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Undergraduate and Graduate Research Forum

2019

Student Center Ballrooms

A, B, C & D

April 8, 2019

SIU CARBONDALE
SOUTHERN ILLINOIS UNIVERSITY
VICE CHANCELLOR FOR RESEARCH

2019 SIU Carbondale Student Research Forum

Program and Abstract Guide

"**Creating new knowledge** is the pulse of SIU. Our students have direct access to renowned faculty and facilities typically found at universities several times our size, leading to accomplishments in diverse places such as the laboratory, studio, and stage. Not only do our students leave SIU with a degree in hand, but also a creative mind. And with hard work and some serendipity, our graduates may find themselves with a published article, a novel musical score, a unique piece of art, or most importantly, a fresh view of the world. At SIU, all things are within your reach."

—James Garvey, Vice Chancellor for Research

Undergraduate and Graduate Research Forum
April 8, 2019
Student Center Ballrooms
Southern Illinois University Carbondale

Sponsored by the Office of the Vice Chancellor for Research, Graduate School, and Graduate and Professional Student Council

Program

Students can check in and display their posters: 8 a.m. – 9 a.m.

Poster Judging Session: 9 a.m. – 11 a.m.

REACH students will perform a live work of art: 11 a.m.

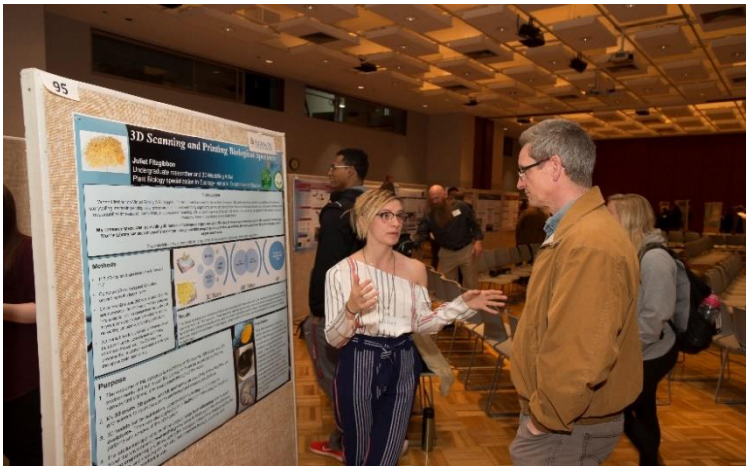
Public Viewing Session: 11 a.m. - 3 p.m.

Award Presentations: 3 p.m.

- **Welcome by Dr. John M. Dunn, Chancellor**
- **Undergraduate Poster Awards presented by Dr. Jim Garvey, Vice Chancellor for Research**
- **REACH 2019-2020 Awards presented by Dr. Jim Garvey, Vice Chancellor for Research**
- **Graduate Poster Awards presented by Dr. Juliane Wallace, Associate Dean and Director of Graduate School**
- **Outstanding Thesis Awards presented by Dr. Juliane Wallace, Associate Dean and Director of the Graduate School**
- **Graduate and Professional Student Council Research Awards by Dianah McGreehan, GPSC Vice President for Administrative Affairs**

2019

ABSTRACTS



(* represents graduate)

Agricultural Sciences

***Alexandra Akaakar**

Agribusiness Economics

Oil Dependency and Food Security in Nigeria

Food insecurity is a condition of insufficient access to quality nutritious food, it is often rooted in shocks that interrupt the food production/distribution system in an area. Amidst the capabilities of Nigeria's agricultural system, the number of households across Nigeria experiencing food shortages increased rapidly, the main reason for this increase were price shocks. This incident highlighted a huge vulnerability in Nigeria's food system, the vulnerability to economic shocks. Incidences such as poverty, conflict and climate change, magnify the frequency of food insecurity, the ability to reduce vulnerabilities to all three depend on a stable economy and innovative policy. As a major oil exporter Nigeria's economy is affected by oil price fluctuations, this paper analyses the extent of the effect and how such volatility could increase vulnerability in the food system. Our analysis examined economic and agricultural factors to identify trends that negatively affect Nigeria's current food system, a time series model was used to analyze the relationship between the Nigerian economy and oil prices.

Food price shocks are one of the symptoms of economic downturns. Agricultural innovation and economic policies need to be formulated to prevent such shocks in the future. Given the dependency of economic performance on oil prices, a major move would be to diversify the Nigerian economy with adequate attention being paid to agriculture.

Hamza Ajeena and Dr. Amer AbuGhazaleh (McNair Scholar)

Animal Science

Use of oils to mitigate methane formation in the rumen

The effects of two essential oils (oregano (ORO) and moringa leaf extract oil (MLE)), and moringa seed oil (MSO)) on in vitro rumen fermentation and methane (CH4) production were examined in a 24-h batch culture experiment. Treatments in the study consisted of control (no oil supplemented), control plus ORO, control plus MLE, and control plus MSO. The oils were added to rumen cultures at 500 mg/L and each treatment was run in triplicate. After the 24-h of incubation and relative to control, CH4 production was reduced ($P<0.05$) only with the addition of ORO. Additionally, dry matter degradability, propionate concentration and total fatty acids (VFA) were only reduced ($P<0.05$) with the addition of ORO. The addition of ORO also increased ($P<0.05$) the concentration of butyrate relative to other treatments. To conclude, our results showed that ORO was the only oil effective in reducing rumen CH4 formation, however the effect was also associated with negative effects on rumen fermentation.

Sarah Dintelmann, Ron Krausz and Dr. Karla Gage

Crop, Soil, and Environmental Management

Effects of Tillage and Fertility on the Weed Seedbank over 49 Years in Southern Illinois

Reduced- and no-tillage soil conservation practices provide many benefits, including decreased soil erosion and increased water infiltration and soil organic matter. Tillage practices may also cause weed species shifts over time, but there are relatively few long-term studies on the impacts of reduced- and no-tillage on weed communities. A long-term study was established in 1970 to examine the interactive effects of tillage (conventional, chisel, alternate, and no-till) and fertility (No fertilizer, N-only, and NPK) treatments on grain yield and soil characteristics in St. Clair County, Illinois, at the Belleville Research Center. This study also provides the opportunity to test for differences in weed communities as a result of treatment over this 49-year period. In order to assess the below-ground weed community assemblage present in the seedbank, 50-5 cm diameter soil cores were taken per plot to a depth of 20 cm. Using these soil samples, a seedbank grow-out was conducted in the greenhouse and emerged weeds were identified and quantified. Data were analyzed using Analysis of Similarity (ANOSIM), Non-metric Multidimensional Scaling Ordination, and Analysis of Variance. Species-associated variables of richness, evenness, and Shannon-Weiner diversity index were observed based on tillage treatment. There were significant similarities and differences in the weed community by tillage and fertility treatments. There were 14 total weed species present in the seedbank, of which two were significant by tillage or fertility, henbit (*Lamium amplexicaule*), and common chickweed (*Stellaria media*). Henbit was most abundant in no-till treatments and less abundant as disturbance increases; no-till, alternate, chisel, and conventional, respectively. Fertility significantly influenced the emergence of henbit and common chickweed, both with their highest emergence in high fertility systems (NPK). Species richness was highest in chisel tillage systems. Absolute lowest diversity was found in no-till systems.

Brooklin Frisch (REACH)

Crop, Soil, and Environmental Management

Improving Control Efficacy of a New Forest Invader, Arum italicum, in Southern Illinois

Arum italicum (Italian arum) is a new, invasive plant of concern for southern Illinois, with the potential to disrupt forest ecosystems and negatively impact native plants. Anecdotally, control success has been limited in other geographies using hand-digging and chemical methods. Therefore, the objective of this study is to test the control efficacy of forest-labeled herbicides, to investigate potential control methods for a local, spreading population of *A. italicum*. Herbicides were tested at fall and spring application timings with four replicates. In May 2018, twenty-four 0.25 m^2 research plots were established within a dense *A. italicum* invasion in Campus Woods and randomly assigned to the following treatments: 1) control, 2) metsulfuron-methyl, 3) aminopyralid, 4) metsulfuron-methyl + aminopyralid, 5) metsulfuron-methyl + glyphosate, and 6) metsulfuron-methyl + imazapyr. Plots were permanently marked for repeated observation. Applications were made with a hand-held spray bottle. Fall applications were made in November 2018 in 24 new plots randomly assigned to one of the treatments. Data collected include percent cover, stem count, and seedling and adult numbers of *A. italicum*. Following application, visual assessments of percent control were taken at 7, 14, and 21 days after application (DAA). Additionally, percent injury was estimated for non-target plants in each plot. Spring 2018 data suggest that metsulfuron-methyl + aminopyralid had the highest control efficacy of all other treatments by 14 DAA with 20 to 25% control, exhibiting 35% control by 21 DAA before the plants began to naturally senesce. Non-target plant injury for this treatment was similar to other treatments, ranging from 30 to 60% at 14 DAA and 40 to 75% at 21 DAA. While the metsulfuon-methyl + aminopyralid treatment had the greatest control, 35% is not acceptable in most management scenarios. Fall 2018 data are still being collected and will be analyzed for differences by application timing.

Alexander Mueth

Crop, Soil, and Environmental Management

Influence of a Winter Wheat Inter-seeded Crop on Common Waterhemp Control in Dicamba-Resistant Soybean

Herbicide-resistant weeds are a major problem across the globe in multiple cropping systems, including soybean (*Glycine max*). As a result, weed management costs have increased in order to maintain season-long weed control. Multiple herbicide-resistant biotypes of common waterhemp (*Amaranthus tuberculatus*) are prevalent across the Midwest. The lack of novel herbicide sites of action necessitates investigation of innovative nonchemical weed control practices. A field study was initiated in Belleville, Illinois investigating a novel approach to cultural weed control by inter-seeding winter wheat (*Triticum aestivum)* in soybeans for the suppression of common waterhemp. Traditional PRE followed by POST herbicide programs were compared to the inter-cropping treatments in regards to weed control. The winter wheat was terminated when the soybeans reached the V5 growth stage, and this allowed for adequate winter wheat biomass accumulation. Visual weed control ratings were taken at 7, 14, 28, and 56 days after treatment (DAT). The PRE followed by POST program of fomesafen plus s-metolachlor followed by glyphosate plus dicamba provided 99% control of common waterhemp at 56 DAT, which was not different than the common waterhemp control provided by the inter-seeding of winter wheat followed by glyphosate plus dicamba. These data suggest that the inter-seeding of winter wheat into a soybean crop, in combination with herbicide, may provide a potential alternative to manage common waterhemp. Further studies to determine the best agronomic practices to mitigate competition of inter-seeded winter wheat in a soybean crop should be investigated.

Anastacia Hanauer[1], Amanda Weidhuner[2], and Dr. Amir Sadeghpour[2] (REACH)

[1]Forestry, Southern Illinois University Carbondale, Carbondale, IL

[2]Plant, Soil, and Agricultural Systems, Southern Illinois University Carbondale, Carbondale, IL

49 Years of Tillage Impacts on Soil Aggregates and Aggregate-Associated Carbon and Nitrogen

Tillage practices could significantly influence soil aggregation. Stable aggregates could protect carbon (C) from mineralization, improve soil structure, and increase soil moisture availability and crop yield. The objective of this study was to evaluate the effect of four tillage practices including moldboard plow (CT), chisel-disk (RT), 2-yr no-till and 1 year CT (AT), and no-till (NT) on (i) soil aggregate size distribution, (ii) soil aggregate stability, (iii) aggregate-associated C and N, (iv) soil moisture and temperature, and (v) corn (*Zea mays* L.) yield. Percentage of large dry (2-4.75 mm) aggregates generally increased in the order of AT > RT > CT ≥ NT; indicating disturbing the soil after 2-yr of NT offsets the benefit of increasing aggregation by NT. High percentage of large aggregates in CT reflects false aggregation supported by a low percentage of water-stable aggregates in CT. Therefore, CT was prone to water erosion losses more than other tillage treatments. No-till had the greatest percentage of small water stable aggregates (65%). Large water stable aggregates were similar among all tillage treatments (P<0.06). Soil C and N were higher in large and small aggregate sizes in NT compared with other tillage treatments, in line with our hypothesis that NT provides protection against C mineralization. Improved soil structure resulted in higher volumetric water content during the growing season in NT (35%) vs. RT (26%); but all these benefits did not translate into greater yield in a year with ample and timely precipitation and corn yields were 5% less in NT compared with RT and CT. This indicates that NT will most likely improve yield in dry growing seasons and thus, future research should focus on yield stability and resiliency of NT vs. other common tillage practices over time and assess modification options to increase NT yield in wet seasons.

Kyle Yorke (REACH)

Forestry

Effects of white-tailed deer on vegetation in Southern Illinois

White-tailed deer (*Odocoileus virginianus*), are important to humans and ecosystems as a game species and shapers of forest dynamics. Deer populations have become overabundant in much of their range in the U.S., and have a wide and varying diet, including tree seedlings and saplings. When overabundant, deer can negatively affect several different types of vegetation, including oak (*Quercus spp.*) and hickory (*Carya spp.*) tree species. Both tree species are native to Southern Illinois and the broader Central Hardwoods region and are key factors in promoting the health of their surrounding ecosystems. This project investigates the impact that deer and forest management have on oak and hickory tree regeneration in central hardwood forests. By examining the differences between densities and heights of oak and hickory seedlings in fenced deer exclosures and unfenced control plots we can determine how deer are impacting forest vegetation communities. Located in Southern Illinois, Trail of Tears State Forest has recently implemented several types of forest management in attempt to boost oak and hickory regeneration. These treatments include prescribed burns and vegetation removal cuttings. While this approach to management is effective in many forests, potential deer-use effects are often overlooked. Few regional studies have assessed the impacts deer may have on forest regeneration in forests undergoing active management. I aim to determine the different impacts white-tailed deer have across these various forest management units. As a result of the study, foresters and wildlife managers will be able to see what the most effective management plans are to restore oak and hickory in deer habitat, which is critical to forest health and sustainability.

***Ibrahima Coulibaly**

Agri-Business Economics

Evidence that State Tuition Guarantee Policy Can Adversely Impact the research University Enrollment More Than the Regional University: Illinois Truth-in-Tuition effect on Southern Illinois University Carbondale Versus Southeast Missouri State University

The education policy implication for a research university like SIUC is huge since many universities across the United States have seen their retention rate and enrollment declines. There is public pressure on the politics to enacted law that prevents tuition increase. Therefore, one of the aims of this research is to understand the effect of such tuition freeze policy has on university ability to maintain its student population and the same time its ability to pay the operating cost. Such a plan has huge implication not only on the university like SIUC operating cost but also the school ability to fulfill its mission and keep the tuition cost lower. This research is unique in the sense it adds value to the policy and educational literature. It also gives insight into why and how university like SIUC enrollment decline over time. Furthermore, this study is also unique because it uses time series to forecast SIUC's enrollment swing. This study uses difference in difference (DiD) with fixed effects as the main estimator to explain the impact of tuition guarantee policy effects have on the Southern Illinois University Carbondale.

These preliminary results show that in the presence of university traits, regional and state characteristics, the Truth-in-Tuition policy does impact Illinois university enrollment negatively. Furthermore, it negatively impacts intensive research university enrolment more than regional university. SIUC is the research-intensive university versus SEMO, which is regional university like SIUE, according to the Carnegie 2016 classification. Therefore, the Truth-in-Tuition impacts the SIUC enrollment more than its counterpart regional Illinois universities like SIUE.

***Das, K[1]., Dr. R. Choudhary[1], and Dr. K. Witrick[2]**

1 Plant, Soil and Agricultural Systems, SIU
2 Animal Science, Food & Nutrition and the Fermentation Science Institute, SIU

The utilization of apple fiber to determine the impact it has on the physical and sensory characteristics of made in transit (MIT) yogurt

Made-in-transit (MIT) is a supply chain concept for the complete or partial manufacturing or production of perishable foods while being transported to the market. Fermented foods like yogurt are ideally suited for the MIT concept, due to the fermentation period required to produce it. The period required to transport the product from the manufacturing facility to the market should coincide with the time required for the fermentation process to be completed. A 3^3 factorial design was carried out looking at the fermentation temperature (25°C, 30°C, and 35°C), apple fiber concentration (0.5%, 1.0%, and 1.5% v/w), and experimental treatment (vibration or no vibration to mimic that associated with transportation). Apple fiber was added to the milk matrices prior to fermentation to assist in the gel properties when the yogurt was being fermented under vibration conditions. Yogurt was manufactured using one of the three apple fiber conditions and then fermented under one of the three fermented temperatures for 48 hours before being shifted into a 4°C cold room to finalize the gelling process. The physical-chemical properties (titratable acidity, pH, whey syneresis, and texture analysis) were analyzed for all conditions. Samples were analyzed using three-way ANOVA. There were noticeable differences between the fermentation temperature and the experimental treatment on the physical-chemical attributes measured. The apple fiber had no impact. A total of 51 people participated in a hedonic testing study to look at the impact the fermentation temperature, apple concentration, and the experimental treatment had on the appearance, aroma, taste, and mouthfeel of the yogurt. Consumers found the MIT yogurt to be unacceptable based upon all attributes tested (appearance, aroma, flavor, and mouthfeel).

***Zhou Zhou[1], Naoufal Lakhssassi[1], Tri Vuong[2], Henry T. Nguyen[2], and Dr. Khalid Meksem[1]**

[1]Department of Plant, Soil and Agricultural Systems, Southern Illinois University, Carbondale, IL 62901, USA. [2]Division of Plant Sciences, University of Missouri, Columbia, MO, 65201

New sources of soybean seed composition traits identified through forward and reverse genetics

Soybean [Glycine max (L.) Merr.] is the world's most widely grown protein/oilseed crop and provides about 68% of global food oil as well as protein meal and renewable fuels. Using mutation breeding, the novel soybean germplasm with modified seed composition traits have been successfully produced to meet the different needs of end users. The soybean oil typically consists of five major fatty acids with high in unsaturated fatty acids. Soluble carbohydrates present in soybean meal attract more interests as an effort to understand their contribution to livestock metabolizable energy. The Ethyl methanesulfonate (EMS) mutagenized 'Forrest' populations have been extensively employed using both forward and reverse genetic approaches to study the function of genes controlling economically important traits in soybean. In this study, a subset of 810 Forrest M3 families was forward genetically screened to measure the contents of protein, total oil, carbohydrates, and fatty acids. The M4 families presenting altered fatty acids profile from M3 generation were selected for subsequent forward re-screening, and then mutants showing traits heritability have been chosen for genotyping analysis. One *GmSACPD-C* and two *GmFAD2-1A* mutants were identified to have stable high seed stearic acid and oleic acid content between M3 and M4 generations by target sequencing. Correlation analysis of M3 families revealed that sucrose, raffinose, and stachyose content were not statistically correlated with protein content, while the negative correlation between oil and protein content was observed. Within seed carbohydrate profiles, the positive correlations were shown among sucrose, raffinose, and stachyose content. Identification of mutants with altered carbohydrate profiles were ongoing with the advantage of the availability of candidate genes in soybean carbohydrate biosynthesis pathway. The obtained mutants with altered fatty acids and carbohydrate profiles can be used in soybean breeding for the desired seeds phenotypes.

