the purpose of this preliminary study is to examine filler word frequency and duration in young children, across three experimental tasks designed to elicit filler words. Sixteen typically developing children, ages 6;0 to 7;11, participated in the study. All children performed within the average to above average range on language testing and passed a hearing screening. In addition, they completed the following experimental tasks: sentence completion, sentence formulation, and confrontation naming. Research questions for this feasibility study were: (a) Do the tasks result in filler use by the children; (b) How does use of “um” vs. “uh” vary in frequency and duration; and (c) Does frequency of filler use relate to children’s vocabulary and overall language skills? Theoretical and clinical implications will be discussed.
Skeletal muscle in adult mammalian species exhibits the capacity to regenerate to adapt to physiological demands, such as exercise or injury. This is due to a population of progenitor cells known as satellite cells, which reside between the basal lamina and sarcolemma of muscle fibers. These somatic stem cells remain dormant until activated and prompted to migrate to the location of injury and begin differentiating into skeletal muscle. In order to arrive at the target location, invasion of the extracellular matrix (ECM) by satellite cells may be necessary. This is primarily mediated by proteins known as matrix metalloproteases (MMPs) and their endogenous inhibitors, tissue inhibitors of metalloproteinases (TIMPs). In myopathies such as Duchenne’s muscular dystrophy (DMD), myogenesis is not compensatory to atrophy and fibrosis, leading to a gradual loss of muscle function. DMD, the most common form of muscular dystrophy, is an early-onset autosomal recessive disease affecting roughly 1 in 3,600 males. We hypothesized that satellite cells from individuals with muscular dystrophy might show altered invasive capacity due to their prolonged exposure to a fibrotic environment. 23 of the 25 known MMPs, all the TIMPs, as well as nine collagen subunits associated with various myopathies were screened via RT-PCR to try to identify intrinsic differences between human satellite cells from healthy and dystrophic muscle. We have previously shown that MMP-14 is required for invasion by these cells into 3D collagen type I, so we initially measured MMP-14 protein expression by immunocytochemistry in four different dystrophic human satellite cell lines DMD5, KM571 (loss of exon 52), and KM390 (Becker’s Muscular Dystrophy) as compared to healthy human satellite cells, KM155. Each of the four human satellite cell lines assayed exhibited the capacity to invade 3D collagen, with an equal capacity to traffic MMP-14 to their invadopodia. To test for other potential differences in MMP expression and function, conditioned medium from each cell line seeded on top of the 3D collagen type I was collected and analyzed by Western blot and gelatin zymography. Wild type human satellite cells express active and latent MMP-2, and MMP-2 activation is inhibited when MMP-14 expression is reduced via siRNA. Interestingly, DMD5 and KM571 (loss of exon 52), show qualitatively lower levels of active MMP-2 when compared to KM390 (Becker’s Muscular Dystrophy) and KM155. These data support the hypothesis that DMD satellite cell function is indirectly affected by tissue pathology that accompanies the genetic loss of dystrophin, and emphasize the need to better understand satellite cell-ECM interactions in vivo.

This project was completed to fulfill a Capstone requirement.
Heritability of energy storage in *Drosophila melanogaster*

Michael Reed and Elizabeth King

Obesity affects 34.9% of adults in America according to The Journal of the American Medical Association. The two factors that affect this are dietary changes in society, and the genetic predisposition for energy storage, or weight gain. Individuals vary widely in how they respond to different diets. For example, some individuals on a westernized diet accumulate stored lipids while others do not. Our goal is to quantify the proportion of variation in the response to diet that is due to variation in genetic factors, or the heritability. We use *Drosophila melanogaster* as a model system and measure the storage of the macromolecules, total lipids, total carbohydrates, and total protein on multiple different diets. We estimate the heritability in two ways. First, we use a large set of inbred lines to estimate broad sense heritability. Second, we use a half-sibling, split-family breeding design to estimate narrow sense heritability. Our results will inform both the relative importance of genetics and diet in determining energy storage, and will allow us to make predictions about how we expect these traits to evolve in different diet conditions.

*This project was completed to fulfill a Capstone requirement.*
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Senior
Civil Engineering

Faculty Mentors: Dr. Carlos Sun, Dr. Praveen Edara, Dr Henry Brown, Civil & Environmental Engineering
Funding Source: College of Engineering Undergraduate Research Option; University Transportation Centers program of the USDOT

Improving Missouri highway safety via HSM calibration

Erin Reinkemeyer, Kristin Hofstetter, Boris Claros, Amirhossein Khezerzadeh, Praveen Edara, and Carlos Sun

The American Association of State Highway and Transportation Officials (AASHTO) Highway Safety Manual (HSM) is a valuable resource in transportation safety. The HSM provides several empirical methods and processes that are used to predict the frequency and / or severity of a crash. This information is then used to evaluate highway safety. Specifically, the HSM can be used to identify high-crash frequency locations, contributing factors, and potential solutions to correct safety problems. The purpose of this research was to classify crashes in order to calibrate the HSM models to provide more accurate safety analysis and to create a long term calibration process. The calibrations accounted for driver populations, conditions, environments, and local conditions throughout the state of Missouri. Local conditions included, but were not limited to, geometric design, signage, and climate. An iterative process was used to develop the calibration. During the process, predicted crash frequencies determined from the HSM methods were compared with the actual crash frequencies for a location. Data was collected from a total of 11,768 crash reports at 890 randomly selected sites in Missouri. Interchanges from all seven Missouri Department of Transportation (MoDOT) regions were used to develop a variety of geographic sites. The locations included terminal and non-terminal interchanges. Terminal facilities included various designs such as cloverleaf, partial cloverleaf and diamond interchanges. Non-terminal facilities included entrance and exit speed-change lanes and ramps. Three years of crash reports from 2010 to 2012 were categorized based on the physical and functional location of a crash. The physical classification was based off the location where the first physical impact occurred. The functional classification was based on the location where the cause of the crash initiated. The crash locations were then categorized based on facility type, exit or entry, and direction. The three facilities used were speed-change lanes, ramps, and freeway segments. If the crash was not associated with any of the previously listed facilities, but instead was related to the ramp terminal, it was designated with the compass direction relative to the main freeway: north, south, east, and west. Once the crashes were classified, the information was combined to determine the calibration factors for terminals, speed-change lanes, and ramps. A total of 44 calibration values were determined.
Severity of pre-treatment sexual offenses as a moderator of MST-PSB treatment outcomes

Kaley Roberts, Kaitlin M. Sheerin, Elizabeth L. Letourneau, Scott Henggeler, and Charles Borduin

**Purpose:** Multisystemic Therapy for Problem Sexual Behavior (MST-PSB; Borduin, Letourneau, Henggeler, & Swenson, 2009) is a family- and community-based treatment that has been shown to reduce juvenile sexual offending by addressing social-ecological risk factors related to sexual offending (Borduin, Schaeffer, & Heiblum, 2009). Researchers have yet to evaluate the severity of pre-treatment sexual offenses as a moderator of MST-PSB treatment outcomes for juvenile sexual offenders. Data from a recently completed randomized clinical trial of MST-PSB will be used to evaluate the potential moderating effect of sexual offense severity on treatment effectiveness.

**Method:** Males aged 11-17 years (N = 124) with adjudicated sexual offenses were randomized to MST-PSB or treatment as usual (TAU; i.e., cognitive-behavioral group therapy). Outcomes that were assessed at 12 months post-baseline included (a) problem sexual behavior (Adolescent Sexual Behavior Inventory; Friedrich, Lysne, Sims, & Shamos, 2004), (b) youth criminal behavior (Self-Report Delinquency Scale; Elliott, Huizinga, & Ageton, 1985), (c) substance abuse (Personal Experience Inventory; Winters & Henly, 1989) and (d) mental health symptoms (Child Behavior Checklist; Achenbach, 2001).

**Analytic Strategy:** Youth will be divided into two sexual offense severity groups: those who committed assault crimes (i.e., aggravated criminal sexual assault and criminal sexual assault; n = 61), which are more serious, and those who committed less serious sexual crimes (i.e., aggravated criminal sexual abuse and criminal sexual abuse; n = 63). Negative binomial regression analyses will be used to test whether pre-treatment offense severity moderates the relationship between treatment condition and outcome measures.

**Implications:** Results of this study may influence the conceptualization of MST-PSB. Juvenile sexual offenders who commit more severe sexual offenses may need a more intensive course of treatment than other juvenile sexual offenders. Enhancing the effectiveness of MST-PSB could further reduce the social and fiscal costs of juvenile sexual offending to victims and taxpayers.

This project was completed to fulfill a Capstone requirement.
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Faculty Mentor: Dr. James Birchler, Biological Sciences
Funding Source: National Science Foundation grant to J. Birchler

GZ36-1 Mini-Chromosome project

Chandler Robertson, Nathaniel Graham, and James Birchler

Engineered mini-chromosomes could provide a platform for stacking transgenes in crops. Methods of modifying these chromosomes in vivo are essential for the development of systems to add and remove selection genes (Gaeta et al., 2013.) Previous studies have performed telomere-mediated truncations to construct a ‘Minichromosome’, which contains only necessary chromosome components and a transgene. The specific mini-chromosome in this study is derived from a truncated B-chromosome. B-chromosomes are supernumerary chromosomes found in maize that have no necessary genes, and in low copy number, have no phenotypic effect on the plant. In creation of the mini-chromosome in this study a translocation of a piece of the B onto chromosome 1 was discovered. The current project is to determine if this translocated fragment contains the region required for the B accumulation mechanism, and if the mini-chromosome contains an intact transgene. If the accumulation mechanism region has been translocated to chromosome 1 it may be possible to use this chromosome to accumulate mini-chromosomes, which could be used to increase the number of mini-chromosomes without requiring the presence of B chromosomes.

This project was completed to fulfill a Capstone requirement.
Probing the path less traveled by: Elucidating interaction between *Arabidopsis* immune suppressors

Conner Rogan, Christopher Garner, and Walter Gassmann

Plants are constantly exposed to a myriad of potential threats by pests and pathogens, many of which target unique plant structures to gain virulence. Because of this, plants have developed a robust immune system that implements defense proteins and hormone signaling to recognize and appropriately respond to attacks. *SRFR1* is a negative regulator of plant immunity and its role is to prevent hyperactivity of the immune system, which would be deleterious to the plant. Members of the TEOSINTE BRANCHED1/ CYCLOIDEA/PCF (TCP) transcription factor family have been identified as interactors of *SRFR1*, and higher-order *tcp* knock-out plants showed reduced expression of defense genes and were compromised in immunity. Given the interaction between *SRFR1* and TCPs and the contrasting phenotypes of *srfr1* and *tcp* mutants, *SRFR1* is hypothesized to be repressing TCP function.

The four TOPELESS RELATED (TPR1-4) are a family of transcriptional co-repressors that are recruited by transcription factors and associated proteins to the promoters of genes to repress gene transcription. Interestingly, we found that *TPR2* and *TPR3* interact genetically with *SRFR1*, the immune suppressor. A possible explanation of the interaction between these three proteins is that *SRFR1* is regulating TCP suppression via *TPR2*. To further confirm interaction between these proteins bimolecular fluorescence complementation and fluorofusion vectors were made with *TPR2*, *SRFR1* and *TCP8* and *TCP15*. Using agrobacterium-mediated transient expression, *TPR2* was observed to co-localize and interact with both TCPs in the nucleus. While *TPR2* was not found to interact with *SRFR1*, they seemed to co-localize in distinct locations around the cell wall. *TPR2*’s interaction with the two TCPs supports our hypothesis and warrants further study of defense gene expression. While *SRFR1*’s interaction was not as clear, the co-localization is promising for further analyses using alternative methods.

This project was completed to fulfill a Capstone requirement.
Inducible artificial micro-RNAs to investigate functional redundancy in Dynamin-Related Proteins DRP2A and DRP2B in plant growth and endocytosis

Sean W. Rogers, Michelle E. Leslie, and Antje Heese

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Automated oxygen control system for use in the NICU

Dick Ross, Xuefeng Hou, Akram Faqeeh, and Roger Fales

Our research team is developing an automated oxygen control system to help regulate the SpO₂ saturation levels of premature infants. An algorithm was created to replicate the performance specifications currently defined by manual control protocols and is used to track the changing model parameters. The algorithm communicates directly with the physical device to automatically adjust the flow of FiO₂ through nasal cannulas. Nurses’ in the NICU are currently alerted by an alarm system when oxygen levels fall outside of the prescribed SpO₂ ranges, and the goal of our research is to create a device that continuously and optimally adjusts oxygen levels to most effectively combat retinopathy of prematurity. A simulated baby model was used to obtain preliminary data, which was able to demonstrate the feasibility of the device.
Polyphenolic compounds present in American elder flower extracts

Michael A. Rotondi, Michael C. Greenlief, and Paul H. Bruner

Elderberry flowers have been shown to contain flavonoids such as quercetin. Flavonoids are antioxidants which may reduce the risk of cancer and heart disease. This study was undertaken to determine the polyphenolic compounds present in American elder (Sambucus nigra subsp. canadensis) flowers. Fresh elder flowers were cleaned, destemmed, and frozen. Extracts of the flowers were prepared in ethanol and water. The presence of the phenolic compounds was determined using high performance liquid chromatography (HPLC) coupled with mass spectrometry (MS). Data was collected by acquiring 50 Da-wide total ion chromatograms (TIC). The mass spectra of TIC peaks were then identified by matching peak masses with a database of known molecules. A list of flavonoid compounds including quercetin were obtained by method. Additional tests will be run with freeze-dried flower extracts to find potential flavonoids that are typically present in lower concentrations. Tandem mass spectrometry experiments utilizing collision induced dissociation are also planned to help elucidate compound structures.
Design of maintainable drains for earth retaining structures

Ronald Roustio, Kyle Friedman, Eric Koenig, Samuel Runge, and Andrew Boeckmann

Retaining walls and sheet pile walls all across the country have normal PVC drains cut into them to allow the release of excess pore pressures that build up behind the walls due to seasonal weather and water levels. These drains alleviate extra loading on the walls that when not released can cause failure and collapse of the structure. Jet Filter System has revolutionized the drain market with 2-inch, 4-inch, and 6-inch drains that can be post-installed into walls and have filters to keep them working properly. One may ask if all these sizes are necessary and which one would I choose? The focus of this research was to analyze the pore pressure mitigation effects of the drains on a compacted sandy-loam to maximize the efficiency with the size of the drain to see which drain is the most cost-effective to manufacture and produce for the consumer. A model was constructed inside the bed of a dump truck for each drain where soil was compacted into lifts approximately 6 to 10-inches in height with a push roller and tamper until it reached approximately 4.5 feet tall with a slope of 2:1 (Horizontal: Vertical) with water filled behind the soil wall to a height of approximately 4 feet. Probes were placed strategically in each lift to monitor negative pore pressure values throughout the life of the model. Once all of the soil is saturated in the model the probes will all be reading zero and now the test can begin by unblocking the drain and measuring the amount of water put into it and the amount of water that comes out. Once the models are complete for all the different drain sizes a computer program will be used to help determine the most effective drain layout which can be used in future wall designs and how this system compares to the use of traditional PVC weep holes.
A critical component of the avian feeding apparatus is cranial kinesis: the mobility of bones within the skull due to intracranial joints. Key joints include the flat palatobasal joint between the pterygoid and the parabasisphenoid, the condylar otic joint between the quadrate and the braincase, and the saddle-shaped jaw joint that connects the mandible to the quadrate. However, underlying patterns between avian skull function and joint shape, and their significance for ecology and evolution remain largely unknown. Although the cranial musculoskeletal system responsible for cranial kinesis is modestly understood, the ecomorphological patterns of avian cranial joints is poorly known. Gallinaceous birds, including chickens, guineafowl and turkeys vary in size and have diverse diets but feed similarly and have similar skull shapes. Therefore, we expect their cranial joints will only differ relative to size and the forces loading them. To explore this relationship I developed 3D models of a wild turkey (Meleagris gallopavo), and a Helmeted Guineafowl (Numida meleagris), and using computational modeling methods, I quantified joint shape, muscle forces and cranial forces to determine relationships between joint form and function in the complex 3D biomechanical environment of a bird skull. I then compared joint shape data with similarly derived data from chicken (Gallus gallus), and the primitive Screamer duck (Chauna chavaria). This is the first comparative analysis of muscle and joint function within the heads of birds. Data gathered from this study will provide valuable groundwork for further studies in the mechanics and evolution of cranial kinesis in other bird species as well as in their extinct dinosaur ancestors.
Healthcare systems process improvement using NFER technology