Applied Sciences and Arts

Nathaniel Shaw and Dr. Shintaro Kano (REACH)

Physical Therapist Assistant

Veterans' reintegration to civilian lifestyle: The roles of communities and recreational activities

Many military veterans experience difficulties in reintegration into civilian society. Several studies examined how medical model interventions facilitate veterans' reintegration. However, some studies have also found that veterans do not proactively seek traditional health services largely due to associated stigma and lack of confidence in their efficacy (Hoge, 2014). Thus, there has been increasing attention to recreation or activity-based interventions, including rock climbing, hiking, and running, as an alternative, more engaging and sustainable treatment for rehabilitation of wounded veterans and their reintegration in civilian lifestyle (David Donaldson, 2016). While these studies seem promising, the extant research only examined recreational activities exclusively for veterans. This is problematic because veteran-civilian interaction is crucial to successful reintegration. The current study aims to fill this gap in the literature with the purpose of better understanding how veteran-civilian interaction during recreational activities assists in veteran reintegration into civilian life. The current mixed-methods study is composed of two parts. First, qualitative semi-structured interviews regarding what facilitated reintegration are conducted with 10 veterans in the Southern Illinois area. The average interview length is approximately one hour. We are currently analyzing the data using thematic analysis method (Braun & Clarke, 2006). Following the interview, a quantitative questionnaire on key predictors of veterans' reintegration will be soon administered with approximately 100 veterans during events and via email and social media. The survey includes validated scales of participation in recreation (Walker et al., 2011) and veterans' reintegration (Sayer, 2011) as well as measures of variables unique to the current study and the foregoing interview study results (e.g., civilian-veteran interaction). Once data are collected, we will conduct a multiple regression analysis, where the dependent variable is reintegration score and the independent variables are recreation participation, civilian interaction, control variables, and demographics (e.g., gender, combat experience, health issue diagnoses).

Education and Human Services

***Erin Bily-Luton, Caleb Stanley, Dr. Mark Dixon**

Behavior Analysis and Therapy
Rehabilitation

Post-Reinforcement Pause in Gamblers at Slot Machines

Post-reinforcement pause was examined to determine the reinforcing value of a win, loss, and a loss disguised as a win (LDW) for gamblers at multi-line video slot machines. The study was conducted in naturalistic settings across a variety of participants, age 21 years and older. The length of the post-reinforcement pause was recorded using a stopwatch for one win, one loss, and one LDW for each participant and was measured by recording the time between the outcome delivery and the initiation of the next spin. The different times were evaluated to determine which of the three provided the most reinforcement to the gamblers. The present study replicates and extends previous research on post-reinforcement pause in slot machine gambling, and provides discussion around the clinical utility of such findings on the prevention of problem gambling. Problem gambling is an epidemic, and there are numerous variables that contribute to its development. Post-reinforcement pause is one for those factors, and the present study can help us gain a better understanding of the events that encourage problem gambling and ways to prevent it.

Keywords*:* Post-reinforcement pause, Loss-disguised-as-win, Gambling, Slot machine, Problem gambling

***Kwadwo Britwum, Anne Sheerin, Caleb Stanley and Dr. Mark Dixon**

Behavior Analysis and Therapy

Rehabilitation

A comparison of blocked verses mixed-trial methods in equivalence-based instruction

The current investigation extends the work of Bentha, Walker, Pluym, and Tejeda (2018), by comparing mixed- and blocked-trial methods in an equivalence-based instruction arrangement. Mixed-trial programs involved presenting different sample stimuli in randomized order, whereas blocked-trial programs involved presenting the same sample stimulus in a single block program. Mixed-trial and blocked-trial programs were selected from an equivalence based instructional curriculum. Programs were completed across two children with Autism Spectrum Disorder (ASD). Results add to the current data base on the utility of selecting appropriate block designs in conditional discrimination training for individuals with ASD.

Keywords: blocked-trial methods, mixed-trial methods, children with ASD, and equivalence-based instruction.

***Haley Davis, Becky Barron, and Dr. Mark Dixon**

Behavior Analysis and Therapy

Rehabilitation

Evaluating a transitional intervention for children with autism from Applied Behavior Analysis therapy to Acceptance and Commitment Therapy

Children with autism often receive Applied Behavior Analytic (ABA) therapy to improve skills in areas related to social interactions, communication, and behavioral deficits. Most often, when children end this traditional intervention, they often do not have a next step in intervention. Acceptance and Commitment Training (ACT) targets areas related to social-emotional development and psychological flexibility. These areas may be beneficial for children with autism who have succeeded in traditional ABA methods to move to. Research regarding this transitional period has lagged behind the majority. Therefore, the purpose of this study was to evaluate a transitional intervention for three individuals who either were beginning this transition or had briefly begun this ACT services, that began displaying problematic behaviors that were interfering with services. Students were taught ACT concepts and skills using a more traditional ABA model, and then transitioned into a more common ACT delivery method once they succeeded within the ABA model. Children were assessed before, throughout, and after the intervention on frequency of challenging behaviors, meaningful participation in sessions, and psychological flexibility. Challenging behaviors reduced for all students across the intervention and maintained into ACT delivery. Meaningful participation and psychological flexibility also improved.

Keywords: Autism, Acceptance and Commitment training, ABA Therapy

***Joshua Hollie, Rebecca Barron, and Dr. Mark R. Dixon**

Behavior Analysis and Therapy

The Impact of Social Variables on People of Different Races and Job Types

The purpose of this study was to assess how social variables such as race and socioeconomic status influence college students' perceptions of people of different races and job types. Twenty-two college students at a Midwestern University participated in the study. During the pre-test, participants rated the degree of "Good" or "Bad" of various pictures of African American males, police officers, and random objects on a Likert-type scale. Next, based on their pre-test ratings, participants completed a match to sample task that paired pictures of African American males and police officers opposite of their initial perceptions. Afterwards, all participants again completed the Likert-scale rating task. Pre-test results demonstrated that African-American students were more likely to rate police officers as bad than were white students. Match to sample task results showed that students took more trials to complete the task when they were required to pair pictures of African-American males with negative stimuli and police officers with positive stimuli. Additionally, post-test results revealed that most participants changed their perceptions for at least one stimulus class following the match to sample task. A subset of students further generalized their post-test perceptions to African-American men and police officers not utilized in the match to sample task. Implications for forming new relational frames that contrast socially loaded stimuli are discussed.

Keywords: Relational Frame Theory, socially loaded stimuli, African American, police officers, match to sample.

***Quincy Huff, Becky F. Barron, and Dr. Mark R. Dixon**

Behavior Analysis and Therapy

Evaluating the effects of Acceptance and Commitment Therapy and Mindfulness on Children's Attention and Psychological Flexibility

Acceptance and Commitment Therapy (ACT) is a behaviorally-based intervention that promotes values-driven behavior change. ACT teaches skills such as acceptance, present-moment awareness, commitment to values-based actions, and new ways to interact with stressful and anxiety provoking thoughts and feelings. Mindfulness is a popular component of present moment awareness that is often taught within an ACT model of intervention. The purpose of this study was to determine if mindfulness alone or ACT could influence the psychological flexibility and attention of children with autism and related disabilities aged 7-18. Ten participants received four weeks of either ACT or mindfulness training in a group therapy setting twice a week. A series of psychological flexibility and mindfulness questionnaires were administered to the participants along with computerized and physical attention tasks prior to and after completing the series of ACT and mindfulness activities sequence. The overall result of the study indicated that ACT may be a way to provide more wholistic services to children and adolescents with autism compared to mindfulness only, but that both interventions have value within this serviced population.

Keywords: Autism, Acceptance and Commitment Therapy, Mindfulness, Behavior Analysis

***Mariah Patz, Caleb Stanley, and Dr. Mark Dixon**

Behavior Analysis and Therapy

Act-Based Statements Effect on Bartending Tips

Acceptance and Commitment Therapy (ACT) is a behaviorally-based intervention that emphasizes psychological processes related to mindfulness, values, committed actions towards values, defusion from troubling thoughts, and acceptance. ACT is often used with populations who experience psychological inflexibility or stress, but not much research has been done understanding how ACT processes may affect everyday tasks within the common public or within business practices. The present study used a randomized controlled trial to determine the effect that statements related to ACT processes given while receiving a bar tending service altered the outcome tipping percentage from guests. The current research also discussed how each statement used relates back to the various components of ACT. The current study suggests a potential way to increase tips that a bartender or server can receive by providing a simple ACT-based statement to their customers while still maintaining an inviting and friendly environment for entertainment. Organizational behavior management (OBM) is an area of behavior intervention ripe for ACT research. Future OBM research could extend upon by incorporating the use of ACT, or ACT related processes into everyday business models and behaviors.

Keywords: acceptance and commitment therapy, randomized controlled trial, organizational behavior management

Tatiana Green and Dr. Maria Claudia Franca

Communication Disorders and Sciences

Vocal Risk for Speech-Language Pathology Majors

Objective: This study was designed to investigate the vocal habits of pre-professional occupational voice users in order to gather information about the vocal habits of occupational voice users, more specifically students majoring in speech-language pathology.

Method: One hundred and thirty seven university students majoring in speech-language pathology, with age ranging from 18 to 36 years, responded to questions related to their vocal habits as well as feelings and attitudes regarding their voice usage. This study involved the use of the Voice Symptom Scale (VoiSS) and self-reported data regarding demographics and voice usage using the Vocal Risk questionnaire, created for this study.

Results: It is hypothesized that ongoing analyses of data will indicate associations between voice difficulties and vocal behaviors such as no rest after prolonged usage and consumption of laryngeal irritating substances.

Conclusions: Results of this study will help understand the impact of vocal habits on the quality of voice among pre-professional voice users. Inappropriate use of voice can impede the quality of performance for occupational voice users. This research yields promising data for the effects of vocal habits of speech-language pathology majors

***Kyle Miller and Brianna Sinche**

Health Education

Vaping Behaviors, Knowledge and Perceptions among Students at Southern Illinois University Carbondale

Background: Discourse about the possible effects of vaping and motivations behind its use has increased in the medical and public health arenas. Little research has been done to describe vaping among college students. To better understand this population, the present study examined vaping attitudes, beliefs, and knowledge of SIU students.

Methods: A survey was distributed to all registered students during November 2018 that assessed vape usage, knowledge of the campus smoke free policy, and beliefs about the potential association of vaping with negative health consequences. Students who completed this survey and reported that they currently vape were invited to take a second survey. This survey assessed frequency and length of use, reasons for vaping, likes and dislikes of vaping, health beliefs about vaping, and methods of vaping. Descriptive statistics and bivariate analysis were performed using SPSS Version 25.

Selected Results: 1914 students responded to the initial survey. Results indicated that 78% of respondents do not vape, 55% are misinformed about the campus smoke-free policy and 75% agree that vaping has the potential to cause negative health consequences. 361 students completed the second survey. 50% of respondents have been vaping for less than one year and 64% did not use vaping to quit cigarettes. Vape mods or pens and Juul were the most utilized vaping devices. 61% indicated vaping multiple times a day. 62% agree that vaping has the potential to cause negative health issues with 54% agreeing that the vapor exhaled can affect others.

Conclusions: The survey provided baseline data on vape behaviors, knowledge and usage for the SIU student population. There is sufficient evidence to suggest that students could benefit from increased knowledge about vaping and its associated consequences. The data collected in these surveys can be used to inform targeted messaging on future campus media campaigns.

***Anthony Hudson and Dr. Michael W. Olson**

Kinesiology

Trunk Muscle Activation Response to Single Leg Drop Landings before and after Trunk Extensor Fatigue.

Neuromotor response of the muscles supporting the trunk are vital to maintaining trunk stability. Previous research has determined that loading of the trunk to fatigue can induce modified electromyographic (EMG) responses to external perturbations.

PURPOSE: To evaluate the activation patterns of the trunk muscle during a single leg drop landing protocol before and after neuromuscular fatigue of the trunk extensor muscles.

METHODS: Sixteen health individuals performed maximal voluntary isometric trunk flexion and extension efforts (MVIE) to determine the maximum EMG from four muscles groups: thorasic paraspinals (TP), lumbar paraspinals (LP), rectus abdominis (RA), and external oblique (EO). A foot switch was adhered to the plantar surface of the participant's foot. Participants performed 10 single leg drop landings from a height of ~30 cm. Participants then performed isometric trunk extension efforts at 60% MVIC for up to 10 min to induce neuromuscular fatigue. Ten additional landings were performed immediately following the fatigue protocol. EMG were normalized to MVIE. Dependent variables of interest were the time delay between initial landing and EMG peak amplitude, and EMG peak of each muscle group. Repeated measures ANOVA was used to analyze the dependent variables between landing conditions. Alpha was set at 0.05.

RESULTS: Significant time delay interaction effects were present for condition x muscle ($p < 0.05$) as LLP and EO timing and EO and RA timing were different ($p < 0.02$). No changes in the peak EMG amplitude were denoted for any muscle group.

CONCLUSIONS: Although there are no significant differences between landing sessions, there are indications that muscle activity from the trunk muscle group may be delayed during landing with induced neuromuscular fatigue. Additional analyses of the EMG and exploration of the kinematics data is warranted to further explore trunk stabilization and trunk muscle activation.

***Paige S. Boydston and Erica S. Jowett Hirst**

Rehabilitation

Perceptions of causes of autism

Practitioners need to be sensitive to variables that may impact treatment services. One such variable is the varying beliefs for causes of autism. Although there is some research on how beliefs may impact treatment decisions (e.g., Dardennes et al., 2011; Moore & Symons, 2009), no standard measure assessing perceptions of the causes of autism exists in the current literature. The current study sought to address the gap in the literature by completing a series of analyses (exploratory factor analysis and visual analyses) with the Autism Perception Evaluation, a 27-item survey created to assess caregiver perceptions of what may have caused or attributed to an autism diagnosis. In total, 507 respondents across three general groups (professionals, caregivers/parents, and individuals unfamiliar with an individual with autism) rated each of the survey items on a 5-point scale based on how likely they thought the item may contribute to the development of autism (1 = “not at all possible” through 5 = “very strongly possible”). Results indicated that patterns of responding were similar across all three groups and that the 27 items could be grouped into five broad categories. The current study is a preliminary step in identifying variables that may impact treatment.

***Ayla Schmick, Kwadwo Britwum, Anne Sheerin, Quincy Huff, and Dr. Mark Dixon**

Rehabilitation

The relationship between delay discounting and derived relational responding in individuals with ASD

Delay discounting as a measure of choice behavior describes the depreciation in the value of a reward as function of the time it takes to access the reward (Matta, Goncalves, Bizarro, 2012). Selecting the smaller sooner reward is termed an impulsive choice, whereas selecting the larger later reward is termed a self-controlled choice (Ainslie, 1974). This measure of choice behavior has been used widely in Psychology research. Despite the many studies on delayed discounting in humans, no study has explored the relationship between delayed discounting and derived relational responding in individuals with Autism Spectrum Disorder (ASD). Monetary discounting surveys, and assessments of derived relational responding were completed across 30 participants with ASD in the current investigation. Monetary surveys included questions requiring participants to choose between an immediate hypothetical monetary reward, and a hypothetical delayed monetary reward, with varying delay periods. Derived relational responding skills were assessed using the *Promoting the Emergence of Advanced Knowledge Transformation Assessment* (Dixon, 2016). Preliminary data provides some useful implications for the treatment of individuals with Autism Spectrum Disorder in applied settings.

Keywords: Derived relational responding, delay discounting, Relational Frame Theory, Autism.

***Tingting Liu**

Workforce Education and Development

Military Service Members in Higher Education: A Literature Review

The Post-9/11 Veterans Educational Assistance Act of 2008 or the "New GI Bill" has led to increasing enrollment and related changes of environment in higher education. The college student population nowadays varies intensely from that of 20 years ago (Deutsch & Schmertz, 2011) and indicates the diverse nature of the U.S. military with a wide range of differences across the demographic and economic aspects. Institutions of higher education aim to develop higher learning for students and offer an education that does not only support them in the future but also provide valuable opportunities for exploring the higher education environment which make them grow and mature. However, research indicates that many military service members who enter higher education after serving in the military lack a thorough understanding of the educational benefits that they are qualified (Ackerman, DiRamio, & Mitchell, 2009). It is crucial that this population be further explored and fully understood in order to fulfill the demanding need for a more knowledge-based workforce in today's global job market. This study investigates current literature published on the military personnel population in the context of higher education particularly. It is the hope of the researcher to identify gaps in the current literature. More specifically, this poster presentation is to provide a glimpse of the educational experience (i.e., barriers, motivations, and academic performances) military service members encounter in higher education.

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Engineering

***Suman Aryal and Dr. Prabir K. Kolay**

Civil and Environmental Engineering

Long-Term Durability of Ordinary Portland Cement and Polypropylene Fiber Stabilized Clay

Soft soil stabilization frequently uses cement, lime, fly ash etc., nowadays, but very limited studies were conducted on its long-term durability. However, few techniques were developed to measure the durability of soil, which are not realistic in approach. The present study deals with long-term durability of stabilizing commercially available EPK clay with ordinary Portland cement and polypropylene fiber, using a much more realistic approach. Experimental investigations were conducted to find the percentage loss of soil during wetting and drying, which is used as durability indicator of cement and mix of cement-fiber combination of stabilized soil. Stabilized soil samples are subjected to harsh environmental conditions in a laboratory set up and their deterioration was observed and studied in each wetting-drying cycle. Samples are stabilized using a different percentage of cement and mix of cement-fiber were subjected to 12 cycles of wetting-drying to determine the percentage loss of soil as per ASTM standard. Although this procedure is tedious, visualization of deterioration with timeframe can be observed. Finally, based on the percentage loss of soil of those samples which survived up to 12 cycles, the optimum content of stabilizing agent was determined. The results indicated that, EPK soil stabilized with 5% and 10% cement in combination with 0.5% fiber survived up to 12 cycles but, only 10% cement with 0.5% fiber was more durable against wetting-drying cycle. For the same stabilized soil, a different approach of predicting durability i.e., freezing-thawing study is ongoing. Both the methods i.e., wetting-drying and freezing-thawing are much more realistic for interpreting the durability of stabilized soil.

Keywords: Clay, Cement, Polypropylene fiber, Stabilization, Durability, Wetting-Drying

***Neekita Joshi and Dr. Ajay Kalra**

Civil and Environmental Engineering

Trend and Step Detection in Sea level along the US coast

Most of the research has suggested that the rise of sea level can have devastating effects on population and coastal habitats. The primary factor driving sea level rise is often related to climate change. However, some studies are skeptical about sea level acceleration. It is important to detect the trend of sea level to further assert these two school of thought. In this study, monthly tide gauge data were collected over 59 stations along the coast to analyze the trend and step changes using a nonparametric statistical test. Four version of Mann-Kendall test was used in this study: (1) Mann Kendall without autocorrelation (MK1), (2) Mann Kendall with lag-1 autocorrelation and trend-free pre-whitening, (3) Mann Kendall with complete autocorrelation and (4) Mann Kendall with long term persistence (LTP) (MK4). Pettitt's test was used to identify the presence of shifts and the direction of change. Overall, a number of stations showing significant increasing trend were 38 and 21 remained unchanged with MK1 test. However, the number of stations with an increasing trend were 32 and 27 remained unchanged with MK2 test. Persistence in data can lead to erroneous detection of trends, to account this, LTP was also considered. Only two stations showed an increasing trend whereas 57 remained unchanged. Results from this study may assist to understand the sea level change patterns across the contiguous US. Overall, this study provides an elaborative view of sea level trends and shifts.

Keywords: Sea Level change patterns; trends; shift; persistence

Cari Rutherford, Peerzada Madany, and Dr. Jia Liu (REACH)

Civil and Environmental Engineering

Bacteria Inactivation in Wastewater Effluent by Eco-friendly Iron Nanoparticles under Light and Dark Conditions for Water Reuse

Due to a scarcity of freshwater in multiple locations around the world, methods for treatment and reuse of wastewater are increasingly being researched. A novel environment-friendly and cost-effective treatment procedure using nanotechnology was developed in this study to inactivate bacterial contaminants in wastewater effluents for its reuse as a sustainable water resource. The types of nanoparticles (NPs) synthesized were zero-valent iron (Fe^0) NPs and three different types of ferric oxide NPs (i.e., γ-Fe_2O_3, chitosan coated γ-Fe_2O_3, and γ-Fe_2O_3/TiO_2). A 'foam' precipitation, a wet chemistry, and an oxidation and co-precipitation method was followed for the synthesis of Fe^0, γ-Fe_2O_3 and chitosan coated γ-Fe_2O_3, and γ-Fe_2O_3/TiO_2 NPs, respectively. Characterization of the NPs was conducted by dynamic light scattering, and scanning electron microscopy with energy-dispersive X-ray spectroscopy. The results showed that the synthesized particles were in nanoscale (i.e., < 100 nm), spherical-shaped, and uniformly sized. *Escherichia coli* bacteria was isolated from wastewater effluent of a local wastewater treatment plant. Interaction of the NPs with *E. coli* was conducted both under visible light and in the dark for 1 hour. Afterwards, the suspension was serial diluted and the bacteria was quantified using the nutrient agar plate cultivation. The desired results were achieved using the chitosan coated γ-Fe_2O_3 and γ-Fe_2O_3/TiO_2 NPs. These NPs inactivated almost all the *E. coli* at a concentration of 1 g/L. However, γ-Fe_2O_3 and Fe^0 NPs promoted the growth of bacteria under visible light and in the dark, respectively. Further study will be conducted in the molecular level by quantitative PCR for the uidA gene of *E. coli* to verify the result. This study showed potential for the use of chitosan coated γ-Fe_2O_3 and γ-Fe_2O_3/TiO_2 NPs under visible light or in the dark for bacterial inactivation in wastewater effluent for potential water reuse.

***Wisam Subhi Al-Dayyeni and Dr. Jun Qin**

Electrical and Computer Engineering

Investigations of Auditory Filters Based Excitation Patterns for Assessment of Noise-Induced Hearing Loss

Noise-induced hearing loss (NIHL) is a health issue that has been studied for decades. To assess NIHL, the excitation pattern (EP) has been considered as one of the techniques to estimate the movements of the basilar membrane (BM) in the cochlea. In this study, two auditory filters (dual resonance nonlinear filter and rounded-exponential filter) are applied to create two EPs which are the velocity EP and the loudness EP, respectively. Two noise hazard metrics are used to evaluate hazardous levels caused by different types of signals. Moreover, Gaussian noise and a tone are simulated to evaluate performances of the proposed EPs and the noise metrics. The results show that both EPs can demonstrate the response of the BM to the Gaussian noise and the tone. For the Gaussian noise, there is a frequency shift between the velocity EP and the loudness EP. For the tone case, both EPs can demonstrate the frequency of the input signal. The results suggest that both EPs can be potentially used for NIHL assessment.

Allison McMinn (REACH)

Electrical Engineering

Tomosynthesis Image Reconstruction for Early Breast Cancer Detection

Breast cancer is the most common cancer among women. It is the second leading cause of cancer mortality (after lung cancer), representing 15% of all female cancer-related deaths. Early detection is viewed as the best hope to decrease breast cancer mortality by allowing intervention at an earlier stage of cancer progression. Improving breast imaging technologies may permit breast cancer to be detected at a smaller size and earlier stage, thereby reducing the number of women who die each year from breast cancer. Digital breast tomosynthesis (DBT) is an emerging three-dimensional imaging technique that allows the reconstruction of an arbitrary set of planes in the breast from limited-angle series of x-ray projection images. In this project, several DBT image reconstruction algorithms including shift-and-add, back projection, and filtered back projection were studied and compared. DBT imaging based on breast phantom images, computer simulation and image quality characterization were investigated. Results demonstrated that DBT enables the three-dimensional low dose breast imaging. Compared with two-dimensional mammography, DBT shows great potentials to improve early breast cancer detection by distinguishing the cancer from its overlying breast tissues.

***Gopi Bylapudi**

Engineering Science

Corrosion monitoring and data interpretation of rock anchors in underground mines with half-cell potential technique

Corrosion of roof support systems in underground mines can be a serious threat to rock related safety with a direct impact on the workforce and then production. The majority of research related to corrosion of roof bolts/rock anchors used in underground mines were focused on identifying the factors responsible for the corrosion and testing the commonly used bolt material in different conditions. Corrosion monitoring work to identify the corrosion severity of roof bolts in the field was new to the underground mining industry and could be a possible solution for the mentioned problem. The only known study in the past was done here at SIUC where the method to determine the corrosion potential of the roof bolts has been developed after testing in several underground mines in the U.S.A. The developed methodology was based on spot readings which give only the chance of corrosion activity at that time and doesn't tell the reader the severity of it. To assess the roof bolt corrosion severity, the long-term corrosion monitoring of the bolts corrosion potential and shift with time is required and hence recorded in situ in this study using half-cell potential technique. The study also explains the factors that influence the potential shift and to achieve that, linear polarization resistance technique was used. Hence, this research is significant to understand and improve the developed technique to be used by the underground mining industry in assessing the roof bolt corrosion severity.

Acknowledgments

The authors thank Prairie State Generating Company management for access to their underground facility to test the instrument and the theory. The authors would also like to thank the SIUC Mining and Mineral Resources Engineering Department for their support. Special thanks to GMC Electrical for supplying the permanent standard reference electrodes that were used in the field. Lastly, the authors would like to thank Minova for their continuous support.

***Sakineh Esmaeili Mohsen Abadi**

Mechanical Engineering and Energy Processes

Existence of TRCs and non-TRCs (Differentiated cancer cells) within tumors in Pancreatic Adenocarcinomas

Among the deadliest cancers, stands pancreatic cancer with less than 8% survival rate [1]. With around 60,000 new cases of pancreatic cancer every year, there is no screening test or known biomarker for early detection, thus most patients are diagnosed too late to get any benefit from treatment. The morphology, composition and structure of pancreatic adenocarcinomas are obscure. Understanding the mechanism of growth, repopulation and migration of these rapid growing cells will give us an insight into preventing, diagnosing and treating them. In human body, cells are in 3D environment with varying stiffness. Adult stem cells which are undifferentiated cells risen from embryonic stem cells, have self-renewal and multipotency potentials and can give rise to progeny of different cell types. Some cancer cells, similarly, hold in common such potencies which is the underlying reason behind the relapses. In this study, the morphology and growth rate of Mia_PaCa 2 (Pancreatic adenocarcinoma cell line) in varying ECM (Extra cellular matrix) stiffness were investigated. The results of this study demonstrate that the remnant of cancer cells can proliferate, propagate and metastasize even if the residue of cancer cells after surgery and chemotherapy are as small as 10 suspended cells. Due to their morphology and structure, they diffuse through capillaries and metastasize rapidly. They also expressed SoX2, the transcription factor for self-renewing and pluripotency in stem cells, which means that these cancer cells have stem-cell-like ability. The Raman Spectrum of these tumor repopulating cells (TRCs) reveals significant shifts in compare with their derivative normal cancer cells. Future studies will focus on the difference between TRCs and normal cancer cells with regards to cell surface protein expressions and DNA sequences.

[1] https://www.cancer.net/cancer-types/pancreatic-cancer/statistics

***Abhishek Chitti**

Mechanical Engineering and Energy Processes

Assess Material Properties of Concrete Using Combined NDT Test Methods

Material properties and strength of concrete specimen are very important for structural design process. Various nondestructive testing (NDT) methods are applied to ensure the quality of concrete specimens. Ultrasonic pulse velocity (UPV) is a NDT method used to test the internal condition of the concrete specimen. Rebound hammer (RH) method is a surface hardness testing method and can be used to test the homogeneity of the specimen. The aim of this research is to assess the material properties of concrete like modulus of elasticity, Poisson's ratio and compressive strength using combined NDT methods. This research addresses two NDT methods; UPV and RH, to determine aforementioned properties of concrete samples. A combined NDT correlation curve will be developed to estimate compressive strength. The accuracy of these NDT methods will be determined by comparing their test results to the results acquired from conventional methods like crushing the test cylinders, strain gauge measurements and Digital Image Correlation (DIC) analysis. Furthermore, the relation between dynamic modulus of elasticity and compressive strength of the specimen will be investigated for better understanding.

***Avishek Debnath[1], Bhavana Talluri[2], Karunanithy Robinson[3], Poopalasingam Sivakumar[3], Dr. Punit Kohli[4], and Dr. Farhan Chowdhury[1,2]**

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ZnO Nanowires based Biosensor Platform for Optimizing Methanogenesis

Global warming is the harsh reality of today's world and CO2 is a major contributor of this. There are many affords to curb the increasement of CO2 amount in our environment. Methanogens are one of the best ways, that can reduce CO2 amount by converting it to methane. However, there has been less research in finding the best candidates for methanogenesis. Here, we propose a ZnO nanowires-based biosensor, which will use the piezoelectric properties of the nanowires, hydrothermally grown on a Gold coated Silicon wafer, to find out the best methanogen strains as well the best environment for optimum methane production with the help of a Keithley device. An anaerobic system is designed to culture the methanogens. Gas samples after each 10 days will be collected for evaluating methane production rate via gas chromatography and corresponding electrical signals for methanogens' responses, will be recorded by using the Keithley device, connected with the sensor. Eventually, we will be able to relate the electrical signals for specific amount of methane, produced by different types of methanogens at different environments. By using these data, we hope to characterize the suitable environment for different types of methanogens to facilitate optimum methane production

***Christopher Mandrell, S. M. Abadi, Dr. F. Chowdhury, and P. Sivakumar**

Mechanical Engineering and Energy Processes
Physics

Machine Learning Techniques Applied to Raman Spectra of Pancreatic Cancer Cells to Improve the Early Detection of Cancer

Early detection of cancer often has a significant effect on the outcome of treatment. There is a rapidly growing amount of research in science and engineering aimed at finding new methods to diagnose cancer earlier and to understand the mechanisms at work within the cancer cells better. This presentation is made possible through a collaboration between the engineering and physics departments at SIUC.

Here we look at the data processing, dimension reduction and classification techniques of machine learning being applied to Raman spectra of pancreatic adenocarcinoma cell lines (MIA PaCa-2) and normal cells in an effort to identify any molecular signatures and patterns that differentiate the cells.

Max Newhart and Dr. Jun Qin (REACH)

Mechanical Engineering and Energy Processes

Development of a Novel Device for In Vivo Analysis of the Biomechanical Characteristics of the Human Triceps Surae Musculotendinous Complex

A common issue for the anatomical function of both athletes and the general population is the lack of proper ankle mobility. Poor ankle mobility could cause orthopedic issues for the whole body. Ankle dorsiflexion is the range of motion described as one moves their toe towards their knee, and it is one of the most important movements of the ankle and its corresponding musculature array. This movement voluntarily involves the triceps surae complex located on the back of the lower leg between the bottom of the heel and the knee. In this study, we are in the process of developing the "TSSFAD1," a device for in vivo analysis of this musculotendinous complex. This device will measure the angle of ankle dorsiflexion to ensure that the user completes proper stretch and relaxation of the triceps surae. The subjects will be asked to stand on the TSSFAD device with their foot stretching on the surface of device for five minutes per foot. The electronic module will then measure the angle of ankle dorsiflexion. When this device is refined and used in human study, many observations and conclusions will be studied. It has the potential to benefit medical practice and diagnosis of the prime angle of dorsiflexion. Not only will medical practitioners be able to study and determine what causes poor ankle-biomechanical movement, they will also be able to derive how, and to what extent, poor ankle dorsiflexion can affect other muscular connective tissue throughout the body.

***Pikam Pun and Dr. Dal Hyung Kim**

Mechanical Engineering and Energy Processes

An Active Omnidirectional Treadmill System with Optimised Control System for Spatial Navigation of Fruit Fly

Animal models are being investigated to study about different human diseases. Such studies of animal have made a remarkable contribution in the field of medical science. Many studies demonstrating the behavior and the brain activities of fruit fly have been performed, with the passive motion tracking system. The information drawn from the passive motion tracking system can mislead from the real motion. This paper proposes the active omnidirectional treadmill system with optimized control system, which enables the Drosophila (fruit fly) to navigate freely on the sphere. The system maintains the position of the Drosophila at the tip of the sphere by compensating the fly motion through the rotation of the sphere. This treadmill system can be integrated with the microscopic optical devices on top, to perform behavior and brain imaging research on the fruit fly, with the privilege of active motion tracking. Identical research can be extended to other animals as well

Jake Wagner (REACH)

Mechanical Engineering and Energy Processes

Analyses of Additive Manufacturing Methods and Processes

Additive Manufacturing (AM) is quickly becoming a major industry leader in manufacturing due to its ability to make extremely specialized components. However, AM faces many challenges due to the nature of the process. These challenges are speed of production, part strength, and post process analysis. This study adds knowledge on material and process properties through the use of tensile testing and ultrasonic testing. The material of interest in this study was Poly-lactic acid (PLA) filament that is one of the two most common AM plastics alongside Acrylonitrile Butadiene Styrene (ABS). Many PLA components made through AM can be used in important applications such as biomedical, so proper analysis techniques for this material are needed. In this study, the nondestructive evaluation method of ultrasonic testing was used to determine its feasibility for detecting defects contained within a PLA component. The process of AM was also analyzed according to two of its most important parameters: infill and layer height. These two design parameters have large impacts on the speed of production, but very little is known about how exactly they affect the strength of a component. In order to characterize this strength, this study used an Instron tensile testing machine and compared the stress-strain graphs and ultimate strengths with altered infill and layer height settings. This study determined the correlation between infill, layer height, and strength in order to better understand the benefits and drawbacks of altering each parameter. The field of AM is relatively new, and its processes will continue to be refined in the future.

***Rohit Pandey and Dr. Satya Harpalani**

Mining and Mineral Resources Engineering

Micro- to macro-scale investigations of fluid flow in biogenic coalbed methane reservoirs

Biogenic coalbed methane (BCBM) reservoirs are designed to produce microbially generated methane from the organic fraction in coal. Economic feasibility of BCBM production depends on two primary factors: methane generation rates and fluid flow rates governed by the reservoir properties. The work presented here reports the results of a four-year multi-experimental study on Illinois coal, highlighting the expected issues that will be associated with field-scale experiments. This encompasses monitoring the variation in the gas storage (ad/de-sorption characteristics) and transport (diffusive) behavior in the micro-scale within the coal micropores, to characterizing macro-scale fracture flow, as determined by the permeability of the reservoir. Results indicated bioconversion improved the sorptive capacity of coal, and changed the pore structure to facilitate faster diffusive flow. However, the permeability of the coal seam reduced significantly post-bioconversion, proving to be the present bottle-neck of BCBM production. Reduction in permeability of the reservoir was accounted by bioconversion induced swelling of the coal matrix, as revealed by high-resolution microscopy and dynamic strain measurement of bioconverted coals. The results thereby indicate improvement in the micro-scale flow regime in BCBM reservoirs, whereas, the bottleneck to a successful operation would be the macro-scale flow-regime. This can be bypassed by selecting high permeability coals for such applications.

Liberal Arts

Kennedy Byers and Ras Michael Brown (McNair Scholar)

Africana Studies
Anthropology

The Intersectionality of Literacy and Christianity during American Slavery

This project sought to identify factors that contributed to the acceptance of Christianity by enslaved people in the eighteenth and nineteenth centuries. Analysis of narratives created by men and women, who had been enslaved, elucidates the crucial role of literacy in the conversion to Christianity. My research has allowed me to show that this process of transformation led to the development of a new cultural identity that intertwined features of African Traditional Religions and European Christianity and remains visible in African-American culture today.

Madison Riden

Anthropology

Charting Western Iceland's Mythscape

How do people connect elements of mythology and history to geological features to create a culturally specific landscape, or "mythscape"? How have such mythscapes carried mythic and historical symbolism from antiquity into present-day contexts? The project aims to answer these questions by drawing upon published sources, as well as first-hand ethnographic research, to provides an in-depth account of Icelandic mythology and history as they intersect with the island-nation's unique geological landscape. This mythscape will in turn serve as a basis for interpreting some of the culturally specific ways in which contemporary Icelanders build their national identity and participate in the growing tourism industry.

Iceland's unique mythology comes from a variety of sources, having roots in Norse Mythology, as it was the Vikings that traveled to Iceland and settled there as farmers. From this Norse mythology parent, Iceland's mythology deviated from Norse mythology as Iceland was christianized in 1000 AD and as Iceland experienced a period of isolation during The Little Ice Age in the 1850s. Thus, much of the remaining mythological influences in Iceland lies within Iceland's fantastical landscape, especially in western Iceland. Western Iceland has a diverse landscape, containing beaches, glaciers, mountains, and lava fields all on one peninsula. Thus, different creatures and sagas are connected to different areas in western Iceland.