Mary Rudy, Brett Watkins, and Jung Hyup Kim

Delay in healthcare delivery is a common patient safety issue in hospitals around the country. Critical care nurses frequently make trade-off decisions between required tasks due to overlapping patient needs or emergency situations. These trade-off decisions could potentially compromise the safety of the patient under the nurse’s care. In order to identify these trade-off decisions that lead to work delays, a time-motion study is utilized within the realm of engineering to analyze workflow data, sequence diagrams, and task breakdowns. However, traditional engineering time-motion study methodologies are challenged by nurses’ workflow complexity and hospital’s dynamic layout. For this reason, a more advanced time-motion tracking device is needed to adequately collect a more accurate time stamp and location data for a larger sample size of nurses. In order to achieve this, the NFER technology will be utilized. NFER technology will provide consistent location data for each nurse so that the research team can collect task data in areas unseen. The nurses being observed will wear a low-frequency AM tag that has constant contact with a triangulation locator set within the nursing unit. These NFER tags will be less disruptive and will solve the limitations that traditional time-motion study collection methodologies create.
Geosynthetic Reinforced Soil (GRS) Integrated Bridge System (IBS) is a bridge construction technology that uses thin layers of coarse aggregate rock reinforced with geosynthetic fabric to develop a stiff composite material capable of supporting loads from small bridges. Use of GRS-IBS eliminates the need for traditional bridge foundations such as spread footings or driven shaft supporting piles (pillars). Elimination of piles simplifies construction, potentially reducing cost up to 60%, and has been shown to prevent the “bump at the end of the bridge” that develops when an abutment settles more than the piles supporting the bridge roadway. Boone County, with support from the Missouri Department of Transportation (MoDOT) and the Federal Highway Administration, recently completed construction of one of the first GRS-IBS bridges in Missouri. Our research involves instrumenting and monitoring this bridge to document its performance. Currently, the GRS-IBS is primarily constructed on small scale bridges and in relatively rural locations. The performance data will provide additional understanding of this design to further improve in harsh conditions and potentially implement on a larger scale as the bridge is one of the first full-scale implementations of the technology. Additionally, a high flood potential and a considerable skew angle make this project site unique.

Bridge performance is being monitored with 3 telltales to measure settlement, 2 inclinometers to measure horizontal displacement, 6 earth pressure cells to measure soil stress, and 9 piezometers to measure pore water pressure. In addition, 24 survey markers installed on the bridge abutment faces will be surveyed routinely as another measure of lateral and vertical movement. Our current measurements provide valuable data regarding the effectiveness of GRS-IBS, particularly with respect to how the technology performs under extreme circumstances. The performance data will help advance implementation of the technology, with potential benefits for deteriorating bridges across the state and country and for cash-strapped departments of transportation that own and operate the bridges.
Pump performance characterization of a variable displacement axial-piston hydraulic pump

Jacob Rusteberg and Roger Fales

In order to successfully create physics based models that are used to optimize the operation of hydraulic systems, it is first necessary to obtain knowledge of how each component of the hydraulic system performs under conditions within the problem domain of the physics based model itself. This necessity is the prompt for a series of experiments that we are currently conducting in which we run an axial-piston hydraulic pump at a range of motor speeds while inducing a range of load pressures that the pump is working against. During the experiment, we will record the values of the pressure of the fluid as it is being discharged from the pump, the pressure of the load that is induced in the system using a pressure relief valve, the flow rate of fluid passing over the relief, the pressure of the control volume of fluid inside the control piston, and the angle of the swash plate inside of the pump. With this data, we will then be able to continue onto analysis to obtain the characteristics of the torque efficiency, the volumetric efficiency, and the overall efficiency and be able to describe them as either a function of the discharge pressure, swash plate angle or the motor speed. The information obtained from these efficiency curves will then be used to help the creation of a sufficient physics based model that would be able to account for the idiosyncrasies of the efficiencies of the variable displacement axial-piston hydraulic pump.
The racial inequality of pay has been an issue in the United States (US) for decades. In 1990, black men made 75 cents to the white dollar. This holds in general and within industries. With large-scale economic and societal impact of the 2008 recession, though, how the racial wage gap looks in more recent years could be drastically different. Therefore research needs to be done regarding the differences in earnings at the intersection of race and occupation around the 2008 recession. As such, we analyze quarterly earnings data from the U.S. Census Bureau’s Longitudinal Employer-Household Dynamics (LEHD) database. Specifically, we consider mean monthly earnings from 2003 to 2014 for combinations of six race categories, two ethnicity categories, and 20 North American Industry Classification System (NAICS) categories. These results indicate that, while wages across groups in general are rising, the gaps between racial groups’ average monthly earnings are widening.
Testing electrochemical microelectrode arrays by examining the effects of reserpine on chromaffin cells

Alexander Salinas, Xin Liu, and Kevin Gillis

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Designing an energy audit process to increase campus building efficiency

Simon Sandler, Chris Wilson, and John Bowders

In 2014, commercial and residential buildings used 41% of the total energy consumed across the US. Certified LEED buildings must show a 5-10% improvement in energy savings when compared to a baseline performance per ASHRE 90.1 standards. The University of Missouri, Columbia is committed to exceeding LEED standards by achieving a 20% energy improvement when renovating existing buildings and constructing new ones. To reduce energy use, save money and lower carbon dioxide emissions in future construction we are designing a process to audit the actual versus modeled energy use of these buildings. The University employs net metering for entire buildings, which limits the information available about energy end-use. The auditing process will use multiple resources to compare a building's actual net energy use against its theoretical use. The theoretical energy use will come from two energy models of the building. One model is derived from ASHRE 90.1 requirements and created by a consulting engineer. The second energy model will be created in house and used to fill in missing elements of the first model. The correlations between the actual and theoretical energy use make it possible to draw conclusions on how to decrease consumption in future buildings through the identification of energy conservation measures.
Thoracic vertebral morphology and locomotor adaptation
anthropoid primates

Blake Sarrazin, Emily Middleton, and Carol Ward

Thoracic shape is related to locomotor adaptation in anthropoid primates. Pronograde quadrupeds tend to have narrow, deep rib cages, whereas those of hominoids tend to be broader mediolaterally. Further, hominoids, especially humans, have the thoracic vertebral column invaginated into the rib cage to support orthograde posture. Humans, and to a lesser extent apes, also exhibit declination of the sternal ends of the ribs. Although the ribs may be the best indicator of overall thoracic shape, they are not well preserved as fossils and are not found in articulation with the vertebral column. However, thoracic form and vertebral invagination should be reflected in orientation of the transverse processes of the thoracic vertebrae, as they articulate with the ribs.

To test this hypothesis, we examined the first, fifth, and ninth thoracic (T1, T5, T9) vertebrae from 168 anthropoids. Landmark data were collected using a Microscribe G2X digitizer and analyzed using Polyworks software (Innovmetric, Inc.). Using this program, planes were fit to the superior surface of the vertebral body and to the median plane. A vector was fit between costovertebral and costotransverse articular facets, and used to measure the angles of dorsal and inferior inclination of the transverse process orientation. Statistical analysis of the data was performed using the R statistical software package.

As predicted, hominoids, in particular humans, have more dorsally inclined transverse processes than monkeys. However, the semisuspensory atelines are similar to hominoids in regards to this feature, suggesting a relationship between suspension and invagination of the thoracic column into the rib cage. Differences are greater in T9 than at T5. Hominoids, including humans, were found to have more horizontally projecting transverse processes than monkeys. For all taxa, the horizontal orientation of the transverse processes decreases from T1 to T9 so that the thoracic vertebrae of the lower rib cage have more inferior oriented transverse processes than those of the upper rib cage. These patterns reflect variation in rib declination among taxa and show that a relatively more superior position of the costotransverse joints contributes to declination of the sternal end of the ribs. Comparing these relationships using in silico models of thoracic shape will further refine our understanding of the geometry of all of these elements together. Overall, our results support our hypothesis that the thoracic transverse processes are able to reflect ventral invagination of the vertebral column into the rib cage and variation in rib declination, and so are a useful indicator of thoracic form in fossil anthropoids.

This project was completed to fulfill a Capstone requirement.
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Faculty Mentor: Dr. Chris Lorson, Veterinary Pathobiology
Funding Source: Grant to Faculty Mentor

An exon-based minimal domain search for the disease-relevant features of SMN

Thalia Sass, Madeline Miller, and Christian Lorson

Spinal Muscular Atrophy (SMA) is a neuromuscular disease that can be classified by the loss of α-motor neurons, resulting in muscle weakness, atrophy, and in some patients death. There are five types of SMA ranging from Type 0, infantile death, to Type 4, adult onset. Deletion of the SMN1 gene is responsible for SMA. While it is clear that SMN1 is the disease-determining gene, the disease-associated function has remained elusive. To this end, my project involves the generation of a series of SMN mutations that lack previously described functional domains. These constructs will be cloned into a viral vector and subsequently delivered to an important mouse model of disease called SMNΔ7. Constructs will be generated through a series of PCR reactions to generate the specific segment of DNA we wish to insert into the scAAV virus. We and others have previously established that full length SMN rescues the mouse model, including life span, weight, gross motor function, and NMJ integrity. We hypothesize that exons, such as Δ2b and Δ3, that disrupt the Tudor domain will fail to rescue the mutant mice, while domains such as the proflin-interaction domain will be dispensable. Collectively, this project provides an in vivo approach to examine SMN functions that relate to SMA development.

This project was completed to fulfill a Capstone requirement.
Patenting fashion: Examining the design work of Marion McCoy, 1938-1944

Allison Satkowski and Jean Parsons

Patents offer significant information for research, and offer insights to the past. One unlikely area that patents can be used to uncover history is the fashion industry. For a short period of time, between 1937 and 1944, the apparel industry rapidly increased the number of garments patented. Many of the designers that filed these patents did so under their own name and not the company name. Because their names were generally not on the label, a study of the patents can offer glimpses of these unsung ready-to-wear designers, and allow their work to be uncovered.

This research focused on one designer, Marion McCoy (1912-1960), who began her career as a designer in the St. Louis junior market. She worked as head designer for Carlye Originations from the company’s formation in 1938 until 1944. During that time she filed 96 dress patents. The purpose of this study was to analyze McCoy’s patents to understand her overall design style, and to analyze changes in the designs before and during World War II.

To organize the study, a data base was developed to break down the components of the designs to quantifiable elements. I then calculated the percentage of dresses where each element was present. Typical elements of McCoy’s designs include full skirts (66%), button closures (80%), crew necklines (60%), and patch pockets (11%). There was a visible shift in design details from before the war to during the war. Marion McCoy’s most distinctive design detail was applique. About one-third (36%) of her patented designs were created with appliques, including flowers, umbrellas, and lobsters. The company filed several lawsuits in an attempt to protect the patented designs, but did not win any of them. The study of these patents offers insight into many as yet not fully researched areas of the apparel industry.
Multi-temporal assessment of rock glacier mass transport in the Spanish Peaks Region, Colorado

Austin Savage, Austin Luecke, and Francisco Gomez

In semi-arid, alpine regions, rock glaciers serve a central role in downslope mass transport. Although not fully understood, rock glacier dynamics are generally regarded to be sensitive to climate variations. This study undertakes a multitemporal assessment of rock glacier movement in the Spanish Peaks of southern Colorado using remote sensing and field-based methods. Specifically, the rates of movement of talus-derived rock glaciers along the flanks of Mt. Mestas are investigated. Methods involve lichenometry (century to millennial time scales), aerial photographs (decadal time scale), satellite radar interferometry (a.k.a. InSAR) (spanning several years), and GPS and ground-based radar interferometry (annual and seasonal time scales). InSAR and aerial photos permit assessing velocities of all rock glaciers on the mountain, and velocities appear to vary with maximum rates of up to 10s of cm/yr. Field investigations focused on two rock glaciers. On one of the rock glaciers, preliminary results of lichenology suggest average flow rates of 8 cm/yr over the past ~2000 years. In contrast, GPS measurements and ground-based radar interferometry spanning one year show that this rock glacier presently moves much slower. A second rock glacier in our study demonstrates much higher rates of movement of up to 1 cm/month during the summer; based on ground-based radar interferometry and GPS measurements. The preliminary results suggest temporal variability of velocity over a short (seasonal) span of time as well as a declining velocity during the Holocene.
Steven Schafer, Kuojiang Li, and C.L. Chen

A series of experiments were performed in order to analyze two different heat sinks. One is a standard parallel plate-fin heat sink, while the other is the same heat sink with a series of airfoil shaped agitators installed. Both heat sinks are used with a fan for forced convection heat transfer. The agitators create periodic eddies and vortices, which enhance mixing between the cold air in the center of the fin channels and the hot air along the fins. The effective heat transfer coefficient of the heat sinks, their corresponding pressure drop, and coefficient of performance, are all analyzed through a series of trade studies. The trade studies aim to determine the effectiveness of the agitators in increasing the thermal performance of the heat sink. An experimental flow visualization setup is also used to aid in visualizing the aerodynamic effects of the agitators. The flow visualization setup is comprised of a commercially available fog machine, a sealable chamber, and a high speed camera. The behavior for each heat sink configuration is noted, and the results are compared with numerical and analytical values.
Bear and deer GPS data analysis

Evan Schaffer, Simiao Sun, Haidong Wang, Nickolas Michael, and Yi Shang

The collection of GPS tracking data for animals has allowed for the manual study of movement and behavior trends over the past two decades. However, when dealing with large amounts of data, this task becomes much more arduous. Rather than follow the traditional models of eyeballing animal stay regions and excursion points, or even hand plotting GPS data to view it in the first place, we are developing a way to try to infer the many Point Of Interest (POI) that these animals visit. Because the data is fairly large, it is not practical to apply the most complex clustering methods due to the amount of time it will take to execute. Also, because the real POIs are unknown, it is impossible to tell if predictions are correct. To solve these non trivial issues, a simulator must be built to simulate animal movement around generated POIs. After this is done, various methods of data reduction or faster running time algorithms will be compared to inspect the accuracy of their predications in the simulated space. The highest accuracy method will be used on our real data sets to calculate both bear and deer POIs in Missouri and we will view these results using GPS based maps to determine what the POIs are and what they infer are the animals’ behaviors.
Planar waveguide light transmission modality for backward-mode photoacoustic tomography

Mason W. Schellenberg, Paul J.D. Whiteside, and Heather K. Hunt

Prior research in photoacoustic tomography has consistently demonstrated its ability to image structures near the surface of tissue with a high degree of optical contrast. However, despite significant advancements in the field, there has been little to no development of clinical applications for photoacoustic tomography, principally due to the requirement for backward-mode operation, i.e., it must detect the photoacoustic signal on the same side of the tissue as the incident laser light. This results in the standard ultrasonic transducer occluding the path of the inciting laser beam. Therefore, developing a technique to deliver light into the tissue, while incorporating commonly available ultrasonic detection equipment without occluding the beam propagation or modifying the equipment in any way, would provide a significant benefit to the field, and potentially improve its clinical applicability. Here, we propose a new method to accomplish this aim, using planar optical waveguides that employ the optical tunneling phenomenon to transmit light directly into tissue (pig skin) through physical contact with the sample. A commercially available, 10MHz, unfocused ultrasonic transducer was positioned on the rear face of the waveguide and was used to detect photoacoustic signals generated within the tissue as the signals propagated perpendicularly through the waveguide substrate. Unlike alternative solutions to the occlusion problem, this modality does not necessitate the use of custom manufactured transducers, expensive dichroics, or additional laser systems, and thereby represents a viable approach for the easy implementation of photoacoustic tomography in a clinical setting.
School-wide positive behavior supports, effective classroom management, school-based interventions for preventing emotional and behavioral disorders