To give an example from my research, Snæfellsjökull, a glacier-capped stratovolcano in western Iceland, is said to contain the protector of western Iceland, Bárður Snæfellsás, the main protagonist of the *Bárður saga*. Snæfellsjökull is also a popular tourism designation today and western Icelander's consider it the official symbol for the western Iceland region. This project strives to find these connections between history, mythology, and geography, and how it has influenced modern Iceland today.

Kate Forer (REACH)

Art

Units; An Exploration of Modular Construction

This project involved an exploration of forms created using a paper sculpture technique sometimes referred to as modular origami. Sculptures produced with this technique are composed of many individual, identically folded pieces which fit together and serve their own roles within the unified whole structure. I have been interested in what is possible to achieve with modular origami and, if possible, to expand the vocabulary of this medium.

The modular origami process was initially pursued using white paper of various sizes, then the same folding approach has been applied and modified when working with alternate materials such as post-consumer cardboard, fabric, sheet metal, and plastic, identifying which routes had the most potential for immediate success and continuing to pursue those, eventually trying to create finished pieces. At the same time, experiments with form and shape were pursued with large numbers of the original white paper pieces.

Techniques such as lost-wax casting and fabric stiffening and tools such as tin snips and metal folding tools were employed during this time. Several finished pieces were completed during this process, and many future avenues of exploration have been opened. Working with post-consumer cardboard proved to be a particularly successful direction, and resulted in several large-scale finished pieces which exhibit a wholly different quality from the original white paper forms. Work with fabric proved to be more difficult, and resulted in little immediate success. Experiments in cast metal and sheet metal were also productive and will be the foundation for future work.

***Bolton Morales**

Communication Studies

Ethical concerns in intercultural training: A pedagogical approach

Intercultural interactions have been taking place for over a millennium. Over the course of time, intercultural interactions have become less hostile and more intimate heightening the need for intercultural training and education. As the breadth of intercultural experiences has broadened, so too has the focus of intercultural training. Using the ethical concerns brought forth by Betina Szkudlarek in her 2009 article "Through Western eyes: Insights into the Intercultural training field", this paper aims to fill an existing gap in intercultural communication training literature by providing a brief review of ethical concerns pertaining to intercultural training, followed by identifying some key ethical concerns identified by Szkudlarek (2009), a section discussing and providing rationale for Critical Communication Pedagogy (CCP) as an effective approach to beginning to resolve these concerns, and a brief section discussing post-colonialism as a complimentary resource to CCP in addressing the pro-western biases evident in intercultural training and critical theory.

***Myunghyun Choi**

Criminology and Criminal Justice

Testing General Theory of Crime and General Strain Theory on Cyberbullying: Assessing a Longitudinal Mediation Model

Cyberbullying has emerged as a new phenomenon in the information age and has been prevalent among youth. Regarding the social issue, the current study examined whether the two widely supported criminological theories, General Theory of Crime (GTC) and General Strain Theory (GST) on traditional bullying also explain cyberbullying. The basic principle of GTC is people who have low self-control do deviant behavior when they have an opportunity and GST is when strained people feel negative emotion try to cope with the emotion by deviant behavior. To test the theories, the individual models for testing GTC and GST were conducted with the variables of delinquent peer association and negative emotion as mediator. As a next step, the previous theoretical paths were brought into a competition to test whether one of the theories is more suitable for explaining cyberbullying in the full model. The sample was drawn from Korean Children and Youth Panel Survey (KCYPS). The survey utilized proportional systematic stratified cluster sampling to estimate nationwide representative sample. The current study used two waves of data, which consisted of 2,284 adolescents from 2011 to 2012. The findings were that low self-control and bullying victimization were significantly related to cyberbullying, and the mediators partially mediated the relationships in both independent and full model. Overall, this study concluded that both GTC and GST are good frame to understand cyberbullying without invading each theoretical path. An integrated approach of the theories on cyberbullying would be beneficial by filling out the portion where is not explained by a theory.

Matthew Gordon

English

Creative Writing Education in Virtual Reality: Literacy in Interactive Narrative Design

Virtual reality as a medium holds greater narrative potential than its predecessors by naturally allowing for audiences to become active participants in a narrative. This is in contrast to other mediums such as cinema or traditional written literature. Similar literary techniques have been attempted by post-modernist authors in the past, yet there now exists a medium which is defined by its audience participation. There is ongoing potential for literary development in the medium. The goal of this creative project is to develop interactive narrative lessons. These lessons will serve to educate other creative writing majors, as well as interdisciplinary students, as to how they can go about creating their own interactive narrative experiences. This project is being conducted with the virtual reality prototyping tool Simmetri. This program is designed so that those with minimal technical backgrounds can develop robustly detailed virtual environments for virtual reality. To construct a lesson, attention is paid to various crucial elements of an interactive narrative experience. These elements include environmental effects such as weather and terrain, the creation and importing of 3D models, the direction of sound and lighting, animating in a 3D space, and the direction of participant-viewers through various methods of participant engagement. Through an ongoing internship with professor Pinckney Benedict these lessons will serve as teaching materials for a class to be taught in the spring semester of 2020. This project advances the education in the fields of interactive narrative and creative writing. No other undergraduate creative writing program has publicized opportunities for experience with virtual reality. Via this work, Southern Illinois University is innovating and defining the trajectory for the future of creative fiction writers.

Connie Kaniewski (REACH)

Geography and Environmental Resources

Flash Drought in the United States: Drivers, Causes and Predictability

The term “flash drought” has increasingly been a part of drought science lexicon over the last decade in response to rapidly intensifying drought events; ultimately to distinguish these extreme events from slower-developing droughts. Flash droughts often result in more extensive economic and environmental damage, because their rapid intensification reduces mitigation time and therefore increases overall drought vulnerability. Since the droughts of 2011 and 2012 in the central United States, the use of the term “flash drought” has increasingly been used in media and scientific literature; however, despite the documented adverse impacts of such events, there has not been a clear consensus on the definition of flash drought nor an evaluation of statistical differences in intensification rates between flash and slower-developing droughts. The lack of a formal flash drought definition and analysis of intensification rates precludes gains in our fundamental understanding of the meteorological drivers and other factors that contribute to flash drought occurrence and persistence compared to longer-lasting drought.

***Jie Shi Liew**

Geography and Environmental Resources

Using Social Network Analysis and Geographic Information Systems to understand the Social Support of Coal Industry in the United States

For the past 180 years, the United States has produced more than 60 billion tons of coal. While it is cheaper to produce coal as a great source of energy, the production, and usage of coal has caused visible harmful effect and pollution to our environment. In this research paper, we are eager to find out public opinion on the coal industry by using free Twitter data available. The Social Network Analysis (SNA) tools will allow us to investigate any existing social structures using networks and graph theory, and we will be able to observe the context of social network on the representation of social support and opposition of the coal industry by Twitter users. On the other hand, Geographic Information Systems (GIS) will allow us to visualize the social network structures on the Earth's surface and function as a better tool for communication. This study is on progress and result will be available soon.

Zhuokun Pan and Dr. Guangxing Wang

Geography and Environmental Resources

Characterizing urban redevelopment process by quantifying thermal dynamic and landscape analysis

Urban redevelopment practices have received substantial attention in urban planning. Remotely sensed thermal infrared monitoring of urban heat island (UHI) is a well-documented topic, however, there is a lack of understanding of the influence on UHI change caused by urban redevelopment process. The objectives of this study was to investigate the urban redevelopment-induced efforts incorporating remote sensing of UHI and land use change. Multi-temporal ASTER thermal infrared images were employed to characterize UHI change; and high-resolution Worldview images were employed to perform land use classification. UHI dynamic was quantified with urban heat island ratio index. Analysis of urban redevelopment-induced land use change with response to UHI were carried out. Landscape ecology methods were employed to quantitatively identify land use change with landscape metrics. Result demonstrated that UHI effect had a trend of mitigation during urban redevelopment process in the study area. Urban heat island intensity could be significantly eliminated or weakened by changes of land use composition and spatial configuration. These phenomena were closely related to redevelopment practices such as industrial relocation, buildings demolition, and brownfield transformation. This article presented a case study for characterizing urban redevelopment process with remote sensing monitoring, quantifying the change with urban heat island ratio index and landscape ecology analysis, research findings could be utilized as indicators for urban planning strategies.

Leia Ruebling and Benjamin Reese

Languages, Cultures, and International Studies

Nothing was in Vain

Our project, *Nothing Was In Vain*, is an accumulation of biographies of women who fought against the Third Reich in different ways. There has already been a lot of interest from the Southern Illinois community regarding this project, as we have already done a radio interview with KZIM KSIM, and have been published in two separate newspapers (*Daily Egyptian* and *The Southern Illinoisan*). Our goal is to translate the courageous stories of these women from German to English and raise awareness for their bravery this way, since these documents had never been translated into English before. We would like to present some of our results in the form of a poster at the SIU research fair on April 8. On this poster, we would like to highlight some of the courageous stories we found most invigorating and share our own process of the translation itself. We would also like to showcase the important role women played in resisting National Socialism.

Asia Ward and Jake Ellsworth (REACH)

Musical Theater

BARE: The Pop Opera

Jake Ellsworth and Asia Ward partnered up with the student lead musical theatre organization, FIERCE, to understand how to develop, cast, and produce an actor-ran theatre company. The musical they chose was BARE: The Pop Opera. Jake acting as the marketing director and Asia as the artistic director. With the help of their mentor and hired director, Tom Kidd, they had to grasp the complications and the beauty that goes into developing a new show or a blank canvas. Collaborating on a concept and vision for the show, constructing the details of the world these characters live in, and designing unique and eye-catching marketing only scrapes the surface of what they acquired skills in. After spending countless hours in rehearsals and meetings, theatre is something that can never be repeated. Once a show closes, it's gone forever. It is an ephemeral work of art. Nonetheless, they learned how to use each show as a building block for the next blank canvas they encounter.

Francis Gatimu and Dr. Stephen Shulman (McNair Scholar)

Political Science

Paralegal Studies

Social factors affecting attitudes towards Hispanic immigration in Southern Illinois

This study looked at the social factors that influence Southern Illinois' attitudes concerning Hispanic immigration. I posit that ethnic composition of a town; that is whether it has Hispanic immigrants, bears a negative impact upon immigration views in rural Southern Illinois towns. Independent variables that affect attitudes toward Hispanic immigration examined include: contact, the majority's economic outlook, and education. First, an independent t-test was conducted comparing attitudes toward Hispanic immigration between Cobden and Central City with controlled cross-tabulations of significant variables as well. Thereafter, a linear regression analysis was conducted. The overall significant findings were that Central City held higher anti-immigrant views than Cobden. Furthermore, within the context of the majority's perception of Hispanics on the U.S. economy, respondents that perceived Hispanics as bad for the U.S. economy exhibited relatively stronger anti-immigration attitudes. Surprisingly, this negative correlation was higher in Cobden than in Central City.

***Soran Tarkhnai**

Political Science

Social roots of intra-ethnic party systems

The literature of the intra-ethnic party competition does not pay considerable attention to the factors that affect the number of ethnic parties within the same ethnic group. This literature is yet overwhelmingly under the influence of the assumptions of the outbidding model that assumed that the intra-ethnic party system was a two-party system (dominant vs challenger) and ethnic politics was a main causal factor of the intra-ethnic party system. However, the number of ethnic parties cannot be limited to two ethnic parties, nor can factors that affect the intra-ethnic party system be boiled down to ethnic politics. Like regular party politics, the number of the ethnic parties within the same ethnic group can be affected by the prevailing electoral institutions and the social cleavages. Therefore, based on the theoretical arguments and empirical methods that have been utilized to study general party politics (Cox, 1997; Norris, 2004; and Posner, 2005), I propose a Kurdish case in Iraq, to explain how the intra-ethnic party system function.

I argue that subethnic cleavages based on the conflictual historical differences and disagreements are a necessary factor for the formation of the ethnic parties within the same ethnic group. Subethnic cleavages generate political identities and ideological differences that are necessary for political mobilization and organizations. I will analyze major subethnic cleavages: linguistic, religion, regional and class cleavages that have historically portrayed Kurdish society to trace the roots of the major Kurdish political parties in Iraq. I shall present a historical account to show how these subethnic cleavages manifested within the Kurdish political parties and shaped their political identity, supporter base and ideological perspectives. My research paper is a first attempt to build a theoretical foundation for intra-ethnic party system.

Chloe Baez and Dr. Karla Fehr

Psychology

The Relation Between Play, Comfort, and Anxiety Reduction

Play is an important part of children's lives and impacts them in ways beyond entertainment value. High anxiety levels among children are extremely common and persistent (Kessler et al., 2012). Pretend play has been shown to help decrease anxiety among children (Christian, Russ, & Short, 201; Li, Chung, Ho, & Kwok, 2016). The purpose of the current study is to examine the impact of play on children's anxiety levels and to determine if there is an interaction between comfort in play and anxiety. Participants included 66 total male and female children between the ages of 4 and 5. Previously recorded videos are currently being analyzed using an adaptation of the Anxiety Dimensional Observation Scale (Anx-DOS) (Mian et al., 2015) and the Affect in Play Scale-Preschool Version (APS-P) (Kaugars & Russ, 2009) to determine how engagement in pretend play impacts anxiety. I expect children with higher levels of anxiety as measured on the Anx-DOS before playing (time 1) to demonstrate higher levels of anxiety after 4 minutes of play (time 2) than children with lower levels of anxiety at time 1. Additionally, I expect children's anxiety levels, to decrease after playing for 4 minutes. I also expect to see an interaction between children's anxiety levels and their comfort levels; if children have higher levels of anxiety at time 1 and lower levels of comfort as measured by the APS-P then they will have higher levels of anxiety at time 2. In contrast, children who have lower levels of anxiety at time 1 and higher levels of comfort will have lower levels of anxiety at time 2.

Erin Boester, Alexandra Perry and Lisabeth Dilalla

Psychology

Evaluating Parental Language Input on Twins' and Triplets' Language Development

The present study compares observed natural language of triplets (and their parents) to twins (and their parents). We predicted that participants' utterances would be positively related to children's memory language scores. Additionally, we expected triplets to perform worse than twins on language skills because we expected that parents spend less time with individual triplets versus twins. By studying differences between these groups, we can compare language abilities and the effect parents' language has on children. Multiples and their parents were observed during a 10-minute parent-child interaction in the lab. The current study investigated the language abilities of twins and triplets at age 3 years, a vital age for language development. During this time, if problems acquiring language occur, children may fall behind in speaking abilities and cognitive processing.

Sarah Brown

Psychology

Political Affiliation and Religion as Predictors for Environmental Concern

Environmental issues can affect human, economic, and ecological health today. The General Social Survey of 2006-2014 was used to explore associations between religious denomination and preference political orientation, and environmental behaviors and attitudes. Environmental concern was examined through multiple variables (e.g., trust in science, environmental behaviors, etc.). We hypothesized that: Republicans and political conservatives will be in favor of less spending on the environment than Democrats or political liberals. Republicans and political conservatives will be less likely to take part in pro-environment behaviors than Democrats and political liberals. Christians will be less likely to engage in pro-environment behaviors than non-Christians. Christians will favor less spending on the environment than non-Christians. Republicans will have less environmental concern if they indicate a high level of understanding of the environment than those indicating low levels of understanding, and Democrats will have more environmental concern if they indicate a high level of understanding of the environment than those that indicate low levels of understanding. Religious Democrats will have more environmental concern than non-religious Democrats, but religious Republicans will have less environmental concern than non-religious Republicans. Multiple regression and t-test analyses were used to examine how religious and political affiliation relate to and affect environmental concern. Factorial ANOVA analyses were used to examine the interaction between political and religious affiliation on concern for the environment. The results from this study can be used to inform advocacy groups, politicians, and educators for how to better communicate their messages. Preliminary results indicate that liberalism is a stronger predictor for environmental concern than is religiosity, and that liberals/democrats tend to be more concerned for the environment than conservatives/republicans.

Zoey Bryant (REACH)

Psychology

Development of Perineuronal Nets in the Hippocampus

Perineuronal nets (PNNs) are structures found in the extracellular matrix of the central nervous system that primarily surround parvalbumin-positive GABAergic interneurons. PNNs have been observed to develop over time, with the start of their development marking the closure of an organism's critical period. Therefore, the development of PNNs is associated with a decrease in plasticity, which is defined as the ability of the brain to support neuronal growth and changes in its synaptic layout. The purpose of this study is to create a baseline of PNN development in the hippocampus that can later be used to compare to PNN development with added variables. In this study, 32 rats have been separated into four groups. Each group has been be sacrificed at a different time period in the rats' lifespan (17, 28, 45, and 60 post-natal days), which will allow the experimenter to compare the quantity of PNNs in the hippocampus across those time points. Additionally, four or more rats out of each group have undergone behavioral testing using Novel Location Recognition (NLR), a short-term memory task. This behavioral testing will allow the experimenter to correlate the development of PNNs in the hippocampus to the strength of the subjects' short-term memory. My hypothesis is that the quantity of the PNNs in the hippocampus will increase as the rats age, and the strength of the rats' short-term memory, as measured by the NLR task, will also improve with age. Preliminary results indicate differences in NLR performance and PNN quantity between post-natal day 17 and post-natal day 60 rats, although significance has yet to be determined.

Kathleen Czyzewski

Psychology

The Correlation between Parent-Child Relationships and Depression Among Children with ADHD

Attention-deficit hyperactivity disorder (ADHD) is becoming one of the most common mental health issues diagnosed in today's society. Specifically, it is very commonly diagnosed among children aged 5 to 17. There have been multiple studies conducted that show many negative outcomes that accompany the diagnosis of ADHD. Those outcomes may include behavioral problems or academic difficulties. Previous studies have separately tested the association of ADHD and depression, ADHD and the importance of attachment, and relational frustration that accompanies ADHD. 165 children ages 8 to 12 with and without ADHD and their parents were used in the present study. The measures used to determine the results were the Parenting Relationship Questionnaire (PRQ), the Children's Depression Inventory (CDI), and the Behavior Assessment System for Children, Second Edition (BASC-2). This study contains three different hypotheses. H1, ADHD is correlated with depression among children. H2, the inability for a child to pay attention causes parental frustration. H3, hyperactivity in a child causes parental frustration. A regression and T-test were used to analyze the results. This study investigates further the correlation between parent-child attachment, relational frustration, and depressive symptoms shown by children with ADHD. The preliminary results show that ADHD is correlated with poor parent-child attachment.

Diamond Doan, Aidan Smith, and Dr. Hylin

Psychology

Double-Cortin Staining

2.5 million people suffer from traumatic brain injury (TBI) annually. Children under the age of 15 are especially vulnerable and often sustain long-term or permanent physical and psychological changes impairing cognitive, behavioral, and emotional development. Current research shows that the diverse neurological and cognitive effects of TBI disrupt typical functions of the brain, having a profound impact on hippocampal and pre-frontal regions. Recovery from TBI during childhood and early adolescence is often limited, which can impair quality of life and proper development into adulthood. Studies have shown that TBI can induce increased neurogenesis after hippocampal injury. However, few studies have evaluated how a pre-frontal brain injury effects neurogenesis in the hippocampus. Even fewer studies have evaluated these effects in the developing brain.