Haley Schemmer, Amanda Hicks, and Barbara Mitchell

The participating elementary school in Jefferson City, Missouri implemented Positive Behavior Supports, which is a schoolwide system. After screening students in participating classrooms for outlier behavior, we observed each participating teacher for fifteen minute time increments. During each observation, we collected data regarding the teacher’s classroom management practices. We documented each time a teacher used positive feedback, negative feedback, general praise, negative then positive feedback, and pre corrects. We also tracked the specific type of instruction that was happening: whole class, one-on-one, peer, or small group instruction. After baseline observations, teachers were instructed upon implementing more use of pre corrects, negative then positive feedback, and positive feedback and less negative feedback and general praise in their classroom. We anticipate that upon evaluating data, as teacher’s professional development and implementation of behavior management increased, the occurrences of student problem behaviors decreased.
Ontogeny of enamel thickness in the teeth of Alligator and significance for Crocodyliform dental evolution

Brianne Schmiegelow, Kaleb C. Sellers, and Casey M. Holliday

Enamel is a key dental tissue responsible for mediating forces which are incurred through biting and feeding, and disparity in enamel thickness among individual teeth as among species can provide important information on diet and feeding behavior. Crocodylians, including Alligator mississippiensis, evolved the highest bite forces among vertebrates, and thus their teeth likely also have adaptations to accommodate these extreme behaviors and loads. Little is known about the ontogenetic and phylogenetic patterns of enamel thicknesses in the teeth of alligators, crocodyliforms and other sauropsids. Characterizing positional and ontogenetic changes in enamel thickness in alligators may reflect their changes in their diet as thicker enamel may be needed to resist increasing bite forces. Moreover, the diversity of extinct crocodyliform teeth suggests significant variation in diet and feeding behaviors indicating enamel thickness may offer key ecomorphological insights into crocodyliform evolution. Mandibular teeth and alveoli from three positions were sampled from a range of different-sized alligators and microCT scanned. Slice data and 3D models were used to measure the enamel thickness, volume, and surface area of the enamel-dentine junction. These data were then complemented by a sample of molariform teeth from fossil crocodyliforms including the durophagous, early Cenozoic Alligatorids Allognathosuchus and Brachychampsa, the herbivorous, Late Cretaceous Iharkutosuchus, and several early Jurassic protosuchian taxa in order to assess variation and potential for ecological signal in the clade. We found the most anterior teeth maintain the thinnest enamel compared to middle and posterior (molar) positions throughout alligator ontogeny. Enamel thickness across all teeth remained consistent relative to head size throughout alligator ontogeny. Comparisons of the molars of fossil crocodyliforms with those from alligators reveal a diversity of enamel thickness and complexity, suggesting phylogenetic as well as ecological signals may be impacting tooth structure, function, and evolution warranting further investigation into the system.

This project was completed to fulfill a Capstone requirement.
An analysis of road signs and markings using the ZouSim bike simulator

Michael Schoelz, Benjamin Shetley, Zhu Qing, Siyang Zhang, Henry Brown, and Carlos Sun

In an effort to make traffic systems more amenable to cyclists, the City of Columbia, Missouri, collaborated with Mizzou to test different wayfinding and signal detection markings. The trials were conducted using the newly constructed ZouSim Bike simulator, which uses a physical bike to input data from a human subject into a virtual scenario created to test the desired criteria. Using ZouSim drastically decreases the costs and safety risks associated with field traffic experimentation. Specifically, ZouSim works by translating the steering, speed and braking of the bike into a digital signal. These inputs are used by the simulation software, Unity, to output a visual display of the subject moving through the virtual testing scenario. The scenario tested subject preferences among three proposed wayfinding systems and five types of detection markings. In each trial, the subject completed three runs of the testing scenario while being videotaped and then filled out a survey regarding their preferences. Simulator data was captured from videos, while stated preference data was extracted from the survey responses. Both simulator and preference results show that the wayfinding system in Proposal 2 and Type 1 detection markings performed best and were most preferred.
How motivation and engagement impact reading standardized test scores

Kara Schrand and Stephen Whitney

Motivation and engagement are central to academic success but little is known about how gender and socioeconomic status differences in reading achievement might be influenced by motivation and engagement in elementary school students. We examined 5th grade reading achievement scores and the possible mediation of reading motivation and school engagement, controlling for 3rd grade reading achievement, reading motivation, and school engagement.

We utilized data from a nationally representative longitudinal data set (ECLS K-8) to examine males and females within five quintiles of socioeconomic status as defined by the census. Of the 15,301 students included in the data set, 7,807 were male and 7,498 were female. We used statistical interpretations to predict missing values to apply the data nationally instead of a focused geographic location. Our results indicated statistically significant differences in school engagement and reading achievement by gender and class. Lower income males had lower levels of school engagement and reading achievement in comparison to most other income groups. Lower income refers to the poverty guidelines in which a family of 4 has a 12-month income of $24,250 or less (this increases with the size of family). Additionally, males had lower levels of school engagement and reading achievement in comparison to females.

Our research detected a mediated relationship between socioeconomic status and reading achievement through reading motivation and classroom engagement. Since a student’s achievement is mediated through these factors, their success in the subject does not solely rely on their school environment. Evidence-based policy implications include an increase in programs to improve male school engagement and male school reading activities. With 100,072 Missouri elementary school students living in poverty, understanding their motivation and engagement can allow for targeted efforts to improve student reading achievement.
Caroline Gershel Davis' fashion piracy and her impacts on the American fashion industry

Collin Schreiber, Danielle Burrage, and Jean Parsons

Leading up to the Nazi occupation of France in 1940, Paris was the spotlight of the fashion world. Home to some of the most influential fashion houses and trendsetters of the time period, Parisian taste was considered the utmost desirable in the industry. This demand for French designs pushed designers around the globe to concoct new ways of pirating these coveted designs. Caroline Gershel Davis was an American designer who systemized fashion piracy and brought hundreds of stolen Parisian designs to the United States by sketching designs from the runway.

Caroline Gershel Davis’ efforts to illegally copy designs speak to an ill that has affected the fashion industry. However, her story goes beyond the effects of fashion piracy. Our findings suggest that the timeline in which Davis was obtaining and mimicking these designs may challenge current conceptions of the fashion industry during World War II.

In order to further our understanding of Caroline Gershel Davis and timeline in which she obtained these sketches, we began comparing Davis’s sketches to fashion publications of the time period, in order to find the original French designs. We were able to uncover exact matches in *Vogue*, *Women’s Wear Daily*, and the *New York Times*. Finding these exact matches allowed us to pinpoint the seasons and year that the majority of Davis’s sketches were based from.

We found that the majority of Davis’s sketches were linked to designs published in spring of 1940. These findings allow us to not only understand the ways in which Americans were accessing “Parisian-inspired” fashion, but also how designs were making their way out of Nazi-occupied France.
Analysis of adsorbed natural gas tank technology

Conrad Schulz, Kolton Speer, Ernie Knight, and Peter Pfeifer

With gasoline being an ever decreasing finite resource and with the desire to reduce humanity’s carbon footprint, there has been an increasing focus on innovation of alternative fuel sources. Natural gas burns cleaner, is more abundant, and conforms to modern engines. However, storing compressed natural gas (CNG) requires large, heavy gas cylinders, which limits space and fuel efficiency. Adsorbed natural gas (ANG) technology allows for much greater fuel storage capacity and the ability to store the gas at a much lower pressure. Thus, ANG tanks are much more flexible in terms of their size, shape, and weight. Our ANG tank employs nanoporous activated carbon as its adsorbent material. This allows it to hold 4.5 times what a tank without carbon would hold at 35 bar. Several different configurations of this Flat Panel Tank Assembly (FPTA) along with a Fuel Extraction System (FES) were examined to compare with the mass flow rate demands of an engine.
Faculty Mentor: Dr. Lane Clarke, Biomedical Sciences
Funding Source: CAFNR On Campus Research Internship - CAFNR Academic Programs Fund

mRNA expression of genes regulating proliferation in the cystic fibrosis intestinal epithelium

Tori Schutz, Ashlee Strubberg, Nancy Walker, Casey Stefanski, and Lane Clarke

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Design and optimization of an ejector pump

Matthew Scott, Bilal Hussain, and A. Sherif El-Gizawy

In this undergraduate research project within the mechanical engineering department, an analytical model describing the behavior of two-phase flow inside ejector pumps is established based on previous work done by Dr. El-Gizawy and his associates. The project also involves the design of experiments using the Taguchi Method for optimization of the pump design. Currently, the optimization of the experimental design, which is used to examine the efficiency of various models of ejector pumps, is being accomplished with the assistance and experience of Bilal Hussain, the graduate assistant involved with the project. Together, we have optimized the system by incorporating new mass flow rate meters that measure the velocity of the flow coming into and leaving the system. By utilizing the capabilities of the new flow meters, we are able to more accurately measure the flow rate, which gives us more accurate, realistic data. It was decided to include clear plastic tubing at the entrance and exit of the ejector pump so that the flow and mixing of the fluid within the system can be observed more effortlessly. Furthermore, the new experimental setup was designed in SolidWorks, a three-dimensional computer aided design package, so that the experiment may be simulated on the computer, which allows for the rapid interpretation, theoretically, of how each new ejector pump design will behave during the experiments. This will save the time, money, and energy it would otherwise require to run experiments on designs that do not improve the overall efficiency of the pumps. Finally, testing has begun on the current designs of the ejector pumps that previous students have optimized, with the goal of obtaining more reliable results due to the more accurate and reliable calibration of the experimental design.
Atypical functions of Eph receptors in Rhabdomyosarcoma

Morgan Seibert, Veronica LaCombe, and Dawn Cornelison

Research abstract withheld at the request of the faculty mentor for proprietary purposes.

This project was completed to fulfill a Capstone requirement.
Florian Seydel
Heroldsbach, Germany

Senior
Physics

Faculty Mentor: Dr. Peter Pfeifer, Physics & Astronomy
Funding Source: UM Award FastTrack-15002C

Enhancing the surface area of graphitic carbon nitride for hydrogen storage

Florian Seydel, Amrit Bal, David Stalla, Andrew Gillespie, Adam Smith, Mark Sweany, Mark Lee, and Peter Pfeifer

Hydrogen is a desirable alternative fuel source for vehicular applications because its full energy cycle produces less pollutants. However, hydrogen must be stored in large, heavy tanks and the storage must be under extremely high pressures. Adsorbent materials, such as nanoporous carbon (NPC), can increase the storage capacity of tanks by storing the gas at lower pressures. This opens up the possibility for more space-efficient tank design with thinner walls. Though NPC materials have a specific surface area ca. 2500 m²/g, they adsorb a low amount at ambient temperatures due to their relatively low binding energy to hydrogen. Therefore, new high binding energy materials need to be characterized. One possible material is graphitic carbon nitride (GCN). Theoretical calculations of the electronic structure suggest that this material has a higher binding energy and an increased surface area due to regular, in-plane voids. Thus, GCN materials may outperform NPC. Initial surface area measurements on bulk GCN showed that the specific surface area is between 5-20 m²/g. In order for GCN to compete with NPC, it is necessary to increase the specific surface area of the GCN. To accomplish this, we attempted to exfoliate the surface using sonication and high energy ball milling. We study the effects of these treatments using analyses of the structure via x-ray diffraction spectroscopy, nitrogen sorption, tunneling electron microscopy, and x-ray photoelectron spectroscopy.
Identifying potential target genes for a future therapeutic molecule in Acute Lymphoblastic Leukemia

Emily Shank and Kristen H. Taylor

Acute lymphoblastic leukemia (ALL) is a hematopoietic stem cell derived cancer, predominantly found in children. ALL is characterized by the accumulation of precursor B-lymphocytes in the bone marrow. Intergenic regulatory regions bound by transcription factors, may lead to the activation or silencing (if the transcription factors recruit repressors) of target genes. The absence of methylation in enhancer regions, allows conformational change, resulting in a loop like interaction with distant promoters, allowing transcriptional activation. Contrarily, hypermethylation can prevent transcription factors from binding to regulatory regions. Differentially methylated regions (DMR) in ALL patients have previously been identified in the laboratory and putative regulatory regions have been identified. Our hypothesis is that the DMR present within intergenic DNA sequence harbor regulatory elements that are misregulated in ALL patients. We have identified 42 hypermethylated putative regulatory regions that are associated with the abnormal expression of nearby target genes. To determine if sequence specific regulatory elements are present within the DMR, the DNA sequence from each DMR was submitted to BLAT to identify other homologous regions in the genome. Of the 42 hypermethylated putative regulatory regions, 37 contained DNA segments homologous to genes. Of the genes with DNA segments homologous to the putative regulatory regions, we found 208 genes to be differentially expressed in ALL. DMR with sequence homology to multiple potential target genes may prove to be effective targets for a future therapeutic molecule.
An RNA-binding complex mediates silencing in fungi

Benjamin S. Shanker, Logan M. Decker, Erin C. Boone, Hua Xiao, and Patrick K. T. Shiu

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
The effects of gender on appetite and eating behaviors in ‘breakfast skipping’ young people

Emily Shaw, Jess Gwin, Steve Douglas, Derik Kincaid, Sabby Reed, Rebecca Shafer, and Heather Leidy

Objective: To examine whether gender alters the appetite, satiety, and food craving responses to consuming a high-protein (HP) vs. normal-protein (NP) breakfast in overweight/obese breakfast-skipping young people.

Methods: Two studies were examined. A retrospective analysis was performed from a previous study in which 57 adolescents (age: 19±1y; BMI: 29.7±4.6kg/m²) completed a 3-month randomized controlled trial. Participants consumed a 350 kcal NP vs. HP breakfast or continued skipping breakfast. Additionally, in an ongoing follow-up study 75 overweight/obese (BMI: 25-34.5kg/m²) adolescents (ages 15-19y) are consuming either a 350 kcal NP vs. HP breakfast or will continue skipping for 4 months. For both studies, daily appetite, satiety, food cravings, and food intake were/are assessed at PRE and POST-study.

Results: Retrospectively, no gender-effects were detected for appetite, satiety, or food cravings. Treatment-by-gender-effects were detected for hunger, desire to eat (DE), and prospective food consumption (PFC). Specifically, daily hunger, DE, and PFC were lower in females vs. males following HP (all, P<0.05), whereas daily DE and PFC were lower in males vs. females following NP (both, P<0.05). Gender-effects were detected for daily food intake. Males consumed more protein (+27±12g) and energy from high fat/high sugar snacks (+967±285kcal) at baseline than females (both, P<0.05). At three months post-study, the males continued to consume more energy from high fat/high sugar snacks (+663±302kcal) than females (P<0.05). Data is being collected for the follow-up study.

Conclusions: Gender influences baseline food choices and alters the appetite and satiety responses to increased dietary protein at breakfast in young people.
The reliability of bridge inspections and ways to improve them

Ivan Shearer and Glenn Washer

The infrastructure across the world is always needing to be inspected and maintained. The standards for a reliable visual inspection is very questionable because of so many factors that can play a part in the effects of a poor inspection. The objective of the research is to evaluate the effects of lighting on visual inspection on bridges and also to discover the different factors that can affect a reliable visual bridge inspection due to personnel or the environment. This study will focus on testing to determine a lighting standard for the visual inspection of bridges for fatigue cracks. Trying to figure out what type of lighting is the best lightening for those micrometer cracks to be found. The study should also examine the color qualities of light, vision qualities of inspectors including color vision and suitable vision tests, and methodologies to test the capabilities of an inspector to detect a crack under different lighting conditions. Through research I’m also going to explore the needs for mid-range/long-range vision testing and lighting to support routine bridge inspection.

I have been given this device, a 12 x 24 inch box, used to test lightning to inspect small cracks. I want to improve the device to see if the size of the device or the setup is affecting the results I collect. I plan to collect quantitative data from several different individuals to see if they will be able to recognize these cracks through different lightning in the box.
An analysis of road signs and markings using the ZouSim Bike Simulator

Benjamin Shetley, Michael Schoelz, Zhu Qing, Siyang Zhang, Henry Brown, and Carlos Sun

In an effort to make traffic systems more amenable to cyclists, the City of Columbia, Missouri, collaborated with Mizzou to test different wayfinding and signal detection markings. The trials were conducted using the newly constructed ZouSim Bike simulator, which uses a physical bike to input data from a human subject into a virtual scenario created to test the desired criteria. Using ZouSim drastically decreases the costs and safety risks associated with field traffic experimentation. Specifically, ZouSim works by translating the steering, speed and braking of the bike into a digital signal. These inputs are used by the simulation software, Unity, to output a visual display of the subject moving though the virtual testing scenario. The scenario tested subject preferences among three proposed wayfinding systems and five types of detection markings. In each trial, the subject completed three runs of the testing scenario while being videotaped and then filled out a survey regarding their preferences. Simulator data was captured from videos, while stated preference data was extracted from the survey responses. Both simulator and preference results show that the wayfinding system in Proposal 2 and Type 1 detection markings performed best and were most preferred.
A comprehensive database of protein subcellular localization

Yihua Shi, Xueyan Wu, Qintai Liu, Ning Zhang, and Dong Xu

Most proteins will be trans-located to their appropriate destinations after synthesized in cytosol, meanwhile about half of them would need to go through the targeting process in order to get settled at their correct subcellular locations. Since any mistake in the localization process of proteins might result in metabolic disorders or diseases, correct subcellular localization appears crucial to the maintenance of cell organization and function. The capability of identifying the subcellular localization given any protein has long been a challenge and is especially helpful in the study of the underlying mechanisms of protein targeting.

The goal of this research project is to develop a comprehensive database that stores the subcellular localization information for proteins across species, which is expected to be a valuable resource for biological researchers. The database will be utilized for investigation of the localizations as well as functions of different proteins aiming at different levels of users, by allowing users to perform analysis tasks or searches for detailed information related to a specific protein.

The project also utilized Basic Local Alignment Search Tool (BLAST) and TargetP to predict the subcellular location of eukaryotic proteins. BLAST for Basic Local Alignment Search Tool is an algorithm for comparing primary biological sequence information, such as the amino-acid sequences of different proteins or the nucleotides of DNA sequences. A BLAST search enables a researcher to compare a query sequence with a library or database of sequences, and identify library sequences that resemble the query sequence above a certain threshold. A Module-View-Controller (MVC) architecture is adopted for easier and better maintenance as well.
Regulation of antimicrobial response by blue-light photoreceptors in *Arabidopsis*

Anthony Shumate, Dan Leuchtman, Walter Gassmann, and Mannie Liscum

Light is required for providing a plant with information about its surrounding environment. While the mechanisms remain unclear, recent studies suggest that light is also necessary to effectively fend off pathogens, and not simply due to energetic needs from photosynthesis. One hypothesis is that plant photoreceptors, known to be involved in sensing changes in the light environment, may regulate pathogen defense in a light-dependent manner. In our research, we examine the potential involvement of blue light photoreceptors, phototropin 1 (phot1) and phototropin 2 (phot2), in *Arabidopsis thaliana* in the defense against model bacterial pathogen *Pseudomonas syringae*. Phototropins mediate several physiological processes such as chloroplast movements, phototropism, and stomatal opening. In this study, we monitored expression of an immune response marker, PR2, following bacterial infection in *Arabidopsis* mutants lacking several components necessary for normal light-signaling. In addition, we quantified bacterial growth in the same mutants throughout the course of the infection. Our results showed that the *phot1-5phot2-1* mutant mounted a significantly weaker and delayed immune response against *Pseudomonas* in correlation with lower levels of PR2 expression as well as higher bacterial growth relative to wild-type. These findings suggest that the phototropins are necessary for a canonical immune response. To further explore this finding, we have also investigated the effects of defense activity on phototropin-mediated responses, namely phototropism and chloroplast movements.
Determining epigenetic modifications causing embryo demise following in utero exposure to endometriosis using a rodent model

Epiphani C. Simmons, Henda Nabli, and Kathy Timms

Endometriosis affects 10% of the female population. Endometriosis is characterized by endometrial tissue growing outside of the uterus, contributing to varying levels of pain and infertility. There is currently no known cure for the disease. Previous work shows first and second generation embryos developing from an endometriosis lineage have altered gene expression in the apoptosis and autophagy pathways associated with cell death. We hypothesize endometriosis is causing DNA methylation of specific genes within developing embryos, leading to their aberrant expression and subsequent demise.

An established surgical model of endometriosis in rats, including suturing uterine tissue (Endo) or sutures only (Control) to the mesenteric arteries, is used to generate a founder (F0) population. Successive generations continue until the F3 generation develops. We collect eight cell stage embryos, a point in development where parental genomes activate, from each generation. These embryos go through a series of reactions leading up to a restriction enzyme cut, COBRA, to determine unusual methylation at the promoter cites of our specified genes.

Overall, breeding and pregnancy rates were lower in Endo versus Control (P<0.05). The qualitative morphological quality of embryos collected from three generations of the Endo lineage was poorer than Controls; the analyses of these data are ongoing. Preliminary processing of ~1ug control liver gDNA from Endo and Control rats shows, as anticipated, no methylation of the 10 selected genes associated with autophagy and apoptosis. As 8 cell stage embryos only have ~ 48 pg gDNA, we begin the difficult task of efficiently amplifying embryo gDNA to generate a sufficient quantity of template before carrying out the COBRA assay.

We report, for the first time, fecundity is reduced across three generations in endometriosis. By identifying epigenetic markers responsible for embryo demise, we can further unravel the disease and create new therapeutic approaches.
Response of Missouri soft red winter wheat to arbuscular mycorrhizal fungi

Logan Simon, Anne McKendry, and Jeanne Mihail

We conducted a study examining the effects of mutualistic arbuscular mycorrhizal soil fungi on four genetically distinct Missouri varieties of soft red winter wheat. Arbuscular mycorrhizae are soil fungi that colonize the roots of host plants, expanding the rhizosphere and increasing the uptake of water and nutrients. In return, the host plant acts as a carbon source for the fungus. Mycorrhizae are naturally occurring in soils, except those that are left fallow, under heavy tillage, or frequently flooded. Commercial formulations of mycorrhizae are available for use in these conditions. Soft red winter is the type of wheat grown in the eastern one-third of the United States, from Missouri east to the Atlantic, and from New York in the north to Georgia in the South. The varieties, Truman, Ernie, Milton, and MO 940317, were evaluated for plant height at maturity, time to heading, foliar nutrient content, fusarium head blight resistance, and final yield. We quantified the responses of the Missouri wheat varieties in the presence of arbuscular mycorrhizae. We did this by growing out our four varieties in two types of growing media, one sterile mix, and one mix containing mycorrhizae. This was repeated over four replications, with four replications of four varieties in two soil conditions. Results from our study will be presented upon, with analysis and conclusions from our research.
Optimization of morpholino modified ASOs targeting repressor element 1 in spinal muscular atrophy mouse model

Madeline Simon, Kyra Florea, Erik Osman, and Chris Lorson

Spinal Muscular Atrophy (SMA) is the second most common autosomal recessive disorder with an incidence of ~1:6000 and a carrier frequency of ~1:35. SMA is caused by the loss of the Survival Motor Neuron (SMN1) gene. However, only in humans a nearly identical copy of SMN1 exists called SMN2. This gene is present in all SMA patients. SMN2 only partially compensates for the lack of SMN1 because SMN2 only produces low full-length levels, while primarily generating an alternatively spliced product that lacks exon 7. This important exon is highly regulated and several intronic regions have been identified that act as splicing repressors. Previously, a regulatory region called Element 1 (E1) was characterized as an inhibitor of SMN2 exon7 inclusion. Our lab developed a morpholino-based anti-sense oligonucleotide (ASO) specifically targeting E1, inhibiting E1’s repression and significantly improving the severe SMA phenotype in SMA mice. To optimize inhibition of E1, we have designed a panel of E1-targeting ASOs that systematically evaluate the entire E1 regulatory element. In this study, we have developed and examined twelve E1 ASO variants to determine the most effective impact on the SMA phenotype. We delivered the ASOs to newborn SMA mice (mSmn^−/−; hSMN2^+/+; SMNΔ7^+/_) via intracerebroventricular (ICV) injection. We observed different degrees of phenotypic differences after delivery of the ASO variants. While many ASOs failed to protect from disease, E1v1.11 dramatically improved all aspects of the SMA phenotype. Based upon this work, molecules that block or inhibit the repressive activity of Element 1 could be envisioned as potential therapies for SMA if they relieve the repression and allow for high levels of full-length SMN expression from the SMN2 gene.
3D nanothermite by solvothermal and chemical reduction of functionalized graphene in direct self-assembly of Aluminium

Brandon Smith and Shubhra Gangopadhyay

Solvo-thermal reduction has been used in the past to develop 3D macrostructure of reduced graphene when it is homogenously dispersed in a hydrocarbon based solvent such as Propylene carbonate (PC) or Dimethylformamide (DMF). The material formed after the reduction is classified as organogel. The objective of this project is to find the highest weight percentage of aluminum (Al) that can bond with Functional Graphene (FG) in a solvothermal reduction. In this experiment we chose to use DMF as the solvent for both FG and Al. The 2 materials were sonicated separately to ensure the FG and Al can easily bond with each other once mixed together. The materials were then combined and sonicated again to form a homogenous mixture. The mixture was placed in an autoclave reactor to begin the reduction process to form pi-pi bonds during reduction. While in the reactor, DMF strips away the oxide groups from both the Al and FG allowing for the two to bind together. The homogenous mixed macro-structure of FG and Al was formed as a small cylindrical disk in the Teflon chamber. The sample was then dried in a vacuum chamber to remove the remaining DMF and tested for structure strength and reactivity.
The effects of collision avoidance technology on driving behavior

Jackson Smith, Alain Chen, and Jung Hyup Kim

Thousands of car accidents happen every year due to lack of attention. To help combat this, many companies have created devices using collision avoidance technology (CAT). The issue is, “how effective are these devices?” A predetermined route through many different road terrains, such as an interstate, a highway, and a college campus was developed to help test these devices. The route also contains many events, for example lane changes, to create instances where a CAT device may go off. This project is testing the Garmin NuviCam LMTHD, Audiovox LDWS100, Mobileye 560, and Safedrive RD 140. These devices provide alerts for forward collision and lane departure warnings. The effectiveness of these devices are measured through EMG (electromyography) muscle strength data, eye tracking glasses, and reaction times. The route takes about twenty minutes to complete, each session includes 4 trials, one control and three with warnings on. Each device will have at least 5 participants.
In a disaster situation, communication and coordination between first responders and incident commanders is imperative. In today’s world, this vital aspect is often overlooked, leading to mis-triage and morbidity. In cases such as the 2011 Joplin Tornado where infrastructure is destroyed, it becomes extremely difficult to both triage a large volume of patients and allocate supplies properly. Furthermore, the current technology used in emergency scenarios has become outdated, as radios and paper triage tags are no longer as effective in these situations.

Our research presents a solution to these situations. Over the past two years, our lab has been working on Panacea’s Cloud, a platform for communicating and coordinating in disaster situations. Panacea’s Cloud provides first responders and incident commanders with real-time information about the current situation at hand, allowing for proper instruction and planning. This infrastructure-independent platform is comprised of an Intelligent Dashboard, heads-up displays, and Internet of Things technologies. First Responders can utilize heads-up displays, such as the Recon Jet or Google Glass, to send live video streams of the current situation to the Intelligent Dashboard, allowing the incident responder at the hospital to effectively coordinate. Additionally, Panacea’s Cloud’s Intelligent Dashboard contains real-time mapping capabilities, along with patient and first responder profiles, providing the incident commander with the locations of first responders and the locations and statuses of patients in the field. This GPS tracking is conducted through the use of Virtual Beacons and heads-up displays. By providing incident commanders with an abundance of information, we strive to provide emergency services with an effective platform to utilize during these dire situations. Our goal is to present a technology that allows for better triage, coordination, and communication among all emergency services involved.
Retirement patterns in city council members

Emma Smoczynski and Marvin Overby

A major part of our countries government resides on the local level. City Councils are often some of the most important yet overlooked governing bodies in the US today. Because of the sheer number of cities over the entire United States, one would assume that there would be exponential amount of research done on their functioning, however the main conclusions that have come from this research state that cities have little power and no larger authority. The research explained here goes into detail about five specific city councils and looks at the retirement patterns of their members (post 1960).

Similar research has been done looking at the retirement patterns of most other federal and state elected offices, however because of the vast differences of city councils all over the country, there are other factors that must be taken into account. These differences include, population, size of council, term length, partisanship, and salary. With different characteristics present in each city council make-up, there will be more of an overall check on commonalities between the cities rather than one overarching finding.

This project was completed to fulfill a Capstone requirement.
Visualizing collagen structures through a fluorescence-enhancing nano-platform

Octavio Sosa, Biyan Chen, Sheila Grant, and Shubhra Gangopadhyay

Collagen type I is the most abundant element of the extracellular matrix and yet much remains unknown about its self-assembling properties. Fully understanding the assembly dynamics will influence our ability to treat collagen-related disorders and advance the biological affinity of implantable devices and tissue engineering scaffolds. Using a fluorescence microscope and a fluorescence-enhancing nano-platform our goal is to visualize collagen self-assembly at high-resolution. The nano-platform is composed of periodic silver gratings and nano-gaps. Light is directed onto the gratings and absorbed by the electrons in the silver, thereby creating an electromagnetic field confined to within a few hundred nanometers. The electromagnetic field amplifies the signal of the fluorescent dye within collagen fibers, allowing us to identify structures beyond the capability of a standalone microscope system. Before proceeding with the visualization of the self-assembly process, visibility of fixed collagen structures must be optimized. By comparing the visual enhancements provided by glass and grating substrates we found that, indeed, the nano-gratings were significantly effective at enhancing the signal of the collagen structures. We were also able to improve the optical resolution of our images by recreating the point spread function of our microscope and utilizing it to perform image deconvolution. Through various other image processing techniques the details of the structures became highly visible. Recreating the in-situ environment of collagen, initiating native growth of its structures and decreasing the time-span from sample preparation to the point of imaging are challenges we still face before achieving visualization of the self-assembly process. Optimizing the nano-platform for live imaging of collagen will not only improve our understanding of the assembly dynamics but will also open doors to live imaging of any biological function through a readily available microscope or even a smartphone. The implications are vast and multi-dimensional.
Biomechanics of the avian feeding apparatus

Anthony Spates, Ian Cost, Kaleb Sellers, Kevin Middleton, and Casey Holliday

Avian musculature resultants and force have not been accurately mapped in 3D space through the evolutionary history of birds. Here we discuss forces and muscle resultants throughout the lineage of avian skull and jaw musculature evolution with an ostrich, a hawk, and a chicken. These changes are explored through anatomical dissection methods, 3D models and computational approaches. These data allow us to visualize muscle homoplasy, the loading environment, and cranial architecture. In particular, we explore the non-homologous temporal muscles, the palatal pterygoid muscles, and the novel musculature in the derived parrots as we trace the evolutionary change.

Using microCT data, we made 3D models by segmenting the data using Avizo 9 software. 3D models were imported into Strand7 where muscle attachments were painted onto the model. Dissections were used to verify muscle anatomy. In Strand, we are getting the resultant vectors from muscle orientation in 3D models. We are plotted orientations on ternary diagrams to compare muscle orientation across taxa. Data from the four taxa will allow us to understand evolution of homologous jaw muscles over time and see trends of reorientation of muscle. We discovered evolutionary convergence in orientation, position, and function of non-homologous muscles mPSTs and mAMEP. Protractor muscles of birds have significantly large fore-aft components reflecting their kinetic capacities. We see differences in resultant forces/vectors and function of homologous muscles. In conclusion, hawk and chicken have more dexterous feeding behaviors when compared to ostrich. We can use these data to infer changes in behavioral ecology and track how ecological patterns influence the changes in muscles across taxa. Additional analyses using different joint axes and comparisons with other birds will expand our understanding of biomechanics of the head.