Neurogenesis is regulated by neuotrophins, including brain-derived neutrotropic factors. A synthetic compound, Dihydroxyflavone (DHF) has been shown to mimic brain-derived neurotropic factors by binding to tropomyosin receptor kinase B and has shown therapeutic efficacy in various neurological disorders. The objective of this study was to determine if pre-frontal injury effect neurogenesis in the hippocampus and if DHF promotes neurogenesis after injury. The hypothesis of this study was that administrating dihydroxyflavone would increase neurogenesis in the hippocampus following a pre-frontal TBI. Using histological techniques, neurogenesis in the dentate gyrus of the hippocampus was assessed via double-cortin. Preliminary data shows that pre-frontal injury reduces hippocampal neurogenesis while DHF causes further reductions when compared to sham animals.

Dalton Francis (REACH)

Psychology

Gender expression, attachment styles and affect in gay male relationships

Problem/Major Purpose: Gay relationships may differ from heterosexual ones regarding gender roles, attachment styles, and minority stress that impacts anxiety and depression levels (Chaplin & Aldao, 2013; Nadal et al., 2010;). Emotion Focused Couple Therapy researchers suggest that people with feminine gender expression may exhibit an anxious attachment style and people with a masculine gender expression may exhibit an avoidant attachment style (e.g., Chaplin & Aldao, 2013; Green & Addis, 2012). Given the high divorce rate among same-sex couples, couple therapists may benefit from more insight into these relationship factors for gay men.

Procedure: For this survey-based study, I recruited 35 couples comprised of two adult, male-identified individuals, 18 years old or older. Couples had been in a relationship for at least six months. All participants completed the Multi-Item Measure of Romantic Attachment; Depression, Anxiety, and Stress Scale-21; Personal Attributes Questionnaire; and a brief demographic form.

I will run descriptive statistics for each couple. Within the avoidant attachment group, I will run a multiple regression analysis to determine if depression and masculine gender expression predict avoidant attachment style. Within the anxious attachment group, I will run a multiple regression analysis in order to determine if anxiety and feminine gender expression predict anxious attachment style.

Results: So far, I have collected my entire sample and I am completing integrity checks and data analyses. I hypothesize that avoidant attachment will positively correlate with depression and masculine gender expression. I further hypothesize that anxious attachment will positively correlate with anxiety and feminine gender expression.

Conclusions & Implications: My results may provide more insight into same-sex couple dynamics. I anticipate that my research will provide important information for therapists who work with same-sex couples. In general, my findings will support more informed use of EFT-C with same-sex couples to reduce relationship distress.

Alexis Lane and Dr. Michelle Kibby (McNair Scholar)

Psychology

An examination of the relationship of learning disabilities and anxiety in school age children

The purpose of this current study was to examine the relationship between learning disabilities and anxiety in school age children. This was examined through self-report, and parent and teacher reports, administered during one 9-hour testing day. The Weschler Intelligence Scale for Children (WISC-IV) and Woodcock-Johnson III Tests of Cognitive Abilities (WJ-III) were used to measure cognitive abilities and achievement. The Revised Children Manifest Anxiety Scale (RCMAS) and the Behavior Assessment System for Children (BASC-2) were used to measure emotional and behavioral factors. The responses were then compared between the RD group and the control group. It was found that students with learning disabilities experience statistically significant higher levels of social anxiety ($p = .016$). These results should be considered when developing programs for children with learning disabilities.

Taylor Laughlin, Elly Walker, Aidan Smith, and Dr. Hylin

Psychology

Frontal Lobe Damage: Effects on Retrieval of Memory

The purpose of this study was to understand the connection between frontal lobe functioning and the retrieval of long-term memory (based on the Morris Water Navigation task) before and after lesions in a juvenile rat population. The platform was placed in the northeast quadrant of the Morris Water maze and remained in this position during pre and post-injury trials. Eight female, Sprague Dawley rats, completed the task until they each hit specific criteria, indicating that the task was successfully learned pre-injury. Four of the eight rats were given lesions to the frontal lobe and then given motor tasks for 6 days of motor tasks to ensure motor deficits were not a confounding variable during the post-injury trials. The distance each rat traveled after being placed in the water maze was recorded, as well as the time it took for the rat to reach the goal point during pre and post-injury trials, using an overhead camera and the ANY-Maze video tracking system. An ANOVA statistical test will be completed to compare the shams (rats with no lesion) to rats with lesions, based on the latency and distance traveled through the maze during pre and post-injury trials. It is expected rats with a frontal lobe lesion will have more difficulty in recalling the previously learned task, based on a significant increase in time and distance traveled to complete the water maze task.

Kelly McKiness, Dr. Lisabeth DiLalla and Dr. Karla Fehr

Psychology

Are Twins Shyer? A Study of Shyness Ratings among Twins and Non-twin Siblings

Twins offer a unique experience in social development where, from birth, each child grows up with the same-aged sibling. This may provide social development opportunities not afforded to non-twin siblings, such as having immediate social interaction with another child their age. The present study examined how sibling status and temperament may interact with observed shyness in a sample of 202 5-year-olds consisting of monozygotic (MZ) twins, dizygotic (DZ) twins, and non-twin siblings, all of which were part of the Southern Illinois Twins/Triplets and Siblings Study (SITSS). Parental ratings are expected to be inaccurate because parents observe their twins together and therefore may not realize how shy they are when apart. MZ twins were expected to have exaggerated shyness ratings during observed play compared to parent-rated temperament, DZ twins' observed behaviors were expected to differ slightly from parent ratings, and in non-twin siblings consistency between temperament and observed play shyness was expected. The current study compared children based on sibling status on the Behavior Style Questionnaire (BSQ), a parent-rated temperament rating, and on observed behavior ratings of children's inhibited behaviors during a play session. MANOVA results indicated that twins showed more inhibited behaviors during play than did non-twins, but there was no sibling status difference for parent ratings. Less temperamentally shy MZ twins were rated higher on inhibited behaviors during play, indicating a possible parental rating bias on the BSQ for MZ twins compared to DZ twins and non-twin siblings. MZ twins may appear more social in the home, but when separated from their co-twin their behaviors may differ depending on the situation. Thus, parents of MZ twins may view their children as less shy and this may impact later social interactions where twins are apart from one another in various environments.

Keywords: temperament, differential parental treatment, twins, zygosity, siblings, inhibition

Vanessa Moran, Keith P. Klein, Dr. Clancy Dollinger and Dr. Kertz

Psychology

The Impact of Pre-trauma Risk Factors on the Development of PTSD

Post-traumatic stress disorder (PTSD) is a psychological disorder that affects many people across the world. The disorder may develop after a traumatic event has been experienced and in turn can affect a person's physical, emotional, and social well-being. Identifying risk factors associated with PTSD is academically, clinically, and socially important. Previous research has examined the risk of pre-trauma factors, but has been limited in part by reliance on limited statistical approaches. In the current study, participants were recruited from an undergraduate sample from a large public university in the Midwest and a total of eight risk factors were examined, including gender, socioeconomic status, race, mental health history, past exposure to traumatic events, social support, attentional control, and distress intolerance. The study aims to assess which risk factor contributes the most to the severity of PTSD symptoms. Specifically, we tested whether risk factors differed in their associations with overall symptom severity and estimated distinctive variances of each factor to examine the degree of differences associated with PTSD symptoms. Research indicates distress intolerance (Banducci, Bujarskim Bonn-Miller, Patel, & Connolly, 2016) and low social support (James, Kampen, Miller, & Engdahl, 2013) is related to PTSD symptom severity. We hypothesized that individuals with high distress intolerance and lack of social support will be significant predictors for PTSD. Of the 102 undergraduate participants in the study, 41 (40.2%) were male and 61 (59.8%) were female. The mean age was 20.32 years (*sd*=3.33). Analysis of the data indicated 52.9% identified as White, non-Hispanic, 25.5% Black or African-American, 8.8% Hispanic or Latino/Latina, 4.9% Asian, 2% American Indian/Alaskan Native, 8.8% Mixed, 1% Native Hawaiian or Other Pacific Islander, and 2 % Other. Results based on LMG metric via the R package RELAIMPO analyses was used to examine how much the unique variance of each individual risk factor was shared with PTSD symptom severity.

Jessica Morrissey

Psychology

Attentional Control Moderates the Relationship between Social Anxiety and Attentional Bias

Social anxiety disorder is a prevalent mental illness that will affect 12% or more of the population within their lifetime (Jin, Kessler, Walters, Demler, Merikangas & Berglund, 2005). The development and maintenance of social anxiety disorder may be associated with attentional bias (Heeren & McNally, 2016). Attentional bias has been shown to contribute to the maintenance of anxiety disorders, including social anxiety disorder, and this may in part be due to attentional control. Derryberry and Reed (2002) found attentional control as a moderator for the relationship between anxiety and attentional bias and results indicated that people with lower attentional control showed a higher level of attentional bias. In the study of Taylor, Cross, & Amir (2016) they looked at attentional control as moderator for the relationship between social anxiety and attentional bias, but only using self-report for attentional control. In this study, our participants will be undergraduate SIU students, 18 and older from Introduction to Psychology and other upper level psychology courses. Our study will replicate and extend upon Taylor et al. by utilizing both self-report and observation to corroborate the levels of attentional control to see if perceived attentional control is in line with actual attentional control. We expect to see a relationship between social anxiety and attentional bias, with attentional control contributing to that relationship, as well as be able to ascertain levels of attentional control because we will have self-report as well as observation.

***Nicholas Sanislo, Kayle Wing, and Dr. M Hylin**

Psychology

Small Molecule 7,8-Dihydroxyflavone has Therapeutic Implications for Functional Recovery after Bilateral Craniotomy and Unilateral Controlled Cortical Impact in Juvenile Male Rats

7,8-Dihydroxyflavone (DHF), a flavonoid compound found in fruits and vegetables, has built strong empirical evidence to have implications in alleviating the functional deficits of traumatic brain injury (TBI). Following the primary injury, secondary injury from TBI contributes to long-term deficits. The purpose of this study was to investigate the administration of DHF on TBI. The TBI model used causes secondary injuries such as dendritic degeneration, mass cell loss, axonal shearing, and cognitive deficits. The study used 26 juvenile male Sprague-Dawley rats reared in paired housing. At post-natal day 21 animals (n= 18) received a bilateral craniotomy and a unilateral controlled cortical impact (CCI) over the parietal cortex. Rats were administered 5mg/kg DHF/DMSO or vehicle injections (PBS/DMSO) 1-hour post-injury and every 24h for a total of 7 days. At three days, post-injury the rats began various behavioral testing including foot-fault, beam walk, novel object recognition task, Morris water maze, and cued fear conditioning. Upon completion of behavior testing the rats were euthanized and perfused. The brains were extracted and prepared for histology. Cortical volume was estimated to determine the effect DHF has on histopathology. Behavioral analysis data suggested that 5g/kg of DHF may not be the optimal dose to produce significant functional outcomes following TBI. Although evidence has suggested that DHF has neuroprotective properties by alleviates secondary injury mechanisms, the behavioral data lacks evidence of functional recovery at 5mg/kg dosage of DHF. These data suggest that either additional studies look at different dosages of DHF or combination treatment with another compound.

Itzel Mendoza and Dr. Stacy Thompson (McNair Scholar)

Psychology

Exploring the protective factors that influence positive outcomes for victims of physical child abuse

The purpose of this study was to explore whether parental emotional support influences positive outcomes for victims of physical child abuse. Using the Longitudinal Studies of Child Abuse and Neglect (LONGSCAN) Assessments 0-18 data set, 973 individuals from the ages of 12-16 years were studied to determine the impact of parental emotional support as a protective factor related to positive outcomes. Physical abuse experienced in childhood and parental emotional support were chosen as the independent variables and positive outcomes, including academic achievement, no history of delinquency and employment status, were the dependent variables. ANCOVAs were run to study the impact of parental emotional support on victims of physical child abuse for each outcome. Parental emotional support did not significantly impact any of the positive outcomes for females. However, parental emotional support was significant in academic achievement and employment for males. There were no significant findings with the outcome of no delinquency.

Caroline Page

Psychology

Evaluation of the Validity of Committed Action and Values in the Valued Action Satisfaction Questionnaire

The construct of values and committed action, within the Acceptance and Commitment Therapy (ACT) network, are principles that are meaningful and influence a person's behavior. These concepts have been implicated to have an effect on one's psychological health and well-being. Previous research has documented the benefits of associating one's behavior in consistency with their values, but recent measurements neglect to look at the interaction between values and committed action. By comparing other measurements of core principles within the ACT framework as well as with other validated measures of psychopathology and psychological well-being, the current study aims to examine the psychometric properties of the Valued Action and Satisfaction Questionnaire (VASQ) and to create a reliable scale to assess importance, action and satisfaction in relation to values and committed action. Participants were recruited from an introductory psychology subject pool as part of a larger study focusing on political attitudes, personality traits, and psychological flexibility and completed a series of online questionnaires using Qualtrics Survey Software. To test the initial findings, a correlational regression was ran comparing the VASQ to other validated measures looking at the ACT framework, psychological well-being and psychopathology. The initial findings provide preliminary support for the VASQ's measurements of particular patterns of valued living based on importance, action and satisfaction.

Keywords: Values, Committed Action, ACT, VASQ

***Chasity L. Ratliff and Allysha J. Kochenour**

Psychology

Discrepant Outcomes Across Testing Modalities

Computer-based testing offers many practical advantages over traditional paper-and-pencil testing, yet assessment experts, researchers, practitioners, and users have expressed concern about the comparability of scores between the two test administration modes (Wang, Jisao, & Young, 2008). The present study aimed to examine whether performance differed across computer-based and paper-based testing modalities for Illinois Nurse Assistant/Aide Competency Evaluation (INACE) test takers. Test scores, as well as information about the length of time that passed between training completion and testing were obtained for all paper-based testers (N = 317) and a random sample of computer-based testers (N = 317) who completed their testing in the month of December 2018. An independent samples t-test was conducted to compare the length of time between training completion and testing for computer-based and paper-based test takers. There was a significant difference in the numbers of days for computer-based (M = 17.77, SD = 47.72) and paper-based (M = 78.14, SD = 82.19) testers; t (632) = -11.31, $p < .001$. These results suggest days between training completion and testing are significantly lower for computer-based testers than paper-based testers. An additional independent samples t-test was conducted to compare exam scores for computer-based and paper-based testers in December 2018. There was a significant difference in the scores for computer-based (M = 61.33, SD = 6.31) and paper-based (M = 55.49, SD = 8.13) testers; t (632) = 10.10, $p < .001$. These results suggest that exam type really does have an effect on exam scores. Specifically, our results suggest that when testers take their exam on the computer, their exam scores are substantially higher than testers who complete a paper-based exam, which may be attributed to the reduced amount of time between training completion and testing.

Kaylee Stillwell (REACH)

Psychology

Use of Combined DHF and Environmental Enrichment in the Treatment of Pediatric Frontal Brain Injury

Traumatic brain injury is one of the leading causes of disability and death in the pediatric populace. The complexities of the brain and the effects that it has on the rest of the body it is important for it to be working properly. The goal of this study was to analyze the effect that the solution 7,8-Dihydroxyflavone (DHF) and environmental enrichment, combined has on the recovery of a frontal lobe injury in rats. DHF is an agonist to brain-derived neurotrophic factor (BDNF), it is involved in growth, maturation, and maintenance of nerve cells. The traumatic brain injury was produced by a controlled cortical impact 28 days post-birth and the DHF treatment and vehicle were given peritoneal injection beginning on the day of surgery for seven days. We found evidence to support the original hypothesis that a combined treatment of DHF and enriched environment will have a positive effect on the recovery of a moderate TBI. Results will continue to be analyzed using cresyl violet staining in immunohistochemistry and golgi staining to view the neurons that reside in the prefrontal cortex.

Aaron Caldwell and Mike Stumbras (McNair Scholar)

Studio Art

Marking the Unmarked: An Exploration of Black American Narratives through Imagery, Textural and Finishing Techniques

Slave cemeteries in the United States mostly went unmarked and unattended in comparison to White American cemeteries. This study reimagines Black American slave cemeteries by creating an installation of a cemetery and marking it with individualized sculptural urns and historical Black American symbols. I pull from the historical context in which black slaves existed in, and the present state of Black Americans as a way to bridge the past with the present. I explore the relationship between human bodies and vessels as a way to create ceramic forms that reflect the human body. I use texture (thick applications, grog and scarring), non-flame based finishing techniques (terra sigillata and patina), and atmospheric firings (pit/barrel firing and low fire reduction) as methods of telling a narrative along with the imagery presented on the ceramic vessels.

Mass Communication and Media Arts

***Ololade Afolabi**

Mass Communication and Media Art

Beyond Abduction: Education Discourse in the Media Coverage of Boki Haram Girls Victims

This study examines the media coverage of the abducted 110 Dapchi school girls on February 19, 2018 in north-east Nigeria. The study argues that educating the Nigerian girl-child is important to social empowerment of Nigerian women. Therefore, education discourse should be critically discussed during Boko Haram crisis to elicit any ideological stance that might empower or discourage girls' education. Existing studies [Chiluwa and Adegoke 2013; Okoro and Chukwuma, 2012; Ayoola and Olaosun, 2014] on Boko Haram showed how the terrorist group threatens national security and peace. However, many studies miss to discuss how media cover the girl-child education which is central to the Boko Haram crisis. Therefore, this study adds to literature on Boko Haram by examining how the discourse of girl-child education was constructed in the coverage and what ideological stance is displayed by the media.

Critical discourse analysis was carried out on 15 news articles from *Vanguard* newspaper, an independent news organization. The choice of independent newspaper was owing to the assumption that some political officials use Boko Haram to achieve their agenda. Therefore, to limit the propensity that the newspaper coverage might not very well reflect the true situation of girl-child education, independent newspaper was deemed appropriate for the study.

The findings show a non-conformity to women representation in Nigeria. The study concludes that educating women and girls is not just a fight against gender inequality but also a fight for national development. If women/girls are prevented from going to school, the development of the country will be limited, and gender problems will continue to challenge social change. Therefore, media should continue employing linguistic choices that push for women/girls' freedom. This can lead to transformation.