This project was completed to fulfill a Capstone requirement.
Kolton Speer
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Faculty Mentor: Dr. Peter Pfeifer, Physics & Astronomy
Funding Source: MU Physics, RIF Pfeifer; MU Campus Augmenting Student Hires (CASH) Program

**Analysis of adsorbed natural gas tank technology**

Kolton Speer, Conrad Schulz, Ernie Knight, and Peter Pfeifer

With gasoline being an ever decreasing finite resource and with the desire to reduce humanity’s carbon footprint, there has been an increasing focus on innovation of alternative fuel sources. Natural gas burns cleaner, is more abundant, and conforms to modern engines. However, storing compressed natural gas (CNG) requires large, heavy gas cylinders, which limits space and fuel efficiency. Adsorbed natural gas (ANG) technology allows for much greater fuel storage capacity and the ability to store the gas at a much lower pressure. Thus, ANG tanks are much more flexible in terms of their size, shape, and weight. Our ANG tank employs nanoporous activated carbon as its adsorbent material. This allows it to hold 4.5 times what a tank without carbon would hold at 35 bar. Several different configurations of this Flat Panel Tank Assembly (FPTA) along with a Fuel Extraction System (FES) were examined to compare with the mass flow rate demands of an engine.
Allison Spence
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Science and Agricultural Journalism

Faculty Mentor: Dr. Sharon Wood Turley, Science and Agricultural Journalism
Funding Source: CAFNR On Campus Research Internship - Dudley & Virgie Alexander Scholarship

The media’s influence on scientific issues related to agriculture

Allison Spence, Amanda Bowling, and Sharon Wood Turley

Research shows there is a gap in knowledge about scientific issues related to agriculture between agriculturalists and the general public. The public receives most of its news about scientific topics such as genetically modified organisms from the media. Primarily, this study investigates whether the media can influence public opinion, attitudes and beliefs about genetically modified organisms. A set of three diverse groups with varied levels of agricultural knowledge was purposely selected to participate in the experiment. Approximately one week after completing an online pretest, the researcher met with study participants and presented them with one of two interventions they were randomly assigned to: a Q-and-A style article from USA today or a video clip from the Discover Chanel that showed a youthful news announcer explaining GMOs in a balanced way. Participants then completed the survey again to see if the information presented led to a change in their understanding, beliefs or attitudes. Results of this research may help to close the gap in understanding between the general public and agriculturists on this topic and other topics on which there is scientific consensus, yet little public acceptance.
The influence of social context on complex calling in meadow katydids

Montrai Spikes, Nathan Harness, and Johannes Schul

In acoustic insects, males often produce signals that attract potential mates and repel potential competitors. Male meadow katydids in the genera *Orchelimum* and *Conocephalus* produce complex acoustic signals, consisting of two phrases, buzzes and ticks, which differ in pulse rate. The function of these two call components has not been well studied. This complexity could be the result of specific call components being more intensely shaped by either female preference or male-male interactions. I hypothesize that the male katydids adjust the ratio of ticks to buzzes in their calls in response to the context of their audience. I recorded males of *O. vulgare* within three different social context: in the presence of a female, within a group of males, and as a control in isolation. Males tend to increase the number of ticks within a call in the presence of a rival males. Conversely, the presence of a female did not significantly affect the proportion of ticks to buzzes when compared to the control. These results suggest that the number of ticks within a call is important in male-male interaction and less significant in female preference. Further experiments are currently being conducted in order to address whether this trait is conserved in related species and what is being communicated when the call components are adjusted.

This project was completed to fulfill a Capstone requirement.
Teaching the past to look towards the future: Teaching with counter narrative pedagogy

Caitlin Steward, Julia Hickcox, and Lenny Sanchez

With the increase of globalization, schools are pressed with greater responsibility to prepare students to know how to live in a culturally diverse and interdependent world. This includes supporting students knowing how to solve real-world problems and participate in dialogue that improves the human condition both locally and globally. The project utilizes counter narrative pedagogy to inspire fifth grade students to analyze multiple perspectives of historical events, develop historical empathy towards the past, and increase civic mindedness for the present and future. Using student interviews, curriculum analysis, and classroom observations, we examined how elementary school children developed sociocritical perspectives of history through social studies learning in their classroom. This qualitative research study occurred in two fifth grade classrooms and focused on the students, their social studies teacher, the school’s media specialist, and a university researcher. This study has important implications for teachers as schools work to deepen the knowledge and skillsets of students so they can more fully participate in and change an ever-growing diverse world.
Testing methods for evaluating bridge inspector proficiency

Claire Stockman and Glenn Washer

The objectives of this research are to describe the state of the art in testing methods to evaluate inspector proficiency and develop recommendations for proficiency testing for highway bridge inspectors. The research will conclude a comprehensive literature review, market research regarding the availability of testing resources, and developing rationale for identifying suitable technologies for application to highway bridge inspection.
Quantitative gait analysis in a canine model of Duchenne muscular dystrophy

Stefan D. Stover, Zachary A. Pfitzner, Gregory J. Jenkins, John J. Hu, Chady H. Hakim, Dongsheng Duan, and Gang Yao

Duchenne muscular dystrophy (DMD) is a muscular disorder that impairs the development of normal muscle tissue throughout the human body, primarily resulting in a visibly uncoordinated and physically exhausting stride in humans. A similar disorder that afflicts a small percentage of dogs, canine X-linked muscular dystrophy (CXMD), closely mimics the symptoms of Duchenne muscular dystrophy found in humans. Such DMD dogs are important models for testing human DMD therapies.

We investigated in this study whether a wireless motion sensor can be used as a quantitative measure of the abnormal gait in the DMD dogs.

Six dogs were used in this study including three DMD dogs and three control dogs. In each trial, the wireless sensor was securely mounted to a dog’s leg. Using Arduino controllers and programming, data from the sensor was sent to a laptop computer where a Matlab-based program was used to examine the data. The dogs were walked at a moderate pace in a straight line over a distance of approximately 10 meters. Video recording was also used to assist the analysis of the canine’s gait.

Trials were repeated multiple times, with consistent locations of the sensor across all six dogs. Significant differences in gait pattern were consistently observed between control and DMD dogs when the sensor was mounted close to the front-right paw. The major differences were in the timing of the movement among three orthogonal moving axes. These findings indicate that DMD dogs alter their gait pattern in a consistent and measureable way. The motion sensor can be used to characterize disease progression and monitor therapy outcomes.
“In ______ We Trust”: Political attitudes of the U.S. Youth and Young Adult (YAYA) market

Megan Strait, Devin Holland, Samantha Kintz, and Jonathan Stemmle

Introduction/Background: As researchers for MOJO Ad™, we specialize in the 18- to 24-year-old market which we call the youth and young adult (YAYA™) market. Because the YAYA market represents such a large, outspoken and diverse segment of voters, politicians, campaign managers and the government cannot ignore the possible influence they have on domestic politics.

Purpose of Research: There are 31.5 million YAYA consumers in the United States. Their buying power is sizeable, but for them the American Dream is changing. They no longer want of the material trappings of their parents. YAYA consumers are also racially and ethnically diverse, are motivated, complicated and distinct, and their lifestyles represent a new life stage.

Research Questions/Hypothesis: This study was conducted to uncover the YAYA market’s views on several aspects of politics and political issues including the government, the economy, the environment, and the media.

Methods: Our survey was distributed through Rewards Now and its e-Rewards platform using a sample of members who were between 18-to-24-years-old. In total, 500 YAYA consumers completed the survey.

Results / Conclusions: Party Affiliation and Distrust of Institutions: YAYA consumers are the politically unclaimed generation and their distrust of politicians has led to the rise of candidates who are not seen as members of the political norm.

Political News and Advertising Views: YAYA consumers don’t seek out political news on their own. They are also tired of being pigeonholed into a single category by the media and advertisers.

The Internet as a Soapbox and a Forum: Today, political supporters are creating their own communities to spread information, opinions, and gather support for a candidate.

Still Concerned About Economy: The majority of YAYA consumers agree that today’s job market remains a difficult one.

Environmental Concerns: A large majority of YAYA consumers are concerned about global warming and climate change, and also worry about the health effects of environmental pollution.

Implications for Further Research: For the majority of eligible YAYA voters, the upcoming 2016 Presidential Election will be their first. Whatever candidates emerge from the primaries and go on to be President, it is important for researchers to think critically about the impacts of increased political activism on social media and a shift away from the two party system will have for the political sphere going forward.

This project was completed to fulfill a Capstone requirement.
Joseph Struttmann
Union, MO

Faculty Mentor: Dr. Paula McSteen, Biological Sciences
Funding Source: National Science Foundation Grant to P. McSteen

Auxin Evo Devo: Reverse genetic approaches to understanding the role of auxin in shoot development

Joseph Struttmann, Kiley Marshall, Qiujie Liu, Diana Roberts Coats, Jacob R. Withee, Simon Malcomber, Andrea Gallavotti, and Paula McSteen

The growth hormone auxin regulates nearly all aspects of plant development. A better understanding of the genes controlling auxin biosynthesis, transport, and perception is therefore fundamentally important to basic plant biology with applications in crop improvement. Previous research has demonstrated both conservation and diversification of the role of auxin in maize and Arabidopsis development. We are using maize vegetative and reproductive development as a model to further understand how auxin regulates development using both forward and reverse genetic approaches.

Phylogenetic analyses of 15 gene families controlling auxin biosynthesis, transport and response illustrates complex relationships amongst monocot and eudicot clades. Reverse genetic analysis has confirmed 85 transposon insertions in 51 genes. Higher order mutant analysis is being guided by both phylogenetic and expression analysis. Results from the vanishing tassel2 (vt2), ZmPIN, ZmTIR/AFB, ZmARF and ZmAux/IAA gene families involved in auxin biosynthesis, transport and perception, respectively will be presented.
Role of emotional valence in word learning for school-age children

Kayla Symonds and Stacy Wagovich

The primary purpose of this study is to explore whether children learn unfamiliar words with a negative emotional connotation more easily than words with a neutral connotation when they encounter the words while reading. Word learning through the use of oral and written context is a critical skill for the development of vocabulary at all ages. In the school-age years, children’s exposure to vocabulary in text, both in casual and curricular reading, is a powerful means of vocabulary acquisition. We hypothesize that children will learn more negative than neutral words because of greater emotional salience. Emotionally valenced (positive or negative) words are processed more quickly and recalled more easily than neutral words. However, the facilitative effect of emotionally valenced words on word learning has received little research attention. School-age children, ages 9 to 12, with typical language skills participated in the three-session experiment. In the first session, children received a multiple-choice pretest to assess their prior knowledge of 12 negative rare words (e.g., noxious, slander) and 12 neutral rare words (e.g., surfeit, aplomb). One week later, the children read along with a recording of two stories containing the rare words, presented via computer. Following story presentation, the children received a multiple-choice posttest to assess understanding of the words. Finally, a week after hearing the stories, the children completed the multiple-choice test again to assess retention of the words’ meanings. Data analysis is underway to compare learning of the negative words presented in the stories to learning of the neutral words in the stories. Analyses will also include the impact of a word’s part of speech (noun vs. adjective) on word learning and the relationship between children’s language skills and the development of word knowledge.
Web interface for waterfowl forage availability research

Mingqin Tan, Bing Wang, and Yi Shang

Some scientists want to analyze the situation about the amount and quality of forage availability of waterfowl. There’s an R program that will used to generate the result from given data. Lots of scientists don’t know how to use an R program, so we create a web interface that interacts with R program. This interface will allow user input their data in a web page and the generated result from R program will display on the website.

For this project, we use OpenCPU to interact with the R program, Highcharts as data visualizer and we use Local storage to automatically store the data in client side. OpenCPU is an open source application used to interact with R and it provides some API which only requires little knowledge of R language, which is easy to use and just fits our goal. HighCharts can display user’s data in charts as a set of points which allow user to view their data visually and dynamically in a graph. The whole project is in single page application architecture, which reduce the server side logic and have more response than traditional Client/Server architecture and we are using MVC architecture to make the development logics more clear.

This project is building a web interface to solve the problem that normal user can’t use R program directly. It provides an interface for user to input data and view results. During the development, we learned many knowledge and concept about web development. And after comparing different technologies, we get better understanding toward application development
Inlet metering project

Matthew Taylor, Levi Manring, and Roger Fales

As undergraduate research assistants, we recently tested an idea related to hydraulic pumps that is rather unique in its fundamental applications. It is common for hydraulic pumps to have control systems composed of actuators and valves to control how the pump behaves, specifically its output flow. The purpose of our testing was to determine the effectiveness of using an area-control valve as the primary control and thus simplify the control scheme for hydraulic pumps.

The principal idea is this: using an area control valve, control flow by closing the area of the inlet to the pump and vaporizing part of the hydraulic fluid. The amount of area we close will determine how much fluid is vaporized. The saturated solution then flows through the pump and is condensed. Before testing was actually started, it was clear that two issues could occur. The first is the issue with getting oil to evaporate, and the possibility that air could come out of solution instead. The second is potential issues with cavitation.

After testing this experiment, it became clear that regardless whether or not the oil was evaporating or air was being taken out of solution, the control mechanism behaved as expected. It is possible that if air was evacuating the solution, that the size of reservoir could become a factor if the oil does not have time to reabsorb air from the atmosphere and continue the cycle. It was determined that cavitation was not a contributing factor to the success of this experiment after careful examination of the pump after disassembly. The test results seem prospective and realistic, but overall efficiencies were at best in the 70-80% range. Slow response check valves on the inlet and outlet of the pistons are the most likely reason for the low efficiencies, and we believe that higher efficiencies could be achieved with a simple redesign of the check valves.
Sara Thompson  
Cedar Hill, MO

Junior  
Elementary Education

Faculty Mentor: Dr. Matthew Burns, Educational, School & Counseling Psychology

**PALS: Effectiveness in classwide K-2 reading intervention**

Sara Thompson, Vivian Chang, and Matthew Burns

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Recipe for success for fashion small businesses in college town: Fresh urbanism with a heaping side of country hospitality

Sarah Thompson and Sarah Southworth

Purpose: With 67 fashion-related businesses in Columbia, MO, what does it take for a small fashion business to be successful in this unique college town environment? The purpose of this study was to gain insight on how these small fashion businesses were staying lucrative in this college town through a series of qualitative interviews with five local fashion-related businesses.

Method: Qualitative interviews were conducted two different times with store owners and managers from five local, fashion-related businesses: a men’s clothing store, a women’s boutique, a unisex boutique, a fabric store, and a fair trade non-profit store. The interviews were then transcribed and analyzed to identify two emerging themes regarding how small businesses were staying lucrative in the college town.

Findings: All of the five local fashion businesses in college town expressed that providing an urban experience in their stores mainly through their product offerings and store environment provided a unique perspective to the town, offering products that shoppers were usually unable to find in small college town stores.

At the same time, these stores expressed the importance of providing customer service that is reflective of country hospitality, such as knowing the customers’ names and their personal preferences. These stores believed that their loyal customers were coming back to their stores because of this hospitality. Furthermore, these businesses needed to extend this hospitality to not only their customers, but also to other nearby local businesses. For example, these small fashion businesses were sending customers to each other and collaborating together in local events. Thus, these businesses naturally created a mutually beneficial system to build their customer bases. According to these local stores, these two ingredients combined have helped them to stay lucrative in Columbia’s college town.
Lorisidae, how many are there really: Investigating the classification of *Nycticebus*, *Loris*, and *Perodicticus*

Chelsea Titus, Rachel Munds, and Lori Eggert

We are investigating the evolutionary history of genera within Lorisidae primates: slow and pygmy loris (*Nycticebus*), slender loris (*Loris*), and potto (*Perodicticus*). Our study has produced the most complete phylogenetic tree for this group to date. By understanding the natural groupings within for the family Lorisidae, we can better inform management plans for these endangered animals.