***Zahedur Arman**

Mass Communication and Media Art

Framing politics: A content analysis of political fake news in Bangladesh

Fake news is considered a direct threat to the politics and democracy. Several studies find that fake news not only miseducate audiences regarding the political campaign and candidates, but it contributes to a change in the reader's attitude toward, and perceptions of the political world (Balmas, 2014; Moy, Xenos, & Hess, 2006; Pfau, Cho, & Chong, 2001; Young, 2004, 2006). There is a gap in the literature of fake news regarding how it frames political parties and their candidates during election cycles. Also, it can be assumed that the study of fake news in the sustainable democratic countries are not likely to produce the same results in a fragile democratic country like Bangladesh, although the importance of fake news is no less important in the national parliamentary election of the country. The intent of this study is to examine how political fake news frames politicians and political parties in Bangladesh.

The study uses a content analysis of political fake news collected from Bangladesh's only political fact-checking organization, BD Factcheck. Every political fake news item from January 1, 2018 to December 31, 2018 has been examined. The timeline was selected in conjunction with the national election of Bangladesh on December 30, 2018. The study finds that political fake news takes sides by portraying politicians and political parties both positively and negatively. With the lack of evidences, fake news creators used several logical fallacies and fake sources to justify their position to the political parties and candidates. The study provides practical implications of how audiences identify frames on political fake news. It also contributes to the literature of framing theory as this is the first study of political fake news using framing theory.

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Science

Lulu M. Abou-Jabal, Riley L. Marshall, and Dr. Lisabeth F. DiLalla

Biological Sciences

Interaction Between Birth Weight and Home Chaos Predicts Differences in Somaticizing Behavior

Objective: Research has shown that low birth weight predicts internalizing behaviors (e.g., depression, somatization; Boyle, 2010; Klein et. al., 2015). Also, children living in chaotic homes are at risk for higher somatization (Lachar, 1984; Rousseau et.al., 2014). However, no studies have examined the interaction of birth weight and a chaotic home in predicting somatization later in childhood. Thus, we hypothesized that lower birth weight twins would have more somatization, especially in chaotic homes. Methods: Participants included over 100 twin pairs tested at ages 4 and 5. Parents completed a chaos measure when children were age 4 using the Confusion, Hubbub and Order Scale (Matheny et al., 1995) and reported somatic complaints when children were age 5 using the Child Behavior Checklist (CBCL; Achenbach & Rescorla, 2001). Parents reported twins' birth weights at initial testing, between ages 1 and 4. Linear regressions were performed to determine whether twin birth weight differences and household chaos, and their interaction, predicted twin differences in somatization. Results: Preliminary results show that the main effect of birth weight difference ($t = 1.12$, $p = 0.27$) and chaos ($t = -1.23$, $p = 0.22$) were not predictive of difference scores on somatization. However, the interaction of birth weight differences and home chaos predicted somaticizing differences, $t = 3.14$, $p = 0.003$, Adj. $r2 = .14$. In a high-chaos home, the higher birth weight twin showed more somatic problems at age 5. Conclusions: Our findings suggest that the interaction of birth weight differences and home chaos can predict somatic complaints. Chaotic homes may relate to more somatic complaints because perhaps parents are unable to attend equally to both children and may preferentially attend to the child who was most at risk initially. Future studies should examine twin risk factors during prenatal development due to limited research on the ramifications of this.

Lillian McIntyre and Jacob Chisausky (REACH)

Biological Sciences

Pollination Networks of Limestone Glade Communities in Southern Illinois

We are exploring bee diversity and pollination networks of two high-quality limestone glade communities in Southern Illinois. Bees, lepidopterans, and other floral visitors were collected via hand netting and pan traps. We sampled three times throughout the growing season in 2018 at each site. We recorded floral associations of all hand-netted insects, plus additional associations observed in the field. Cave Creek Glade (Johnson County) and Lafarge Limestone Glade (Hardin County) had similar pollinator taxon richness (66 and 56, respectively). Collections of interest from Cave Creek Glade included a new state record, *Halictus tripartitus*, a bee previously known only from west of the Mississippi River, and *Bombus pensylvanicus*, a species of conservation concern due to recent declines in more northern parts of its range. Collections of interest from Lafarge Limestone Glade included *Megachile xylocopoides*, a coastal plains species with a predominantly southeastern US distribution. A preliminary bipartite pollination network was produced. Four of the five most important plant species in the network were members of the composite family (Asteraceae), though the invasive legume *Melilotus albus* was the fourth most important plant (as determined by species strength index). Important bee taxa included the green sweat bee *Augochlorella aurata* and native bumble bees *Bombus griseocollis,* and *Bombus bimaculatus.*

Cody Germain

Biological Sciences

Bite Force of Naked Mole Rats

Naked mole-rats (*Heterocephalus glaber*) are burrowing rodents from the Bathyergidae family. Due to their high dependence of the incisors, naked mole-rats have been the subject of studies involving dentition. Naked mole-rats use their incisors for a variety of tasks such as object manipulation, feeding, digging of tunnel systems, and navigation. In addition, naked mole-rats operate under a eusocial system of social organization in which social interactions rely on the use of the incisors for defense. Other studies have presented data on naked mole-rats regarding skull and masticatory muscle adaptations that might enable strong bite forces. However, no study to date has directly measured the bite force of this species. In this study, we analyzed the relationship between the naked mole-rat bite force and body size measures. Additionally, we compared the eusocial caste system standings of each animal (i.e., dominant vs. subordinate males and females). Each naked mole-rat was placed in a housing chamber with a connecting tunnel-like tube that lead to the bite force sensor. The animal was allowed enough time to explore the enclosure and interact with the force probe sensor that was blocking a possible exit. Each bite was read through a piezo-resistive force sensor connected to a Raspberry Pi for data recording of each session. Due to the behavioral significance and specialization of the incisors, we hypothesized that the bite force of the naked mole-rat would surpass the predicted bite force derived from its body size. Overall, this study observes the variation of bite force over the naked mole-rat social hierarchy, and how these social and ecological factors affect the relationship between bite force and anatomical structures.

Tori Rhone and Dr. Joe Cheatwood (McNair Scholar)

Biological Sciences

Understanding the neuroanatomy of naked mole-rats (Heterocephalus glaber): Dentition

In this study, we investigated the neuroanatomy of naked mole-rats with a focus on their dentition. We researched the projections from their thalamus to their somatosensory cortex as well as their brainstem. This research has not been fully conducted until now. We conducted two surgeries per mole-rat, with one being a survival surgery and the second surgery we sacrificed and perfused the mole-rat. We made injections into the ventral posteromedial nucleus with glass micropipettes to see projections from the thalamus to the cortex and brainstem. They were alive for 2 weeks for transport of axonal tracers. Afterward, we cut brain sections and then mounted them onto slides to use various staining techniques. At the time of this presentation, our results were limited due to experimental constraints (time, etc.), but work on this project will continue. This project laid a foundation for the continued study of the naked mole-rat brain.

Sarah Zeman

Biological Sciences

Construction of an Experimental Wetland on Campus Lake

Wetlands are functional ecosystems that aid in the maintenances of larger bodies of water as well as increase biodiversity. The filtration performed by macrophytes near wetlands reduce trace nutrients as well as cools shallow water with shade. Lower nutrient levels and cooler water temperatures decrease opportunities for harmful algal blooms. Over many years, Campus Lake has suffered from harmful blooms of Microcystis. This led to closures as well as an excavation and removal process in 2016 that dredged approximately 20 acres of shoreline to remove excess decaying material. This material contributed considerable amounts of trace nutrients which led to the increase of algal blooms. Since the dredging process concluded, algal blooms have decreased but have not yet been eliminated. Many interdisciplinary plans have been put in place to remove nutrients, cool the water temperature, and restore fish populations in Campus Lake. Throughout this experiment, both survey and chemical analysis were implemented to collect data on the area. Water samples of the lake's surrounding culverts were collected and analyzed for their nutrient levels. In addition, water samples were analyzed at different depths throughout the main area of the lake. Once the parameters of the lake were established, planning for the experimental wetland took place. The experimental wet land was built in roughly a 300 ft^2 drained pond adjacent to Campus Lake at the Nature Observatory. The plans consisted of over ten species of macrophytes with various depth requirements to be planted and labeled at the site. The wetland was then refilled and left to grow over winter. Come spring, new samples are to be collected around Campus Lake and compared to the original data to determine the effect that the experimental wetland had on the overall water quality of the lake.

***Md Aswad Ali, Nathalie Becerra-Mora, Rajesh P Balaraman, Kexin Jiao, Katherine Bolte, Annie Vargas, and Dr. Punit Kohli**

Chemistry and Biochemistry

Design, fabrication, and characterization of low-cost materials and devices

Our research interest focusses on the design, fabrication, and characterization of novel-materials and devices for low-resource countries. The students and researchers work on a range of projects with the main objective of producing functional materials and devices at low-cost utilizing local human expertise in mind. In the first project, we fabricate 3D materials for device fabrication in a one-step without any post-processing (assembling, cutting, and sorting of devices). Controlled thermal treatment of a thin polymeric film on planar and curved substrates yielded nanoporous 3-D spiral shaped ribbons which are used for oil-water separation and super-high resolution near field imaging. In the second project, non-invasive super-resolution microlens based nanoscopy technique is demonstrated to overcome the diffraction limit of light (~λ/2) observed in conventional microscopes utilizing high refractive index microlenses (n ~1.55-2) for capturing the evanescent waves from the object near to the microlenses. Muscle sarcomere, 100 nm nano-windows (FIB), nano-fluorospheres force-assembled nanopatterns were resolved using a 10x objective (NA 0.25). In the third project, electrochemical erasing of microscale conductive electrodes to fabricate functional devices (photodetector) on flexible and hard surfaces (ITO substrates) is accomplished by delivering redox etchants to the metallic coating utilizing chemically polymerized polyacrylamide pyramidal polymer lithography editor (PLE) hydrogel probes which allows maskless micropatterning. Silver and copper metal erasing with efficiency ≈100%, areal erasing rate ≈160 □m^2/s, and pressure dependent spatial erasing (features≈3 □m) on metal surfaces allowed fabrication of functional devices. Finally, we demonstrate an easy and efficient silver nanowires (AgNWs) patterning using low-cost commercially available master templates (CD and DVD) resulting in high aspect ratio, low sheet resistance & high repeatability for the fabrication of flexible and wearable AgNWs-based strain sensor. A wide range of analytical tools including electron and optical microscopy, AFM, and X-ray and optical spectroscopy are used for characterization of the synthesized materials and devices.

***Nathalie Becerra-Mora, Milinda Wasala, Md Aswad Ali, Rajesh P Balamaran, and Dr. Punit Kohli**

Chemistry and Biochemistry

Integrated Microscopy and Expertise Graphics-IMAGE Center

The Integrated Microscopy and Expertise Graphics-Image (IMAGE) Center is a facility that supports teaching, research, and outreach across the SIUC community. It also offers imaging services to local and national universities and industries. The IMAGE center works closely with graduate and undergraduate students, post-doctoral fellows, and principal investigators from a large number of departments and colleges. For example, researchers from science (chemistry, physics, plant biology, biology, microbiology, anthropology), engineering (civil, mechanical, electrical, and mining), medicine, library sciences, and recreation sciences make use of our facility. Thickness, surface morphology, and topography, of organic and inorganic, semiconductors, and photoactive coatings are measured and characterized using a *Park Scientific-Auto Probe CP atomic force microscope*. Surface properties including surface topography, roughness, and thickness of magnetic nanoparticles, bacteria, viruses, semiconductors, metal organic frameworks, conductive wires, and metallic films are characterized using a *FEI Quanta FEG 450 SEM*. Interactions of liquid-solid vapor solid phase of materials can be monitored using environmental scanning electron microscopy (ESEM). Energy dispersive X-ray spectroscopy (*EDS*) allows researchers to identify and obtain a semi-quantitative estimate of elemental and chemical composition on their samples. Internal structure of biological samples and imaging of nanoparticles and novel materials are acquired at high magnification and resolution (up to a fraction of 10 nm) using a *Hitachi H-7650 TEM*. *Confocal laser scanning microscope Leica TCS SP5* allows researcher to reconstruct images in 3D (z-stacking) of biological and non-biological- fluorescent tagged samples. In addition, sample preparation instrumentation for electron imaging of biological and non- biological specimens are also available. For example, critical point drying and ultra-microtomy aid sample preparation for scanning and transmission electron microscopy. Apart from college students, elementary and high school students as well as Girls Scouts come over to our facility to learn more about nature at microscale

***Yachu Du**

Chemistry and Biochemistry

Linking Cyclopenta-Polycyclic Aromatic Hydrocarbons via Five-to-Five Connections

This poster surveys recent advances from our lab related to compounds based on cyclopentafused-polycyclic aromatic hydrocarbons (CP-PAHs). We show that a new class of five-to-five planar PAH can be prepared via a Yamamoto homo-coupling reaction. The resulting compound is planar owing to five-member ring to five-member ring linker between the monomers. The planar structures provide benefits such as increased in the delocalized π system, small band gap and low LUMO energy level. Furthermore, the five-to-five π extention strategy can be used as a novel method to synthesize new planar structure organic semiconductors to decrease the band gap. The 2,2'-biaceanthrylene presented here exhibited UV-Vis absorption at long wavelength with narrow optical energy gaps of 1.79 eV. Cyclic voltammetry (CV) was utilized to further elucidate the electronic structure and assign energy levels to the frontier orbitals. Both HOMO and LUMO orbitals was decreased 0.20-0.55 eV after the five to five homo-coupling reaction.

***Li Fan and Dr. Ian Suni**

Chemistry and Biochemistry

Cathodic Electrodeposition of WS_2, and Anodic Electrodeposition of Element S Thin Films

Polycrystalline WS_2 thin films were fabricated by electrodeposition onto ITO from an electrolyte containing 4 mM $(NH_4)_2WS_4$ + 0.1 M $LiClO_4$ in acetonitrile, followed by a two-stage sulfurization and crystallization procedure at elevated temperature in a tube furnace. The as-deposited films had a S:W stoichiometric ratio of ~2.8, which decreased to 2 after annealing. X-ray diffraction indicates that the annealed WS_2 films crystallize into the 2H polytype with an average grain diameter of ~22 nm.

Elemental sulfur electrodeposition has not been widely studied due to its usage primarily in compound rather than in elemental form, and also due to its high electrical resistivity. Sulfur thin film electrodeposition is reported here from electrolytes containing 0.10 M Na_2S_4 in dimethyl sulfoxide (DMSO), with either 0.10 M $KClO_4$ or $LiClO_4$ as the supporting electrolyte.

***Hannah Gianga, Madhavi Palia, Li Fana, and Dr. Ian Suni**

Chemistry and Biochemistry

Mechanical Engineering and Energy Processes

Impedance Biosensing atop MoS_2 Thin Films with Mo-S Bond Formation to Antibody Fragments Created by Disulphide Bond Reduction

Immobilization of antibody fragments to 3-phenoxybenzoic acid (3-PBA), which are created by disulphide bond (S-S) reduction with tris (2-carboxyethyl) phosphine (TCEP), is reported atop MoS2 and Cu-doped MoS2 thin films. MoS2 and Cu-doped MoS2 thin films are electrodeposited using previously reported methods and tested for their ability to immobilize antibody fragments, before and after annealing in Ar at 500°C for 3 h. This annealing procedure removes excess sulphur in the as-deposited films, and creates coordinatively unsaturated Mo sites that are highly reactive towards sulphur, as previously reported for MoS2 hydrodesulphurization catalysts. As demonstrated by electrochemical impedance spectroscopy (EIS) measurements, both annealed MoS2 and Cu-doped MoS2 thin films adsorb antibody fragments through Mo-S bond formation, unlike the as-deposited films. Impedance detection of 3-PBA is reported utilizing antibody fragments bound to both materials, with a sensitivity of 2.7x108 Ω·cm2·M-1 and a detection limit of 2.5x10-6 M atop MoS2, and a sensitivity of 5.9x108 Ω·cm2·M-1 and a detection limit of 3.8x106 M atop Cu-doped MoS2. The rms surface roughness obtained by atomic force microscopy (AFM) measurements atop annealed MoS2 and Cu-doped MoS2 ranges from 60-140 nm, so the methods described herein are not limited to ultra-smooth substrates.

***Waseem A. Hussain, Sambasiva R. Bheemireddy, Ain Uddin, Yachu Du, Matthew P. Hautzinger, Paul V. Kevorkian, Frankie A. Petrie, and Dr. Kyle N. Plunkett**

Chemistry and Biochemistry

Cyclopentannulation and Cyclodehydrogenation of Isomericaly Pure 5,11-DibromoAnthradithiophenes leading to Contorted Aromatics

The rapid growth of research on organic semiconductors in the past two decades[1] can be associated with the advantages they have over the inorganic 'Silicon' based semiconductors. *Although* this research is still in its infancy in academia and industry yet, the ease of fabrication by solution processing, flexibility, customization, and durability attached with organic semiconductors may prove them to be far more superior to the silicon-based semiconductors.

This poster encompasses the work resulted in successful synthesis and characterization of Isomerically pure 5,11-dibromo-2,8-dihexylanthra[2,3-b:7,6-b']dithiophene, which is a brominated analog of anthradithiophene (ADT). Cyclopentannulation with 3,3'-dimethoxyphenylacetylene using Palladium catalysis developed in our Lab was carried out to synthesize 4,10-dihexyl-1,2,7,8-tetrakis(3methoxyphenyl) cyclopenta[6,7] aceanthryleno[4,3-b:8,9- b']dithiophene (**11**) . Scholl cyclodehydrogenation of (**11**) with $FeCl_3$ resulted in the formation of contorted 2,14-dihexyl-5,10,17,22 tetramethoxytetrabenzo [4,5:6,7:11,12:13,14]rubiceno[2,3-b:10,9-b']dithiophene(**4**). Our synthesized molecule (**4**) not only offers higher degree of contortion but is also more stabilized than our previously synthesized CP-pentacenes. The contorted aromatic **4** in addition to having better solubility and stability also possess a small HOMO-LUMO band gap (**1.50 eV**) and relatively low lowest occupied molecular orbital energy (-**3.70 eV**).

***Gajanan C. Kulkarni, Jean L. Morales-Cruz, Waseem A. Hussain, Dr. Ian J. Garvey, and Dr. Kyle N. Plunkett**

Chemistry and Biochemistry

Electron Acceptors Based on Cyclopentannulated Tetracenes

Cyclopenta-fused polycyclic aromatic hydrocarbons (CP-PAHs) based on extended acene backbones are a new class of electron accepting molecules because of their ability to form cyclopentadienyl anion-like structure that are stabilized by Huckel aromatics. Although acenes are defined as benzene rings fused together linearly, CP-PAHs have a pseudo-acene structures and their reactivities are similar to that of the traditional acenes. In the recent past, considerable amount of effort has gone into the expansion of the acene core. Acenes have undesirable stability when incorporated into electronic devices. Traditional acene stabilities decrease with increasing rings fusion. Several studies have been reported in order to modify the CP-PAHs to develop new compounds with better stability, and optical and electrochemical properties. It has been recently shown that the modifications of anthracene and pentacene cores can lead to low energy Lowest Unoccupied Molecular Orbitals (LUMO) and small band gap materials. These properties are attractive for electron accepting materials. In this work, new CP-PAHs based on tetracene core have been developed as a bridge between the previously reported anthracene and pentacene cores. These tetracene derivatives were prepared by palladium-catalyzed cyclopentannulation between 5,11-dibromotetracene and two diaryl-ethynylene derivatives. The new compounds have low-energy LUMO and relatively small band gaps. The photooxidative stability was intermediate to previously prepared CP-PAHs based on anthracene and pentacene derivatives. Scholl cyclodehydrogenation of pendant aryl groups led to materials that quickly form endoperoxide products. Our efforts to control the oxidation were unsuccessful. The general photostability of the cyclopentannulated structures match those of traditional acenes (e.g., CP-anthracene > CP-tetracene > CP-pentacene).