We collected photographs and hair follicle samples from 36 individuals in North American zoos. We performed cluster, discriminant, and Pearson’s chi-squared analyses on facemask features using photographs to determine how individuals separated morphologically. This resulted in seven distinct groups, conflicting with the current taxonomy. We then plotted localities of our species, resulting in two distinct groups; a concise African group and a more scattered Asian group. The geographic results showed some support for results found using facemask analyses. To investigate further, we conducted phylogenetic analyses on hair follicle samples using Bayesian methods on two commonly used genes; mitochondrial Cytochrome *b* and nuclear RAG2. The two trees resulted in mito-nuclear discordance; nuclear RAG2 tree supported less specificity, much like the current classification, and mitochondrial Cytochrome *b* tree supported results found using facemask and geographic analyses.

Our study showed discrepancy between groups found using different analyses and current taxonomy. To overcome this, future studies will include multiple genes to provide more robust evolutionary analysis and investigation into the importance of morphological characteristics by analyzing candidate genes influencing coat color and pelage.

*This project was completed to fulfill a Capstone requirement.*
Rachel Trout
Kirkwood, MO

Faculty Mentor: Dr. Alexis Callender, Art

Linda Montano and Tehching Hsieh’s Rope Piece Study

Rachel Trout, Edward Henuber, and Alexis Callender

We, Rachel Trout and Edward Henuber, plan to do a 72 hour performance.

We will stay together for 72 hours and never be alone.

We will be in the same room at the same time, when we are inside.

We will be tied together at the waist with an 8 foot rope.

We will never touch each other during the 72 hours.

The performance will begin on April 26, 2016 at 12 A.M. and continue until April 29, 2016 12 A.M.

Our performance is a re-creation of a year long performance done from July 4, 1983 to July 4, 1984 by artists Linda Montano and Tehching Hsieh. Montano and Hsieh are both dedicated to blurring the boundaries of life and art through their work. This collaboration, which we plan to explore through our adaptation of the work, could be understood as an investigation of freedom and entrapment, correspondence and movement or, more suitably, of the universal human condition. Using their conceptual framework, we will live physically connected for three days, negotiating the differences between our habits formed by the networked environment of the University of Missouri. Additionally, we will perform drawings in tandem that explore the connections and impact that binary code and text messaging have on our bodies and relationships.
Yowting Tsay  
Branson, MO 

Faculty Mentor: Dr. Heather Hunt, Bioengineering  
Funding Source: College of Engineering Undergraduate Research Program;  
3M Non-tenured Faculty Award 

**Studying biomaterials dissolution of MgF\textsubscript{2} thin films with Optical Tunneling Photoacoustic Spectroscopy (OTPAS)**

Yowting Tsay, Jonathan Baumstark, and Heather Hunt 

Thin films are essential in the development of optical applications, such as improved chemical sensors based on surface plasmon resonance devices. Particularly, MgF\textsubscript{2} films are frequently used as antireflective coatings on lenses and other optics, many of which may come into contact with aqueous environments. It is important to characterize these films by determining the refractive index and thickness. Standard characterization techniques, such as Ellipsometry, rely on empirical equations and require highly reflective/polished films, limiting the types of the materials that can be explored. Optical Tunneling Photoacoustic Spectroscopy (OTPAS), on the other hand, can be used without empirical equations or in cases of low optical reflection, as is common in most biomaterials. OTPAS uses an evanescent field to induce a photoacoustic effect in the surface of a biomaterial, allowing us to spectroscopically probe materials on the nanoscale. Here, we apply this technique to the study of materials biocompatibility, and in particular, the study of materials dissolution, which provides insight into how long a material is expected to survive in biologically relevant conditions. In this work, we demonstrate OTPAS’s ability to track the dissolution of standard MgF\textsubscript{2} thin films in aqueous solution by dissolving small amounts of the MgF\textsubscript{2} film away over time and monitoring the change in film thickness and refractive index with both ellipsometry and OTPAS. We will, for the first time, use OTPAS to track this process, and demonstrate the use of this technology for biocompatibility assays.
Correlations between discrimination and Latino and African American college students’ academic aspirations, expectations and satisfaction

Kristen A. Turner, Deidra S. Bibbs, Carlton D. Slaughter, Symone L. Lenoir, Alexandra N. Davis, Katharine H. Zeiders, and Antoinette M. Landor

The current study examined the relations between discrimination and academic aspirations, expectations, and satisfaction of self-identifying African American and Latino/Hispanic college students. Existing literature examining this relation has rarely included college students and experiences of in-group discrimination; this research has focused exclusively on discrimination experiences from out-group members (e.g., individuals outside of one’s ethnic/racial group). Current racial climates on college campuses around the United States call for an investigation of the possible effects of discrimination on ethnic and racial minorities’ academic outlooks. We examined college students’ experiences of in-group and out-group discrimination, and the relation of these experiences to academic experience.

African American and Latino/Hispanic college students attending the University of Missouri in the Fall 2015 semester were asked to participate in an online weekly diary study. Students (N=91), reported on their discriminatory experiences, academic aspirations, academic expectations, and satisfaction of their college experience. Participants were compensated $35 for participation in the study.

Bivariate correlations revealed a positive correlation between academic aspirations and out-group discrimination. Out-group discrimination was negatively correlated with satisfaction of academic experiences, relationships with other students and faculty members. In-group discrimination was negatively correlated with satisfaction of academic experiences at Mizzou.

Findings suggest that out-group discrimination negatively related to Latino/Hispanic and African American college students’ peer relationships, faculty relationships, and satisfaction of academic experience. However, out-group discrimination related to greater academic aspirations. This could be due to resistance of the discrimination experiences faced; students may strive for greater academic achievement in order to combat the discrimination they face while in school. Experiences of within-group discrimination may be particularly important to students’ satisfaction of academic experiences at Mizzou. Our findings highlight the relevance of both out-and in-group experiences of discrimination in college students’ academic well-being.
Soy isoflavones improve insulin resistance in ovariectomized mice through estrogen receptor alpha

Bridget Upton, Terese M. Zidon, Rebecca J. Welly, Olivia Stricklin, Michelle Gastecki, Makenzie Woodford, Young-Min Park, Dennis B. Lubahn, Jaume Padilla, and Victoria J. Vieira-Potter

Menopause (i.e., loss of ovarian hormones such as estrogen) is correlated to weight gain, obesity, metabolic dysfunction (such as dyslipidemia and insulin resistance (IR)), and reduced energy expenditure in women which all increase the risk of type II diabetes. Soybean isoflavones containing phytoestrogens, which are estrogens that naturally occur in legumes, have proven to reduce some of the side effects related to menopause. The mechanisms of how soy isoflavones reduce some of the side effects of menopause are unknown, and in this study the hypothesis was that the estrogen receptor alpha (ERα), which is the supreme estrogen receptor in adipose tissue, is correlated to the insulin sensitizing effect of soy isoflavones. In this study, adult female mice were ovariectomized (OVX) and put into groups of 7-12 mice around age 1 consisting of knock out for ERα, knock out for ERβ, and wild-type with preserved ERs. One week after OVX, mice were randomly assigned from each group a diet containing soy or a control diet without containing soy which created the groups of ERαKO/C, ERαKO/SOY, ERβKO/C, ERβKO/SOY, WT/C, and WT/SOY and were followed for 12 weeks. It was found that OVX increased adiposity in mice with ERα (WT and ERβKO). In ERβKO mice, soy diet made this increase less severe. Soy diet also improved insulin resistance in WT mice but the same effect in ERβKO was not significant. From this finding, soy-induced insulin sensitization needs ERα and ERβ, and this effect is not correlated to soy-mediated adiposity reduction. Thus, soy-mediated IR reduction is mainly through ERα but is not dependent on soy-mediated reduced adiposity.
Graphene is a 2-D nanoscale material with very high thermal, mechanical, and electrical properties

Phil Uwaemenyi and Matthew Maschmann

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Shayne Wadle
Chicago, IL

Faculty Mentor: Dr. Ye Duan, Computer Science
Funding Source: College of Engineering Undergraduate Research Option

iTongue concurrency

Shayne Wadle, Siyang Liu, Zhang Meng, and Ye Duan

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Faculty Mentor: Dr. Abraham Koo, Biochemistry

**Biochemical study on initial steps of jasmonate biosynthesis**

Taylor Wagner, Tong Zhang, and Abraham J.K. Koo

Research abstract withheld at the request of the faculty mentor for proprietary purposes.

*This project was completed to fulfill a Capstone requirement.*
Joshua Walkup
Ellisville, MO

Senior
Electrical Engineering

Faculty Mentor: Dr. Michela Becchi, Electrical & Computer Engineering
Funding Source: College of Engineering Undergraduate Research Option

GPU power performance analysis of Deep Neural Network Parameters through neural network generation and validation

Joshua Walkup, Cody Price, and Michela Becchi

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Rib curvature, thoracic shape and locomotor adaptation in anthropoid primates

Annie Wallach, Emily Middleton, and Carol Ward

Thoracic shape is hypothesized to reflect locomotor adaptation in primates, with hominoids having broader rib cages associated with a laterally-positioned shoulder joint compared with monkeys who have narrower rib cages that position the shoulder joint to face ventrally. Rib curvature should reflect overall thoracic shape and so differ among taxa with varying locomotor repertoires. Using the image processing program ImageJ, we quantified rib curvature from photographs of all ribs of over 200 anthropoid primate individuals. Curvatures of upper, middle and lower ribs were compared among taxa using analysis of variance with post-hoc adjusted pairwise comparisons. Contrary to our predictions, monkeys and apes do not differ appreciably in rib curvature throughout the thorax. Humans and hylobatids, however, were significantly more curved than other taxa in the upper ribs, perhaps reflecting a relatively broader upper thorax. In the lower ribs, humans were more curved than nonhuman primates, but other taxa were equivalent. This research suggests that rib curvature itself is not a sensitive indicator of locomotor differences in anthropoid primates. In addition, our results show that taxa may differ throughout the rib cage in curvature that may reflect overall thoracic shape, and that these patterns vary among ribs and across taxa. Other factors such as vertebral form and rib declination may also contribute to rib cage shape. Understanding thoracic shape in primates is important for exploring body form and its relationship with body shape and locomotor adaptation in extant and fossil species.
Web interface for waterfowl forage availability research

Bing Wang, Mingqin Tan, and Yi Shang

Some scientists want to analyze the situation about the amount and quality of forage availability of waterfowl. There’s an R program that will used to generate the result from given data. Lots of scientists don’t know how to use an R program, so we create a web interface that interacts with R program. This interface will allow user input their data in a web page and the generated result from R program will display on the website.

For this project, we use OpenCPU to interact with the R program, Highcharts as data visualizer and we use Local storage to automatically store the data in client side. OpenCPU is an open source application used to interact with R and it provides some API which only requires little knowledge of R language, which is easy to use and just fits our goal. HighCharts can display user’s data in charts as a set of points which allow user to view their data visually and dynamically in a graph. The whole project is in single page application architecture, which reduce the server side logic and have more response than traditional Client/Server architecture and we are using MVC architecture to make the development logics more clear.

This project is building a web interface to solve the problem that normal user can’t use R program directly. It provides an interface for user to input data and view results. During the development, we learned many knowledge and concept about web development. And after comparing different technologies, we get better understanding toward application development.
Pretreatment and synthesis of superabsorbent hydrogel based on soybean husk

Haoqi Wang and Caixia Wan

Superabsorbent polymers (SAPs) are hydrophilic polymers which can absorb and hold a significant amount of water. Among various SAPs, cellulose-based SAP is very popular due to its low toxicity and biodegradable properties. However, the strong intermolecular and intramolecular hydrogen bonds in cellulose hamper its water solubility and reactivity, and pose challenges to its application in SAPs. Pretreatment of the raw cellulose can help to generate cellulose more suitable for SAP synthesis. The object of this research is to find an effective and low cost way to extract and pretreat cellulose from soy bean husk to produce superabsorbent polymers. In this experiment, the efficiency of several pretreatments, including physical milling and acid-alkali pretreatment on product properties are compared, In the synthesis of SAPs, acrylic acid as copolymer, potassium persulfate as free radical initiator and N,N’- methylenebis-acrylamide as cross-linker are added to the pretreated soy bean husk. Poly (Acrylic acid) is the main functional group in the polymer that will have very high water absorbent property. The initiator is to stimulate the hydroxide bonds on the soy bean husk cellulose that generates radicals to initiate free radical polymerizations. Cross-linker will significantly improve the property of the water absorbency with the linking of polymer chains. The factors like temperature, optimal pH, composite ratio and reaction time that can influence absorbencies of the super-absorbent polymers through the process of the synthesis are also investigated.
MU Operations

Ruirui Wang, Tianbo Wang, Weijian Li, Yihan Xu, Jing Su, Yijie Ren, Hao Mu, and Dong Xu

Our research is a project founded and mentored by MU Operations. The project is called “MU Operations”, which is about reconstructing all of University of Missouri official websites that are out-of-date and connecting them together. Currently the websites being reconstructed are: MU Police, Staff Council, MU Printer Service, Campus Facility, MU Operation, Parking Service, etc. The project aims to be finished by the end of April. We then plan to publish the official sites after a few months of testing.

“MU Operations” is built upon Drupal 8. We use a Content Management System, based on our departments requests. Drupal 8 enables each department to modify content more conveniently and more efficiently based on their needs. We selected Drupal 8 as our Content Management System because it is the newest version of Drupal, so we don’t expect major updates to Drupal in a few years. Thus this promotes efficiency in maintenance towards inexperienced users. Also Drupal has many features that highly simplify our project’s goal. Drupal is designed to handle large websites, which helps us handle around one thousand web pages in total for “MU Operation”. This allows security to be handled on one platform too.
MU Operations

Tianbo Wang, Ruirui Wang, Weijian Li, Yihan Xu, Jing Su, Yijie Ren, Hao Mu, and Dong Xu

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Xiaochuan Wang
Anshan, China

Faculty Mentor: Dr. Zhen Chen, Civil & Environmental Engineering
Funding Source: College of Engineering Undergraduate Research Option

An evaluation of the material point method

Xiaochuan Wang and Zhen Chen

Research abstract withheld at the request of the faculty mentor for proprietary purposes.

This project was completed to fulfill a Capstone requirement.
Healthcare systems process improvement using NFER technology

Brett Watkins, Mary Rudy, and Jung Hyup Kim

Delay in healthcare delivery is a common patient safety issue in hospitals around the country. Critical care nurses frequently make trade-off decisions between required tasks due to overlapping patient needs or emergency situations. These trade-off decisions could potentially compromise the safety of the patient under the nurse’s care. In order to identify these trade-off decisions that lead to work delays, a time-motion study is utilized within the realm of engineering to analyze workflow data, sequence diagrams, and task breakdowns. However, traditional engineering time-motion study methodologies are challenged by nurses’ workflow complexity and hospital’s dynamic layout. For this reason, a more advanced time-motion tracking device is needed to adequately collect a more accurate time stamp and location data for a larger sample size of nurses. In order to achieve this, the NFER technology will be utilized. NFER technology will provide consistent location data for each nurse so that the research team can collect task data in areas unseen. The nurses being observed will wear a low-frequency AM tag that has constant contact with a triangulation locator set within the nursing unit. These NFER tags will be less disruptive and will solve the limitations that traditional time-motion study collection methodologies create.
State-of-the-art in algal growth modeling

Dana Wegge, Feng Feng, Christopher Sinks, and Satish Nair

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Brooklynn White
Maryville, IL

Junior
Biological Sciences

Faculty Mentor: Dr. Mirela Milescu, Biological Sciences
Funding Source: Mizzou Advantage Undergraduate Research Team

Analyzing the partitioning ability of amphipathic toxins in a lipid bilayer

Brooklynn White, Autoosa Salari, and Mirela Milescu

Amphipathic toxins modify the gating of ion channels via an initial lipid partitioning mechanism. As the target site for these toxins (the voltage-sensor of voltage-gated ion channels) lies within the membrane, this lipid partitioning behavior greatly facilitates toxin action. Lipid bilayers are composed of different combinations of lipids with various concentrations. These lipids are important not only for the structural integrity of membrane proteins, such as ion channels, but also for their function and pharmacology. By modifying the composition and concentration of a lipid bilayer, the ability of a toxin to partition and inhibit an ion channel can be altered. Using intrinsic tryptophan fluorescence we studied the strength of partitioning for toxins that exhibit different levels of channel inhibition. Amphipathic toxins have a characteristic fluorescence spectrum due to one or more tryptophan residues on their active surfaces. As a toxin transitions from an aqueous solution to the hydrophobic environment of the lipid bilayer, a shift in fluorescence is observed. Here, we show differences in lipid partitioning strength between several tarantula toxins exposed to the same composition of lipids, as well as, a given toxin exposed to differential compositions of lipid bilayers. Interestingly, our data support a positive correlation between toxin lipid partitioning strength and channel inhibition.