Madison H. McMinn, Chelsea Bridgmohan-Gemeinhardt, Dr. Lichang Wang and Dr. Gary R. Kinsel (McNair Scholar)

Chemistry and Biochemistry

Investigation of the Catalytic Properties of Cerium(IV) Oxide in Metal Oxide Laser Ionization-Mass Spectrometry

Matrix-assisted laser desorption/ionization-mass spectrometry (MALDI-MS) has emerged in recent years as one of the most powerful tools available for characterizing the molecules involved in the biochemistry of life. Metal oxide laser ionization (MOLI) is a recently described variation on MALDI in which a metal oxide, rather than an organic acid, is utilized as the matrix. Unlike other metal oxides, Cerium (IV) Oxide (CeO_2) demonstrates a unique property of laser induced catalytic side chain cleavage of fatty acids when applied to phospholipids and energized by standard lasers found in MALDI-TOF MS instruments.

In previous work, a technique for CeO_2 deposition on mouse brain tissue was developed that allows fatty acyl catalysis directly from tissue for possible bacterial detection. Although MOLI using CeO_2 was shown to be promising for this application, the mechanism of fatty acyl catalysis remains poorly understood. In the current studies, a negative ion mode calibration mixture is optimized to ensure mass-to-charge (m/z) assignments are accurate thereby allowing structural assignments to be confirmed. This calibrant mixture is used in the analysis of a phospholipid standard used in previous work; palmitoyl-2-oleoyl-glycero-3-phosphocholine (POPC). This study ensures that the mouse brain imaging results obtained earlier can be replicated on the Bruker MicroFlex MALDI-TOF-MS. With this assurance, structural variants of POPC will be studied to determine how slight variations in structure affect the catalytic cleavage with a goal to gain insight into the cleavage mechanism. Additionally, computational studies will be performed to gain insight into the photo-physical properties of phospholipids and their derivatives found in mouse brain tissue.

Jackson Wood

Chemistry

Determination and Correlation of Volatile and Nonvolatile Compounds with Coffee Quality

Coffee is one of the world's most traded commodity items. Numerous investigators have examined the constituent components of coffee (both volatile and water soluble) in an effort to characterize this popular drink and the methods used to brew it. Our studies compared eight medium roast coffees that were ground for classic drip brewing. Freshly brewed coffee was analyzed using two instrumental techniques: gas chromatography mass spectrometry (GCMS) to generate profiles of the volatile compounds and high performance liquid chromatography (HPLC) with UV-visible detection to quantitate several water-soluble compounds. Using this data, the volatile and water-soluble compounds that vary among the eight medium roast coffees were identified. Subsequently, the results of both professional and amateur taste tests were used to correlate variations in the compound makeup with specific aroma and flavor profiles. These correlations were used to reveal specific compounds (or combinations of compounds) that favorably influence coffee's appeal. Preliminary results indicate the professionally ranked coffee scores correlated with coffee cost per ounce, and there were differences between professional and amateur tasters.

Cecilia Albert-Black (REACH)

Geology

Arsenic Filtration from Contaminated Groundwater

Arsenic (As) is a highly toxic and carcinogenic metalloid that is tested in many groundwater sources worldwide. These contaminated waters could harm the surrounding ecosystem and community especially in areas with no water treatment process (i.e. private wells). In my research I have tested different naturally occurring materials that are inexpensive and widely available for their capacity to adsorb arsenic from water under different experimental conditions. Kaolinite, activated kaolinite, iron oxide, and aluminum hydroxide were each reacted with solutions with four As concentrations (5, 1, 0.5, and 0.1 mM) for 24, 48, and 168 hours. The final solutions was separated from the solids and the As concentration was analyzed by ICP-MS while the solids were analyzed at Argonne National Laboratory to measure the amount of As adsorbed onto each material. The results show that aluminum hydroxide (AlH) and iron oxide (FeOx) adsorbed As the best, with FeOx absorbing 100% of 0.05 mM As solution at 48 and 168 hrs. Aluminum hydroxide was the only material that increased in adsorptive capacity over time; 90% adsorption of 0.05 mM As adsorbed after 168 hrs compared to 62% at at 48 hrs and 59% at 24 hrs. There was little difference between activated kaolinite to standard kaolinite, which was not hypothesized, both having minimal absorptive capacities. Further research would include a drying the final solids before analyzed to get more accurate results from the APS as well as testing AlH and FeOx at reaction times close to their maximum adsorptive capacity to be able to predict the availability and number of adsorption sites per particle. In conclusion, this research has shown potential groundbreaking further research for AlH and FeOx while noting their exceptional adsorptive capacity compared to the other materials.

***Ryan Bowman**

Geology

Clay Mineral Transformations: Finding an Earthen Analogue for Mars

Understanding the past environment on Mars is challenging due to only having remote sensing data in real time without any hand samples from the present surface of the planet. Using spectroscopic data, we can interpret the surface mineralogy of Mars and compare that to those found on Earth. Along with determining the environment on Mars, we can also determine what types of clay minerals will be present in the presence of iron oxyhydroxides. Clay minerals have the ability to transform while in the presence of these compounds and incorporate iron into the octahedral layer (which is composed of aluminum and oxygen). The degree of morphological, chemical, and redox changes of the mixed mineral system will be associated by local pH, redox, and biological activity.

For preparation, clay mineral samples were collected at the Tab Simco acid mine drainage site in Carbondale, IL. After collection, samples were then treated with a solution of sodium citrate, sodium bicarbonate and sodium dithionite to remove any iron oxyhydroxides on the clay minerals. To analyze the clays, one of the methods that were employed to conduct this experiment involved near infrared spectroscopy. This method was used to determine the types of bonds that are present within the clay minerals, specifically Fe to Fe, Al to Fe, and Al to Al. Results indicate that the clays have incorporated iron into the octahedral layer. Mössbauer spectroscopy was then employed to determine the oxidation state of the iron that is present in the clay minerals (ferric vs. ferrous). X-ray diffraction (XRD) is then used to determine mineralogy. Finally, a scanning electron microscope (SEM) was used to determine morphological changes within the structures of the clays.

*__Priyan De Alwis and Dr. S. Yaser Samadi__

Mathematics

Fourier Methods for dimension reduction in Time Series

Prior to conducting any kind of data analysis, it is important to reduce the dimension of variables, while preserving or extracting the key information or other properties of interest. In time series analysis, dimensionality reduction techniques are often used to estimate the conditional mean and variance functions. The central and central mean subspace can be used to project the high-dimensional feature space to a lower-dimensional space to estimate the conditional mean and variance functions in which preserve sufficient information and other features of interest contained in the data. Using the Fourier transformation technique, we have derived a candidate matrix whose column space span the central and central mean subspace with a cost and time frame efficiently. Simulation results for different types of models are presented to support our theoretical findings.

Area of Specialization: Mathematical Statistics.

Key words: Time series data, Dimension reduction, Central Mean subspace, Fourier Transformation, Column space.

B. L. K. Gunawardana and John McSorely

Mathematics

Mutually Orthogonal Latin Squares of Different orders

A Latin square of order n is an n×n array in which each row and column contains symbols from an n-set, S = {a1,...,an}, exactly once. If two Latin squares L1 and L2 of the same order can be joined such that each of the n2 ordered pairs (ai,aj) appears exactly once, then L1 and L2 are said to be orthogonal. This project will involve a variation of this idea. We define orthogonality of two Latin squares Lm and Ln, for m < n, as follows:

When we place an m×m Latin square Lm inside an n×n Latin squareL n, in all possible ways, the so obtained m2 ordered pairs (ai,aj) are always distinct. We first investigate the situation when m = 2 and n = p, where p is a prime.

Area of Specialization: Combinatorics

*H.M.W.B. Herath and Dr. S. Yaser Samadi

Mathematics

Tensor Regression and Tensor Time Series Models for High-dimensional Data

Many real data are naturally represented as multi-dimensional array or called tensor. In classical regression and time series models, the predictors and covariate variables are considered as a vector. However, these types of models are inefficient for analyzing high-dimensional data. In contrast, tensor structured models use covariate variables in a tensor format. Tensor regression and time series models can reduce high dimensional data to a low dimensional framework and lead to efficient estimation and prediction. The results of simulation study and numerical analysis will be presented.

***Qilun Luo, Ming Yang, and Dr. Mingquing Xiao**

Mathematics

Computer Science

Multiview Clustering for High Dimensional Data Set with Non-Convex Minimization

In this paper, we study the multi-view subspace clustering problem via non-convex low-rank representation under the framework of tensors. A tensor log-determinant function is proposed as the objective function regularizer, aiming to achieve the low-rank approximation. Instead of directly solving the minimization problem, the corresponding non-convex optimization is conducted in the Fourier domain, which is shown to be feasible. An algorithm associated with augmented Lagrangian multipliers is established and the convergence is mathematically validated. Simulations on four benchmark image datasets are provided, along with detailed comparisons with the latest existing approaches. The obtained results demonstrate that our proposed method outperforms the current approaches consistently.

***Hadi Safari and Dr. S. Yaser Samadi**

Mathematics

Copula-based models for discrete data: An application to STDs and Cervical Cancer Data

In this presentation, we derive the population version of Spearman's rho correlation via copulas when both marginal random variables are discrete. The upper and lower bounds of the Spearman's rho for Bernoulli random variables are derived. Moreover, the proposed Spearman's rho correlations are compared with their corresponding Kendall's tau values based on different types of copulas with different discrete marginal distributions. An extensive simulation study is conducted to demonstrate the validity of our theoretical results. A cervical cancer data is analyzed to find the effect of number of years of using IUD on sexually transmitted diseases. The results show that patients with more years of using IUD tend to be more vulnerable to sexually transmitted diseases.

Amanda M. Blocker[1*], Jeremy Dodsworth[2], and Dr. Scott D. Hamilton-Brehm[1] (REACH)

[1]Microbiology, Southern Illinois University, Carbondale, IL
[2]Biology, California State University, CA

Physiological and genomic characterization of strain SIUC-1, a strict anaerobic thermophilic bacterium isolated from 751 meters underground, represents the first cultured member of the candidate phylum OP9 'Atribacteria'

Microorganisms compose a significant portion of the biomass on this planet. They are essential for regulating the cycling of nutrients and carbon in all ecosystems. The majority of knowledge about microbes is surface centric. This is in stark contrast to the paucity of knowledge regarding life in the subsurface, which may constitute the majority of biomass of the planet. From a borehole drilled into the Amargosa Desert located between California and Nevada, a bacterium was isolated from a depth of 751 meters underground in geothermally heated water and given the strain name SIUC-1. This microorganism is a thermophilic, rod-shaped (approximately 2 μm x 0.5 μm), strict anaerobic bacterium that utilizes xylitol as a carbon and energy source. Sequencing and comparison of the 16S rRNA gene from SIUC-1, revealed that *Ammonifex thiophilus* (84% identity) and *Ammonifex degensii* (83% identity) were the closest cultured genetic relatives. Yet the closest uncultured genetic relative (95.9% identity) was from the candidate phylum OP9 'Atribacteria'. This enigmatic phylum was first identified in the year 1998 by environmental sequencing of 16S rRNA genes from Obsidian Pool located in Yellowstone National Park, WI. Atribacteria are found in many habitats, both marine and terrestrial, yet it is not clearly understood what geochemical role they serve in the environment. SIUC-1's genome has been partially sequenced, consisting of 21 contigs of approximately two million nucleotides, with a G + C content of 56.5%, and 2,060 open reading frames (>76% are annotated as hypothetical). SIUC-1 optimally grows at 65ºC at a pH of 6.51. SIUC-1 is the first cultured representative of this global microorganism, combined with a sequenced genome it will become a model type strain for the phylum Atribacteria. In this study, we detail the morphological, genomic, and biochemical characterization of this novel subsurface species of bacteria.

***Azam Baharlouei and Dr. Scott D. Hamilton-Brehm**

Microbiology

Biochemistry

Identification of benthic and subsurface anaerobic microbial communities that reduce lignin and furfural into value-added molecules

Fossil fuels and other petroleum-based non-renewable chemicals cannot meet the energy needs of modern society. Therefore, there is an urgency to find sustainable renewable resources to make biofuels and value-added chemicals. Consolidated bioreactors using anaerobic microorganisms have been investigated as a means to produce value-added molecules. Microbial metabolic respiration under anaerobic conditions occur by transferring electrons from a highly reduced molecule to an oxidized molecule. This process is demonstrated in fermentation, where electrons are harvested from sugar molecules, producing oxidized waste carbon that act as electron acceptors and are reduced (i.e. ethanol). In anaerobic respiration, harvested electrons can be transferred to other molecules or atoms (i.e. Fe^{3+} to Fe^{2+}). In this study, we are evaluating benthic and subsurface anaerobic microorganisms that can utilize lignin, furfural, and furfurol as electron acceptors. Environmental samples used in this study were obtained from three distinct sites: 1) A borehole located in Amargosa Valley, CA, 2) Benthic sediment from the Southern Illinois University Carbondale Campus Lake, and 3) Benthic sediment from the Northern Nevada Fly Geyser Pool. These environments were used to inoculate enrichments containing electron acceptors as starting materials for chemical conversion to value-added molecules. Resulting microbial communities were identified using next generation sequencing targeting the V4 region of 16S rRNA gene. In total, 2.8 million DNA sequences were obtained, representing 7,746 operational taxonomic units. The most abundant microorganisms identified in the enrichments were from the phyla Firmicutes and Proteobacteria. In lignin containing enrichments the cultures were found to be dominated by *Candidatus* Caldatribacterum, Closteridum, and Hypnocyclicus genera. In furfural containing enrichments the cultures were found to be dominated by Closteridium and Aeromonas genera. Finally, in presence of furfurol cultures were dominated by Closteridium, Morella, Lachnoclostridium, and Helicobacterium genera. Here we present anaerobic bacteria that can contribute in the production of renewable value-added molecules.

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Characterization and Geochemistry of novel bacterium, nov, gen. nov, sp. Anaeropaleothermus hephaestusseraphensis strain SIUC-3, isolated 3.2 kilometers underground from the Driefontein Goldmine, South Africa

Increasingly, microbial ecosystems of the deep continental subsurface are becoming recognized as their own distinct biome. However, access to isolated fractured rock ecosystems is limited to boreholes, mines, and springs. Analysis of these environments are most commonly accomplished through culturing independent methods involving 16S rRNA gene surveys. This provides an understanding of the biodiversity (bacterial and archaeal) and implies what functions communities are capable of. Characterization of the microorganisms that inhabit these environments is necessary for a more complete context of how these organism's metabolism and geochemical interactions operate in the oligotrophic conditions of the subsurface.

In 2005, anoxic paleometeoric fracture water samples were collected from an exploratory borehole in the Driefontein gold mine in South Africa, 3.2 km below land surface (kmbls). The sample remained in storage for over twelve years. Recently enrichments produced a single species of bacteria, which has been given the strain name SIUC-3. This is one of the first microorganisms successfully cultivated from depths greater than 3 kmbls. SIUC-3 is a non-motile obligate anaerobe, growing optimally at a temperature of 60°C and a pH of 7. This microorganism reduces sulfate and can utilize formate, pyruvate, fumarate and oxaloacetate as sole carbon and energy sources. Nearest genetic neighbors to SIUC-3 by 16S rRNA phylogeny are *Desulfotomaculum thermobenzoicum* (91.3%) and *Pelotomaculum thermopropionicum* (90.9%), taxonomically placing this microorganism as a putative novel genus. Here we show SIUC-3's geochemical interaction with the minerals dolomite and quartzite, genomic content, and morphological structure. Based on our characterization analysis we propose the name *Anaeropaleothermus hephaestusseraphensis* (the hot anaerobic ancient tear shaped fire god). Our results describe a cultured, novel genus of bacterium, combined with a sequenced genome that provides insight into the metabolism strategies of the deep subsurface biosphere.

Kaitlyn Hutson and Blaze Rightnowar (REACH)

Microbiology

Chemistry

Using Infared Spectroscopy and Molecular Modeling to Investigate the Structure of BAX Protein in Lipid Bilayers

Human Bcl-2 associated protein X (BAX) is a nine-helix Bcl-2 family protein that oligomerizes in the mitochondrial outer membrane and forms a pore which triggers a signaling cascade that leads to apoptosis. The ninth helix of BAX is the protein segment which imbeds itself into the mitochondrial membrane and has been found to form amyloid like fibrils *in vitro*. By using both computer modeling and spectroscopic techniques to investigate the structure of BAX while in an amyloid state, we are able to obtain additional information on secondary structures of the individual peptides. Comparing a combination of molecular modeling, dynamics suites, and algorithmic prediction software possible secondary structures for BAX in amyloid form were investigated. Algorithmic and dynamic examination suggest that helix 9, with the sequence of TVTIFVAGVLTASLTIWKKMG, prefers to form up to two beta-strands with a loop occurring at the sequence LTAS. Experimental FTIR spectra show that the aggregation of BAX is condition dependent and indicates the formation of parallel beta-sheets in aqueous buffer and antiparallel beta-sheets in the presence of lipid vesicles. To investigate the aggregates formed in buffer, several possible arrangements were constructed and exposed to solvent in dynamic simulations to evaluate the stability of each arrangement. The simulations show that parallel beta-sheet oligomers are stable over 5 ns of simulation time and suggest the beginnings of conversion to the antiparallel beta-sheet state.