This project was completed to fulfill a Capstone requirement.
Investigation of the evolution of hydrodynamic instabilities and the affect of particles in the flow

Justin White and Jacob McFarland

The Rayleigh-Taylor Instability (RTI) is an instability that occurs at an interface of two fluids of different densities. Often time a heavier fluid is resting on a lighter fluid relative to the acceleration vector. The equilibrium that exists between the two is highly unstable and the slightest disturbance in the interface will cause the heavier fluid to accelerate downwards into the lighter fluid and the lighter fluid to move into the region of the heavier fluid. The Richtmyer-Meshkov instability (RMI) is similar to the RTI, but the acceleration is impulsive and almost instantaneous. Such an acceleration is created by a shock wave.

Both of these natural phenomena often encounter obstructions in the flow while they develop. For example, a RTI instability, which is often seen in the evolution of supernovas, encounters dust in the interstellar medium as it evolves. This dust can be thought of as particles that affect the flow and evolution of the instabilities.

In this research the growth of both the RT and RM instabilities are presented through simulations using high performance computing and the ARES code at Lawrence Livermore National Laboratory. Then the results of particles present in the flow are investigated to see how parameters such as particle size and density affect the evolution of the instability. Our research team at the Mizzou Fluid Mixing and Shock Tube Laboratory has the goal of running experiments to compare and validate these high-resolution simulations.
Quantification of BB2r in prostate cancer cell lines

Reneise White, Tammy Rold, and Timothy Hoffman

In 2015, the American Cancer Society projected prostate cancer to be the second leading cause of cancer related death in America. With the BB2 receptor (BB2r) known to be over expressed across multiple human cancers, including prostate cancer, targeting the BB2r is a viable option in the field of receptor targeted radiopharmaceuticals. This work focused on the preparatory studies to validate the western blot assay for use in quantitating the BB2r protein in three human prostate cancer cell lines.

The full BB2r protein at target concentrations of 0.200 to 0.003 ug of protein/well was loaded onto 10% Bis-Tris gels (12-well, 1mm) before being transferred to PVDF membranes. The membranes were dried prior to being re-wetted and blocked for 1 hour at room temperature (RT). Membranes were incubated overnight in the primary antibody solution containing the BB2r antibody. Following overnight incubation, the membranes were incubated with the secondary antibody solution for 30 minutes at RT. Membranes were washed and placed in the dark to dry. Fluorescent images of the dried membranes were obtained using a LI-COR Odyssey CLx and images were processed using Living Image software.

All lanes containing the BB2r protein were detected at 57 ± 0.62kD (n=18). When plotted (ug protein to measured intensity), the results were found to be linear ($R^2 = 0.9913$ and 0.9935). The two highest concentrations (0.200 and 0.130 ug) showed signs of protein overloading. All levels of protein were visualized.

The BB2r protein was detected at 57kD which was comparable to the projected 62kD. We determined 0.055, 0.036, and 0.023 ug to be used as standards for BB2r protein quantitation. We are currently investigating the utility of this assay to quantitate changes in BB2r expression associated with chemotherapy and targeted radiotherapy treatment of prostate cancer cells.
Relating behavioral and calcium wave dysfunction in fruit flies to better understand the role of glial cells

Alex Willenbrink and Bing Zhang

The main function of glial cells is to ensure that the neurons function correctly and optimally. Dysfunction of glial cells can result in a wide variety of neurodegenerative disorders such as: Huntington’s disease, multiple sclerosis, and Alzheimer’s disease. Increasing our understanding of glial cells can give the medical community tools for disease diagnosis and potential treatment and recovery options to fight these.

I study glial cells in *Drosophila melanogaster*, commonly known as the fruit fly. Because glial cells in humans and fruit flies are similar, understanding basic functions in glial cells of the fly model can shed light on similar functions for human glial cells.

Specifically humans possess a special glial cell type (astroglia) that regulates communication between neurons by sending out their own set of modulating particles (gliotransmitters) that can be used to control the neurons. To initiate this phenomenon, the glial cell must first raise its intracellular calcium level. Interestingly, this rise in intracellular calcium rarely resides in one glial cell, usually traveling to nearby glial cells in a wave-like fashion. These “calcium waves” are a form of communication between glial cells.

I successfully correlated calcium wave dysfunction with behavioral dysfunction. The protein PolyQ78 is a derivative of the toxic protein found in Huntington’s disease. Introduction of the protein within glial cells of fruit flies causes them to become almost immobile as a behavioral response. It also starkly reduces calcium wave intensity and frequency of oscillation. Glial cell expression of TRPA1, a cation channel that opens with the addition of heat, causes epileptic-like behavioral effects in temperatures above 32 oC. At this temperature, the calcium waves of these flies are abolished with incredibly high levels of intracellular calcium.

Our findings suggest that normal calcium wave oscillation and intensity is important for proper neuronal function.
The overall concept of this play was to bring the audience into a house that had just been bombed due to the war and was filled with holes and water damage. During this production, I really wanted to pull my audience into the house and make it as though they were there during the incidents going on during the play. With lightening strikes and rain for atmospheric sound, this play offered many challenges that we, as a production team, overcame.
Mary Madeline Willis
Ellisville, MO

Faculty Mentor: Dr. Frank Schmidt, Biochemistry

Uncovering RNA-RNA interactions to develop a model of RNA networks in the prebiotic RNA World

Mary Madeline Willis and Frank Schmidt

How did we end up with DNA as the genetic material in all free living organisms? Many scientists hypothesize that an RNA-based system preceded the current one, in which information is carried in the DNA sequence and catalysis is mostly carried out by proteins. RNA, unlike DNA, is usually single-stranded and can self-assemble into an incredible variety of structures that allow it to do tasks DNA is incapable of performing. Such diversity makes RNA a great candidate for the first molecule of life. This model is known as the “RNA world hypothesis,” and it supposes that a prebiotic population of RNAs contained sequences with different binding capabilities, leading some sequences to bind to others more frequently and propagate more successfully. These interactions form an evolving network, with properties that can be quantified using computer modeling. Biological systems feature networks of interacting molecules, such as those involved in metabolism; however we don't know how these networks form in a prebiotic environment.

Our research program aims to model network formation in the RNA world. Frequencies of RNA-RNA binding interactions in solution were estimated in previous research, but we still don't understand the relationship between an RNA’s sequence or structure and its ability to select a partner RNAs, forming a network of interactions. To understand this relationship, and the binding network it influences, I have analyzed the sequence relationships among interacting RNAs and have shown that they can be analyzed using phylogenetics. In the future, I will select more RNAs capable of binding to other RNAs, and look for patterns in the resulting population. Once all data is collected, Dr. Schmidt and I will be collaborating with computer scientists to create a computational model of the observed RNA-RNA binding network.
Retrospect

Benjamin Willis-Teff and Joseph Erb

Delve into the mind of a college student crestfallen about his relationships. Wishing he would call his mother more often, he struggles to tell her about his loneliness and regret.
Edric D. Winford, Carmela L. Pratt, Carrie E. Lasky, and Charles R. Brown

Borrelia burgdorferi (Bb) is the causative agent of Lyme disease and is transmitted through the bite of the Ixodes scapularis tick. When susceptible mouse strains are infected with Bb, they develop arthritis of the large joints primarily localized to the ankles. About one week after the onset of arthritis, carditis will develop. Both manifestations of disease will resolve about 60 days after infection. The immunological mechanisms that drive both the onset and resolution of inflammatory diseases are unknown. Eicosanoids are bioactive lipids that regulate inflammatory processes and have been shown to play critical roles in certain infectious disease models. Aside from their primary pro-inflammatory role, eicosanoids have been shown to have anti-inflammatory properties as well. The enzyme 12/15 lipoxygenase (LO) is a component of the eicosanoid pathway that is thought to produce primarily anti-inflammatory mediators. Others have reported severe inflammation in 12/15 LO−/− mice using the K/BxN serum transfer model of arthritis compared to control mice, suggesting an anti-inflammatory role for 12/15 LO. The role of 12/15 LO in the development of Lyme arthritis or carditis has not been established. We hypothesize that infection of 12/15 LO−/− mice with Bb will lead to exacerbated disease. Arthritis development is monitored by measuring ankle swelling and disease severity is assessed using histology of joints and hearts. It is also believed that the expression of 12/15 LO is indicated to be responsible for the clearance of apoptotic cells. Our phagocytosis assays also show that C3H 12/15 LO−/− macrophages were able to phagocytose Bb and apoptotic cells effectively. A better understanding of this pathway may lead to the development of treatments for Lyme and other inflammatory or infectious diseases.
The Supreme Court and the discretionary writ of certiorari: A viewpoint from a historical institutionalist

Michael Winkeler and Justin Dyer

Today, the Supreme Court of the United States controls its agenda in a much different manner than it once did. The power to pick and choose which cases the Supreme Court places on its agenda is important because it increases the power of the judiciary.

Over time, the Supreme Court of the United States has undergone a radical transformation. This Honors Thesis examines the Supreme Court through both long-term and short-term lens, as it maps developmental paths and trajectories that are the result of political calculations and incentives that are embedded in a larger political context. The study uses historical institutionalists methodology, as it examines both law and politics that shaped the historical evolution of the Supreme Court. Historical institutionalists examine the unintended consequences that surround decision-making, legal doctrines, and case law. These findings help one understand how the Supreme Court went from a body that had no control over its docket to having complete control – as they do today – over the cases the institution hears. The first half of this Honors Thesis focuses on the development of the Court as a political institution, and the latter half spotlights the institution’s modern day agenda setting. Specifically, the latter half analyzes the discretionary writ of certiorari because it significantly heightens the power of the Supreme Court.
Parameterization of Continuous Gasification Reaction through two unique Batch Processes

Dustin Wood, Di Zhu, and William Jacoby

Supercritical water gasification of biomass can be used to convert waste and carboniferous material into vapor products. Dominant among these vapor products are hydrogen (H₂), methane (CH₄), and carbon dioxide (CO₂). The conversion of biomass to these vapor products is most feasible in continuous processes. However, continuous processes can last for hours and are necessarily more complex to manage the flows of reactants and products. Batch reactors can be used to collect data about the process, but not to feasibly convert biomass to useful products.

Collecting sufficient data from a continuous reactor to parameterize a model describing the reactions occurring is time consuming and requires significant energy input. Similar data collected from batch reactors, can parameterize a similar model. We expect this model to also describe the continuous system. By collecting data about the effects of the sample's residence time (τ) and solid waste concentration on the total conversion of the sample, we can fill in a model describing the rate of the reaction. While we expect our model to describe the reaction once supercritical conditions are reached, the hot water chemistry involved on the way to the reaction temperature is even more complicated and not represented in this model. So, while parameterizing our model, we will design a new reactor will incorporating a rupture disk used in a novel way to allow the supercritical water to reach a desired pressure and temperature before reacting with the biomass. Ideally, this will facilitate the collection of more accurate data to be used in the development of the model.

Beyond collecting data, this will be a versatile system whose conditions can be changed to produce different results with minimal changes to the hardware. With changes to hardware, more interesting phenomena such as a hydrothermal flame can potentially be witnessed.
Brendan Woodall
Silex, MO

Faculty Mentor: Dr. Lisa Webb, Fisheries & Wildlife
Funding Source: CAFNR On Campus Research Internship - CAFNR Academic Programs Fund

Estimating lipid and protein reserves in lesser snow geese (chen caerulescens) using predictive morphometrics

Brendan Woodall, Drew Fowler, and Lisa Webb

Avian body condition indices are a useful metric in waterfowl research to evaluate differences in nutrient levels during an individual's annual life cycle. The ability to accurately predict nutrient levels of lipids and protein, at a given life history stage can potentially infer an individual's ability to meet energetic requirements for various life history events. Currently, methodologies exist to determine absolute levels of lipid and protein reserves through chemical analyses but these methods are costly, time consuming, and require euthanization of the individual. Alternatively, regression models can be used to solve this problem by creating indices of lipid and protein reserves by relating reserve levels to external morphological measurements and body size. We used lesser snow geese (Chen caerulescens caerulescens), a long distant migrant dependent on endogenous reserves for reproduction, to assess the ability of external measurements of morphological characteristics to accurately predict nutrient reserves using multiple regression techniques. Geese were collected (n=240) during spring migration in Arkansas and South Dakota. Fat pad and the left breast muscle were extracted and weighed. General mixed models considering sampling region, body weight, wing cord, tarsus, and culmen length as predictors of lipid and protein concentration were assessed. We present the models that can be used for rapid assessment of body condition in live or deceased birds.
Xueyan Wu
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Faculty Mentor: Dr. Dong Xu, Computer Science
Funding Source: College of Engineering Undergraduate Research Option

A comprehensive database of protein subcellular localization

Xueyan Wu, Yihua Shi, Qintai Liu, Ning Zhang, and Dong Xu

Most proteins will be trans-located to their appropriate destinations after synthesized in cytosol, meanwhile about half of them would need to go through the targeting process in order to get settled at their correct subcellular locations. Since any mistake in the localization process of proteins might result in metabolic disorders or diseases, correct subcellular localization appears crucial to the maintenance of cell organization and function. The capability of identifying the subcellular localization given any protein has long been a challenge and is especially helpful in the study of the underlying mechanisms of protein targeting.

The goal of this research project is to develop a comprehensive database that stores the subcellular localization information for proteins across species, which is expected to be a valuable resource for biological researchers. The database will be utilized for investigation of the localizations as well as functions of different proteins aiming at different levels of users, by allowing users to perform analysis tasks or searches for detailed information related to a specific protein.

The project also utilized Basic Local Alignment Search Tool (BLAST) and TargetP to predict the subcellular location of eukaryotic proteins. BLAST for Basic Local Alignment Search Tool is an algorithm for comparing primary biological sequence information, such as the amino-acid sequences of different proteins or the nucleotides of DNA sequences. A BLAST search enables a researcher to compare a query sequence with a library or database of sequences, and identify library sequences that resemble the query sequence above a certain threshold. A Module-View-Controller (MVC) architecture is adopted for easier and better maintenance as well.
A comparison of the life cycles of elevated and surface-based convection

Katharine E.D. Wunsch, Neil I. Fox, and Patrick S. Market

Elevated convection is defined as convection that occurs above a stable layer—generally a frontal zone. These storms occur most frequently in the Midwest, with a maximum located in eastern Kansas. Elevated convection is the cause of the majority of warm-season rainfall in the Central Plains, and the primary associated risks are hail, flash flooding and lightning. NCDC level II radar data were used to examine the differences in life cycles and storm characteristics for 16 cases that occurred from 2007-2010 in eastern KS, southeastern NE, southern IA and MO. These cases were previously selected for a study examining the correlation between convective rainfall rate and lightning flashes; in the previous study, the cases were classified as either elevated or surface-based. Each case was also categorized based on the mesoscale dynamics of its stratiform precipitation shield (trailing, leading or parallel stratiform).

The data were processed into netcdf format, then compiled in MATLAB to examine the reflectivity at 1 km above radar, echo top heights for 30 dBZ reflectivity surface and divergence at the 1 km and 2km heights, below 3 km, and between 3 and 7 km. Preliminary results suggest higher reflectivity and higher maximum echo tops in elevated thunderstorms, indicating higher cloud tops and precipitation forming at a higher altitude. Less divergence below 3 km and more convergence between 3 and 7 km found in elevated cases reflect the position of the updraft above the surface stable layer. Additionally, higher heights of mean composite reflectivity illustrate the higher elevation of elevated storm cells. Finally, surface-based storm cells tended to last longer than elevated cells, but elevated cells had greater variability in duration, as the longest lasting cells occurred in elevated cases; this exemplifies the greater impact of mid- and upper-level flow on elevated cells.
Developing tools to investigate the role of TCP transcription factors in the plant immune response

Casey Yocks, Benjamin Spears, and Walter Gassmann

The plant defense response to pathogens is highly regulated. Several members of the TCP transcription factor family of *Arabidopsis thaliana* recently have been shown to be positive regulators of plant immunity, previously found mainly to regulate plant development. A group of TCPs interact with SRFR1, a negative defense regulator. A tcp8 tcp14 tcp15 triple mutant has a susceptible phenotype to pathogens and shows how highly redundant TCPs are. We aimed to develop genetic and protein biochemical tools to further investigate the role of TCPs in plant immune responses. Using restriction cloning we generated epitope-tagged genomic TCP14 and TCP15 constructs, which will be used to transform *A. thaliana* plants. These transgenics can be used to better evaluate the interactions of other proteins with TCPs and look at the specific genes they control. The transgenics will be validated through complementation of a tcp8 tcp14 tcp15 triple mutant, shown by decreased susceptibility in a bacterial growth assay. This tool can be used in various experiments to enhance our understanding of the role of TCPs in the plant immune response to pathogens.
Role of central serotonin in sleep architecture and arousal in infant rat pups

Jacob Young and Kevin Cummings

Sudden Infant Death Syndrome (SIDS) occurs during sleep and is the leading cause of infant death in the post-neonatal period. SIDS cases have more active sleep (AS), a sleep state associated with apnea and cardiovascular instabilities. It is also thought that SIDS involves a failure to arouse from an apneic event during sleep. Defects within the brainstem serotonin (5-hydroxytryptamine, 5-HT) system (including a loss of 5-HT content) are associated with SIDS, and a causal role 5-HT deficiency is suggested by recent studies using rodents deficient in central 5-HT. However, how a specific loss of central 5-HT in neonatal life affects sleep, respiratory control across sleep states and arousal from sleep has not been investigated. We hypothesized that 5-HT deficiency increases the amount of active sleep (AS), compromises breathing mostly during quiet sleep (QS) when 5-HT neurons still fire, and blunts the arousal response to hypercapnia. We monitored sleep and breathing over ~2hrs in two groups of unanaesthetized, 2 week-old rat pups deficient in tryptophan hydroxylase-2 (TPH2−/−) and wild-type controls (WT). One group (n=6 WT, 5 TPH2−/−) was kept in normoxic conditions and the other group (n=10 WT, 8 TPH2−/−) was given intermittent challenges of 5% CO2 at the beginning of episodes of AS and QS until arousal. Sleep state was determined using nuchal electromyography and behavioral observation. Breathing was monitored using whole body plethysmography. We measured the duration of AS and QS episodes (i.e. latency to arousal) in normocapnia and hypercapnia, and in normocapnia measured respiratory variables in each sleep state: frequency (fB), tidal volume (VT), ventilation (VE) and the co-efficient of variation of the respiratory period (CV%). While the duration of QS episodes was not influenced by 5-HT deficiency, TPH2−/− pups experienced episodes of AS that were ~2-times longer than those of controls (~190 vs 90 sec; p=0.003). In AS, hypercapnia had no effect on the latency to arousal of either WT or TPH2−/−pups. In QS, hypercapnia reduced the arousal latencies of WT pups (from ~108 sec to 72 sec), but had no influence on the latencies of TPH2−/−pups (state x gas x genotype: p=0.02). 5-HT deficiency significantly reduced fB and VE in both sleep states (p<0.001 for both). Breathing stability was significantly compromised by 5-HT deficiency, but only in AS (genotype x state: p<0.001). We conclude that at an age close to infancy, central 5-HT deficiency increases the duration of AS episodes, destabilizes breathing during AS, and delays arousal from hypercapnia during QS. These findings lend support the hypothesis that reduced 5-HT signaling alters sleep architecture and breathing in a way that increases SIDS risk.

This project was completed to fulfill a Capstone requirement.
Mindfulness focused on interpersonal interactions predicts friendship quality

Victoria Young, L. Markovitz, S. Pratscher, and Ann Bettencourt

Co-rumination is conceptualized as discussing and revisiting problems, speculating about problems, and focusing on negative feelings with peers (Rose, 2002). Co-rumination is associated with higher anxiety and depression but also with higher friendship quality. Theorists predict that mindfulness enhances relationships (Parker et al., 2015). Research shows that parents who adopt mindful and compassionate perspectives report more positive interactions with their children (Coatsworth et al., 2010). Kozlowski (2013) reveal that higher mindfulness is correlated with greater romantic-relationship satisfaction. No published studies examine the influence of mindfulness on friendships. The current study seeks to understand the influence of mindfulness on friendship quality. We included two measures of mindfulness: interpersonal mindfulness and trait mindfulness. Further, we sought to determine whether co-rumination and interpersonal mindfulness interact in predicting friendship quality (See Table 1).

Participants were 300 undergraduates who completed an online-survey. Participants were asked to enter the initials of one close-friend and to think about this friend while answering the survey. Predictors were the Interpersonal Mindfulness Scale, Five-Facet Mindfulness Questionnaire and Co-rumination Scale. The three primary outcomes were Friendship Quality, Social Perspective-Taking, and Empathetic Distress. Depression and Anxiety Scale were also measured.

Table 2 shows the correlations among the variables. The regression analysis results were consistent with H1 and showed that co-rumination (CR. \( b = .36, p < .05 \)) and interpersonal mindfulness (IM: \( b = .21, p < .05 \)) positively predicted friendship quality, and consistent with H2, these variables interacted to influence friendship quality (\( b = -.11, p < .05 \); See Figure 2). Likewise, CR (\( b = .49, p < .05 \)) and IM (\( b = .18, p < .05 \)) positively predicted friendship empathy; Figure 2 shows their marginal interaction on empathy (\( b = -.09, p = .056 \)). Similarly, CR (\( b = .31, p < .05 \)) and IM (\( b = .40, p < .05 \)) positively predicted perspective taking, and these variables interacted in their influences on perspective taking (\( b = -.16, p < .05 \)). Trait mindfulness did not influence the friendship variables, but did influence anxiety and depression, (\( b = 0.22, p < .05 \) and \( b = -.32, p < .05 \), respectively), consistent with H4. H3 was not supported.

The results are the first to show that mindfulness during interpersonal interactions positively influences variables related to high quality friendships. Moreover, this variable interacts with co-rumination in influencing friendship. Finally, trait mindfulness did not predict friendship quality but did predict anxiety and depression.

This project was completed to fulfill a Capstone requirement.
Optimization of capacitor bank size and location in IEEE 32-bus test system using powerworld

Naadaa Zakiyyan, Bryan Fay, and Robert O'Connell

The IEEE 32-bus distribution test system with optimal switch configuration has four radial lines at a base voltage of 12.66 kV everywhere and a base apparent power for the system of 10 MVA. A problem of the standard IEEE 32-bus test system is power loss and voltage drops due to long radials with loads at each bus. This can be remedied by placing capacitor banks of appropriate size at appropriate locations. The purpose of this poster is to describe Powerworld-based simulations of the 32-bus system with two capacitor banks of various sizes and at various locations, with the purpose of optimizing system performance defined by power losses and voltage profiles. Powerworld is an interactive program used to simulate power systems as one line diagrams to view various parameters such as bus voltage levels, bus loads, current through branches, power losses, and various other data useful for power system reliability. As it happens, the base values of apparent power and voltage for the test system and the corresponding default values in Powerworld are not identical, thus requiring some initializations. With the optimal switch configuration built and simulated in the software, a voltage profile was created. Since a number of busses still had inadequate voltage levels, capacitor banks were incorporated in order to obtain a voltage level of between 0.95 and 1.0 per unit on all busses. Furthermore, varying configurations of two capacitor banks were tested on the 32-bus system and compared using their voltage profiles to determine the ideal placement and rating. As a result, after simulating capacitor banks at various busses on the system, it was clear that bus 15 and bus 30 were the optimal locations to add capacitor banks in the sizes of 0.8 Mvar and 1.8 Mvar, respectively.
Temperature sensitivity of fruit fly gustatory receptors

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Gustatory receptors are a family of transmembrane proteins that have been studied in the context of insect gustatory and olfactory systems. A recent study has found that GR28b, a seven-transmembrane domain protein in the gustatory receptor family in Drosophila melanogaster, may also be involved in temperature sensing. The thermosensitivity of GR28b raises the possibility of using it as a new thermogenetic tool, which could be used to investigate the function of specific neurons and circuits in the brain. To test this idea, we expressed several GR28b isoforms in Xenopus laevis oocytes and measured their relative temperature sensitivities using two-electrode voltage-clamp. Preliminary results show that GR28b exhibits inward sodium current that increases with temperature.
Social skills instruction to reduce bullying involvement among middle school youth

Kirsten Zemke, Lindsay Beachner, Jennifer Buehler, Mikaela Henke, and Chad Rose

Bullying has become a pervasive problem among school aged youth. According to recent data approximately 1 in 4 students report being victimized within American schools. Two of the most common predictors among youth that experience prolonged victimization are social and communication skills deficits. This is especially true for students with disabilities, who are disproportionally involved within the bullying dynamic. Therefore, it’s critical to examine the relationship between social skills instruction and youth who have been identified with low social skills.

The current study used existing data collected by the partner schools’ school climate survey coupled with their social behavioral screener to assess the individualized needs of youth. Students identified by their teachers as having low social skills at the beginning of the 2015-2016 academic year were eligible for involvement in the study. Each school identified approximately 20% of their total population who would benefit from Tier 2 social skills instruction. Of the 20%, a total of 55 students returned parental consent allowing them to enroll in the study. Once enrolled, students received weekly, targeted social skills instruction in ten critical areas. These areas include: Listen to Others, Follow the Steps, Follow the Rules, Take Pride in Your Work, Ask for Help, Conversations, Working with Peers, Self-Management, Do the Right Thing, and Respect Others. Each student received approximately 10 hours of social skills instruction.

These students have demonstrated increased self-awareness, group participation, confidence, peer relationships, and engagement in organized social activities. All of these skills are critical for adolescent development as well as reducing bullying involvement. While the results of this study are preliminary, the improvements are promising and have direct implication in curricular development and implementation. These data suggest that schools should consider implementing targeted interventions to improve the social and behavioral outcome of middle school youth.
Heartrate variability estimation using a hydraulic bed sensor

Lemeng Zhang, Licet Rosales Paniagua, and Marjorie Skubic

A hydraulic bed sensor has been developed by the Center for Eldercare and Rehabilitation Technology (CERT) of the University of Missouri to non-invasively monitor pulse and respiration during sleep. This sensor is designed for in-home use, to be part of an integrated sensor network for the early detection of illness and functional decline in elderly adults [1]. The bed sensor system operates under the physical principle of Ballistocardiography [2]. Ongoing research evaluates the feasibility of the use of the ballistocardiogram (BCG) signals for heart rate variability (HRV) estimation as an unobtrusive replacement of electrocardiogram (ECG) signals. Research work includes, data collection of ECG, pulse, respiration and BCG signals on sixty healthy volunteers and data analysis of their corresponding BCG signals using signal processing and machine learning techniques.


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Data platform for Hexoskin data

Zening Zhang and Yi Shang

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
The maize mutant tassel-less4 has defects in both inflorescence and leaf development

Dennis Zhu and Paula McSteen

Zea mays (maize) is important both as an agricultural crop and as a genetic model system. Maize produces a male reproductive structure called a tassel and female reproductive structure called an ear. The tassel produces small, floret-containing branches called spikelets while the ear produces kernels. However, tassel-less (tls) mutants are characterized by an absent or reduced tassel. Eight tls loci have been identified, and two have been cloned. Here, we present the phenotypic characterization and genetic mapping of the tls4 mutant. Morphometric analysis of tls4 mutants shows that tassels produce fewer branches and fewer spikelets than normal siblings. Reduction in spikelet number is due to both a reduction in the length of branches and reduced spikelet density. SEM analysis of immature tassels shows early defects in spikelet pair formation. In addition, tls4 plants exhibit a number of vegetative phenotypes. tls4 produces narrow, rough leaves. Light microscopy of longitudinal sections of adult tls4 leaves shows defects in vasculature patterning. tls4 mutants also exhibit defects in formation of the blade-sheath boundary. Mutant plants are also significantly shorter than normal plants due to both a reduction in internode length and number. Fine mapping using molecular markers indicates that tls4 maps to a 600kb region on chromosome containing 29 genes, including a predicted auxin response factor. Further mapping and sequencing is ongoing to determine the identity of the tls4 mutant gene. Due to its pleiotropic phenotypes, we propose that the tls4 gene plays a critical role as a regulator of multiple stages of plant development.
Faculty Mentor: Dr. Chi-Ren Shyu, Electrical & Computer Engineering; Informatics Institute
Funding Source: College of Engineering Undergraduate Research Option; Shumaker Endowment for Biomedical Informatics

**Contrast mining to predict super-utilizers of healthcare resources**

Yan Zhuang, Lincoln Sheets, and Chi-Ren Shyu

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
In 1808, immediately after retreating from the traffic, the British Parliament engaged in a campaign to suppress the entire transatlantic slave trade. It was the beginning of a century-long crusade that would help change humanity’s attitude towards slavery and the traffic. Historians have long examined the ideology behind abolition, ranging from evangelism and humanitarianism to self-serving imperialism. However, the actual campaign and how it intersected with British political and economic interests overseas remain largely unexplored. This presentation is part of an ongoing project aimed at tracing the expansion of British abolitionism around the world and its relationship to imperialism in Africa and elsewhere. It involves charting over 30,000 records of letters between the British Foreign Office and British commissioners, naval officers, diplomats, and others from 1808 to the 1880s.

The project compiled these letters, copied from the Slave Trade Series of the British Parliamentary Papers, into a database, containing information on the sender, receiver, date sent, and place of origin. I then uploaded this database to Palladio, an online mapping and graphing platform, to visualize the letters’ geographic and chronological distribution. The results show the global scope of suppression, reaching from the Pacific coast of South America through the Atlantic and Indian Oceans up to Eastern Australia. The campaign gradually grew from the 1810s to a peak correspondence period in the 1840s. In the following decades, the traffic shifted to the Indian Ocean and gradually declined as major carriers retreated from the business. The project thus moves away from earlier Anglocentric perspectives. It recasts the major players and regions in the campaign, reinforcing the role of agents on the ground and how their relationship with local populations helped end the African slave trade.
Chacrton-Marie-Tooth type 2E pathology initiates in the proprioceptive sensory system

Sammy Zino, Eric Villalon, Michael Garcia, and Dawn Cornelison

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Heavy metals are a concern in contaminated environmental sites due to their detrimental effects to the local flora and fauna. Possible solutions to these problems can oftentimes be found by studying the local populations of microbes that survive, or may even thrive, under these harsh conditions. Isolated strains of bacteria from a heavy metal impacted site have been identified by screening for those that could tolerate a mixture of metals which is typically inhibitory. Strains that grew well were identified as strains of interest for further characterization. The goal of my project is to determine which of these strains are genetically accessible so that targeted genes can be mutated and predicted functions explored. In order to reach this goal, we are testing protocols currently used in the lab and will modify them or test additional procedures, if not successful. To achieve the introduction of DNA into these newly isolated strains, we may need to modify growth conditions, plating conditions or transformation protocols. Thus far, we have had good success with a previously isolated strain, Pseudomonas stutzeri RCH2, and preliminarily, have had good success with two of the four additional isolates. Our goals include not only developing a DNA transformation protocol, but also to identify or construct a stable plasmid for additional studies in gene expression and genetic complementation of mutants.