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Characterization of the Bacterial Microbiome from Hawaiian Bobtail Squid Aquaculture

The Hawaiian Bobtail squid (*Euprymna scolopes*) is a model organism for researching human immunology, neurology, and host-microbe interactions. Observation and testing of *E. scolopes* requires an artificial marine environment needing rigorous monitoring and testing to maintain water chemistry that sustains the squid in a laboratory setting. Despite efforts to keep environmental conditions stable, squid can potentially become 'unproductive'. When a cohort becomes unproductive they are no longer suitable for research and show characteristics of disease, along with the cessation of eating, and laying eggs. Microbial communities have a direct influence on nutrient cycling within water systems and their influence on the artificial environment may have a significant impact on the squid. However, little research has been conducted on the microorganisms found in squid aquaculture. Here we examine the V4 region of the bacterial 16S rRNA gene using next generation sequencing, to compare the microbiomes from marine habitats of two cohorts of *E. scolopes* during the years 2017 and 2018. The cohort from 2017 was considered unproductive, while the cohort from 2018 was exceptionally productive. The microbiomes from these environments were discovered to have significant differences in the bacterial phyla Proteobacteria, Planctomycetes, and Bacteroidetes. Potential pathogens such as Chlamydia, and Escherichia-Shigella, were also detected. Here we show the similarities and differences of the bacterial microbiomes from controlled environments of *E. scolopes* that may cause biochemical conditions that compromise the health of the squid and prevents critical research from being completed.

***Anil Aryal[1*], Igor Dubenko[1], Shane Stadler[2], and Dr. Naushad Ali[1]**

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Magnetostructural Phase Transformations and Magnetocaloric Effects in Sb doped MnCoGe intermetallic compounds

The effect of Sb doping on the structural, magnetic and magnetocaloric properties of the $Mn_{1-x}Sb_xCoGe$ system ($0 \leq x \leq 0.02$) have been investigated by room temperature X-ray diffraction, differential scanning calorimetry (DSC), and magnetization measurements. A change in crystal structure from orthorhombic to hexagonal was observed in the room temperature XRD data with increasing Sb concentration. Doping Sb for Mn in $Mn_{1-x}Sb_xCoGe$ results in a decrease in the martensitic transition temperature T_M. For the concentration range $0 \leq x \leq 0.015$, T_M was found to coincide with the ferromagnetic transition temperature (T_C), resulting in a first-order magnetostructural transition (MST) from paramagnetic Hexagonal phase to ferromagnetic (FM) Orthorhombic phase near room temperature. A drastic decrease in T_M by ~ 177 K relative to parent compound was found for $x = 0.02$. As T_M decreased below T_C (~ 268 K) of hexagonal phase a MST from FM hexagonal to FM Orthorhombic phase was observed for compound with $x = 0.02$. Maximum values of magnetic entropy change $|\Delta S_M|$ in the vicinity of MST were found to be about 14.0 $Jkg^{-1}K^{-1}$ and 8.5 $Jkg^{-1}K^{-1}$ for $x = 0.01$ and 0.02, respectively, for $\Delta H = 5T$. The large values of the ΔS_M at the first-order MST illustrates the potential of $Mn_{1-x}Sb_xCoGe$ compounds to be used in magnetic cooling technology.

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***K. Robinson, Torrey Holland, and Dr. P. Sivakumar**

Physics

Micro-particles Immunoassays for Early Detection of Ovarian Cancer using Laser Based Spectroscopy

Detecting cancer cells before any symptoms appear is essential for successful treatment, especially for the type of cancer epithelial ovarian cancer (EOC) with few or no symptoms at the early stages. Although there are methods that have been developed to identify the cancer cells, scientists are looking for other novel promising methods to detect that early stage, also cheap and user-friendly. Here, we cross-link elemental particles to a specific functional group of the targeted biomolecules based on a covalent and non-covalent linking chemistry to improve the sensitivity and the selectivity of biomarker detection.

In this presentation, we look into the sandwich type of micro-particle immunoassay with pair of magnetic and silicon can be used for highly-selective detection of specific Cancer Antigen-125 (CA125) and Human Epididymis Secretory Protein 4 (HE4). The cancer biomarkers are quantified via detecting the silicon using Raman Spectroscopy and Laser-induced breakdown spectroscopy (LIBS).

Keywords: CA125, HE4, antibody, avidin, aldehyde, Iron and silica particles.

Waheed Sawar

Physics

An Overview of Data Science and Application in Spectroscopy

Data science is one of the hottest, growing fields of the 21st century. It lies at the intersection of hacking skills (programming), math (statistics), and substantive expertise (in other fields). Scientists use data science to extract insights from data.

Two important mathematical fields used in data science is statistics and linear algebra. One must understand statistical features such as bias, variance, mean, median, and percentiles; probability distributions (how often an event will occur); dimensionality reduction (reducing the number of feature variables); and over/under-sampling. Python is one of the most popular programming languages for data science work. There are many data science toolkits written for Python that efficiently implement common data science algorithms and techniques. A problem that data scientists face is organizing and gathering initial data. They spend much time doing this.

In this presentation, I present the overview of data science and challenges in analyzing spectroscopic data. I also discuss a few examples in the open source.

Gannon Druessel (REACH)

Physiology

Transgenerational effects of Bisphenol A analog Bisphenol S, on male reproductive function in mice

Bisphenol (BP) A is an industrial chemical widely used in polycarbonate plastic production. Numerous studies have shown its ubiquitous presence and toxicity on human health including development and reproductive function. Due to its toxic effects, replacement bisphenols such as BPS have been used as a substitute for BPA at an increasing rate. However, BPS is now detected in humans at comparable concentrations as BPA. Growing evidence has suggested that prenatal exposure to BPS can cause similar reproductive issues as BPA in offspring. This highlighted my hypothesis that BPS may induce reproductive disorders in multi- and trans-generations. In the present study, I aim to investigate the transgenerational effects of BPS on male reproduction using mice as a model. Pregnant CD-1 female mice (F0) were orally exposed to corn oil (control treatment), BPA (as a positive control), or BPS (0.5 or 50 μg/kg/day) from gestation day 7 to birth. Mice from F1 and F2 generation are used to generate the F3 generation. Prenatal exposure to BPA and BPS significantly reduced sperm counts and motility in F3 males, and those males exhibited disruption in the progression of germ cell development, as morphometric analyses showed an abnormal distribution of the stages of spermatogenesis. Furthermore, BPA and BPS with a dose of 50 μg/kg/day decreased the level of testosterone in F3 males. These results suggest that prenatal exposure to BPA analog BPS, has transgenerational effects on male reproductive function in mice.

Anna Feliciano and Dr. Lydia Arbogast

Physiology

Model for Progesterone Effects on Luteinizing Hormone and Prolactin Surges in Estradiol-Primed Ovariectomized Rats

Estradiol and progesterone interact to influence the secretion of pituitary hormones involved in reproduction. Estradiol is required and progesterone influences luteinizing hormone (LH) and prolactin (PRL) surges of the rat reproductive cycle. The goal of this project is to develop a model to evaluate progesterone's effects on hypothalamic mechanisms associated with LH and PRL secretion. Female rats were ovariectomized and ten days later implanted with a 30 mm silicone capsule containing 400 mg/mL estradiol. Forty-eight hours later, a jugular vein cannula was implanted for blood collection. Progesterone (5.0 mg/rat) or vehicle (0.4mL/rat) was injected at 0900h the following day. Blood samples were collected hourly from 1200h to 1700h and at 1900h. Plasma PRL and LH were measured by radioimmunoassay. Progesterone advanced the afternoon PRL and LH surges. PRL reached peak levels at 1400h (540 ng/mL) in progesterone-treated rats and at 1600h (426 ng/mL) in vehicle-treated rats. LH reached peak levels at 1700h (11.5 ng/mL) in progesterone-treated rats and 6.3 ng/mL at 1900h in vehicle-treated rats. In order to examine progesterone's effect on hypothalamic gene expression, two times were selected at the initiation of the PRL and LH surges in progesterone-treated rats when basal hormone levels were observed in vehicle-treated rats. At 1230h-1300h, PRL was elevated (160 ng/mL) after progesterone treatment, but still basal (41 ng/mL) in vehicle-treated rats. At 1530h-1600h, LH was elevated (3.1 ng/mL) after progesterone treatment, but still basal (1.3 ng/mL) in vehicle-treated rats. Brains were collected, medial basal hypothalamus tissue punched, followed by RNA isolation, cDNA synthesis, and qRT-PCR in 3 groups (Ovariectomized, Ovariectomized+Estradiol, and Ovariectomized+Estradiol+Progesterone). The cycle threshold (Ct) values for GAPDH were similar (17.05-17.89) between groups and will be used to normalize gene expression results. Next steps are to evaluate progesterone's influence on the expression of genes associated with the regulation of LH and PRL secretion. These data will provide information relating to pregnancy, infertility, and oral contraceptives.

Afton Lawver, Piotr Baranski, and Dr. Vjollca Konjufca (REACH)

Physiology

Modulation of bone marrow environment by Salmonella typhimurium infection

Salmonella spp. are Gram-negative facultative intracellular pathogens that infect humans and animals via contaminated food and water. The pathology observed during salmonellosis is complex and characterized by inflammation, fever, anemia, and enlargement of the spleen (splenomegaly). We have shown that *Salmonella*-induced splenomegaly is mainly caused by accumulation of red blood cells (RBCs) due to compensatory RBC development in the spleen called extramedullary erythropoiesis. This indicates that the bone marrow's primary function, which is to generate RBCs (erythropoiesis) may be compromised during infection. Our main objective was to investigate whether *Salmonella* infects the bone marrow and how it modulates the development of RBC and other immune cells. We show that *Salmonella* infects the bone marrow, with the infection being cleared within 3-4 days. We also observed that cell pellets collected from bone marrows of infected mice are paler, indicating that they contain less RBCs, which give the cell pellets a darker red appearance as seen in uninfected control mice. Based on these observations, we hypothesize that infection of the bone marrow by *Salmonella* changes the tissue microarchitecture and compromises the bone marrow's ability to synthesize RBCs. We found that there is a marked increase in immature red blood cells and a significant decrease in the amount of mature red blood cells in the bone marrow of *Salmonella* infected mice. In addition, using qRT-PCR we show that expression of a pro-inflammatory cytokine TNF-alpha steadily increases in bone marrow cells from day 0 to day 6 post-infection. TNF-alpha is a potent cytokine that modulates the inflammatory response by causing fever and stimulating maturation and migration of dendritic cells. We hypothesize that this increase in TNF-alpha is due to activated bone marrow macrophages. Understanding how these new changes in bone marrow microarchitecture impact the generation of immune responses to *Salmonella* has implications for understanding *Salmonella* pathogenesis and for the design of more effective *Salmonella*-based vaccines.

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Interactive effects of simultaneous disturbances drive species composition, dispersion, and exotic invasions in secondary succession over 22 years

Plant communities change via disturbances and exotic invasions. Disturbance outcomes through secondary succession change which species characterize communities. The objective of this research was to investigate community shifts in varying disturbance combinations. A strip-strip block design was established in 1996 in a successional old-field at Touch of Nature Environmental Center (Makanda, IL). Parallel strips were randomly assigned to blocks crossing fertilizer (control, five-year, and annual application) and mowing (control, spring, spring-fall) treatments. Species abundance was recorded for plots within seven blocks during nine surveys over 22 years. Nonmetric-multidimensional scaling (NMDS) displayed species and vectors displayed trajectories based on species richness, exotic invasive cover, and surveys. Confidence ellipses circumscribe plots sharing similar treatments. Repeated-measures permutational analyses of variance (PERMANOVA) and tests for homogeneity of dispersion (PERMDISP) tested the effects of treatments and their interactions. *Post-hoc* pairwise-Adonis tests characterized pairwise contrasts among treatment levels. Indicator species analyses (ISA) identified species significantly characterizing treatments and surveys. PERMANOVA and PERMDISP showed significant interactive effects of treatments on community composition ($F_{4,617}$=1.637; p=0.01) and dispersion ($F_{8,617}$=23.07; p=0.001). This interaction was evident in the NMDS ordination, where confidence ellipses for treatments overlapped for three fertilizer treatments and spring and spring-fall mowing treatments were separate to un-mowed plots regardless of fertilizer treatment. Pairwise-Adonis indicated significantly different combinations of treatment levels occurred where 28 of 36 pairs of treatment combinations were significantly different to each other. Indicator species analyses identified 50 indicator species for at least one treatment during surveys. Six exotic invasive indicator species displayed unique patterns of dominance over surveys and treatment combinations. Over time, exotic invasives became more frequently indicator species (especially in mowing treatments). Treatment levels without exotic invasives as indicators for any survey were five-year and annual fertilizer treatments. Over secondary succession some combinations of disturbances are more susceptible to dominance by exotic invasives.

***William Browning and Dr. Karen Renzaglia**

Plant Biology

An exploration of structural and evolutionary diversity of moss stomata

Stomata are minute pores that regulate gas exchange and water loss. Unlike in vascular plants where stomata are typically located on the underside of leaves, in Bryophyta (mosses) they are confined to the lowermost part of the capsule, which is the spore-producing structure of the diploid plant. Although heavily debated, the purpose of stomata in mosses is thought to be in enabling gas exchange while facilitating capsule drying for spore dispersal. Stomata are homoplastic, evolving in the earliest land plants some 400 million years ago, but only in bryophytes have they been lost multiple times. Few studies have examined the diversity and occurrence of stomata across moss phylogeny, thus the pattern of losses (and possibly gains) has not been determined. This project aims to advance our understanding of the evolution of stomata in mosses by examining the occurrence, density and shape of stomata in select taxa, representing moss diversity. These traits are correlated with other features of the sporophyte such as capsule size and anatomy, and seta and calyptra length. Based on the absence of stomata in at least one genus per family, we document 17 independent losses of stomata in the moss clade. In comparison, no examples of stomata loss are evident in vascular plants, except in aquatic taxa.

Nathaniel Jordan and Dr. Jane Geisler-Lee (McNair Scholar)

Plant Biology

Silver nanoparticles and their effect on Arabidopsis thaliana cell viability

Silver nanoparticles (AgNPs) are unique due to their anti-microbial efficacy and ability to be synthesized in various sizes. The scope of their industrial uses ranges from drug delivery and band-aids to cosmetics and socks. As research and development if AgNP related products increases, so does the bioaccumulation of AgNPs in the environment. This study was designed to test the effects of AgNP concentrations on plants, specifically A. thaliana cells to understand the effects of the increasing amount of AgNPs that are accumulating in the environment. Based on the data extracted from the experiment it is determined that the concentrations of AgNPS that were used had no significant impact on A. thaliana cell viability.

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Phylogenetic structure of the weed seedbank is altered between regions in glyphosate-resistant soybean cropping systems in the United States over 6 years

Phylogenetic diversity as an intrinsic biodiversity component illustrates the evolutionary history of species in a community. However, the effects of assembly drivers on phylogenetic diversity and structure of the soil seedbank in crop fields are largely unknown. The objective of this study was to investigate how the influence of geography and soybean cropping systems affect phylogenetic diversity of the weed seedbank over time. A large, field-scale study was conducted across five plant hardiness zones across the mid-western and southeastern coastal United States over six years. Weed species emerging from soil seedbank samples were identified, counted, and used to construct a phylogenetic tree including 234 species. Mixed effects models were constructed to evaluate regions, cropping systems, and years on four phylogenetic metrics. Plant hardiness zone (Wald's-$\chi2$=200.00, P<0.001) and its interaction with year (Wald's-$\chi2$=28.35, P<0.001) and with cropping system (Wald's-$\chi2$=15.23, P=0.018) had highly significant effects on phylogenetic redundancy. The test on abundance weighted Faith's phylogenetic diversity showed a highly significant effect of plant hardiness zone (Wald's-$\chi2$=35.71, P<0.001) and its interaction with cropping system (Wald's-$\chi2$=23.96, P=0.001). Meanwhile, cropping system and plant hardiness zone individually showed a highly significant effect on the standardized effect size of mean pairwise distances (sesMPD, cropping system, Wald's-$\chi2$=13.95, P=0.001; plant hardiness zone, Wald's-$\chi2$=23.69, P<0.001). These results showed that the weed seedbank in plant hardiness zones 7 and 8 showed higher phylogenetic divergence and lower phylogenetic richness than in plant hardiness zones 4, 5, and 6. The cropping system with a rotation between two GR crops exhibited a more over-dispersed phylogenetic pattern than either a single continuous GR crop or a rotation between a GR crop and a non-GR crop. This study provides a valuable evolutionarily based characterization of community assembly in an agricultural ecosystem and highlights the value of studying the soil seedbank in community ecology.

Keegan Shults, Dr. Daniel Nickrent, and Dr. Kurt Neubig (REACH)

Plant Biology

Host preference in the hemiparasite Agalinis tenuifolia

Throughout the evolutionary history of flowering plants, parasitism has evolved 12 times independently and is present in over 4,700 species. *Agalinis tenuifolia* (Orobanchaceae) is native throughout eastern North America, but like many other hemiparasitic plants, its host specificity and preference are currently unknown. This species is a root parasite, and neither tracing roots back to the hosts nor identification of roots via morphology are practical. We examined the root systems of 31 individuals of *A. tenuifolia* from a large population at Lake Murphysboro State Park in Jackson County, Illinois. Parasite and host root systems were excavated, host roots with attached haustoria were isolated and host DNA extracted. Sequences of nuclear ribosomal DNA internal transcribed spacer were obtained and then matched with reference sequences in GenBank. *Agalinis tenuifolia* is capable of parasitizing a wide breadth of hosts, but most haustoria were found on species of *Quercus* (oaks) and several genera in the grass family Poaceae. In the future we hope to replicate this study in differing habitats of *A. tenuifolia* to further elucidate its host specificity and preference.

Breanna Whitley, Dr. Nancy C. Garwood, and Dr. Kurt M. Neubig (REACH)

Plant Biology

Disentangling the lineages of Trema micrantha using phylogenetics, morphometrics, and biogeography

Species-level taxonomy in *Trema*, a pantropical genus of pioneer trees in the Cannabaceae (Cannabis family), has long been problematic. The Neotropical species of *Trema* contain a considerable amount of this variability, particularly in the polyphyletic and widely distributed *Trema micrantha*. Currently, there are several distinct lineages identified within *T. micrantha*, clades A, B, and C. Clades A and C are well-supported phylogenetically with well-defined morphological differences and deserve recognition as distinct species. However, the monophyly of clade B is not well-supported. In this study, we sought to determine if these lineages of *T. micrantha* clade B can be diagnosed as distinct species through increased phylogenetic, morphologic, and biogeographic analysis. We sampled five gene regions including ETS, ITS, *rbcL*, *trnH-psbA*, and *trnL-F* to resolve relationships within *T. micrantha* clade B across it's geographic and morphological range. We have identified three subclades (B1, B2, and B3), as well as putative hybrids between B1 and B2 where sympatric. We found that clades B1, B2, and B3 exhibit distinct morphology and informative geographic patterns. Clade B1 is restricted to Central America and Southern Florida, while B2 is more widely distributed throughout the Caribbean, Florida, and Central and South America. Clade B3 is restricted to Panama and Costa Rica. We will use these results to guide decisions of species circumscription in a taxonomic revision of *Trema*.

***Caleb Crawford**

Zoology

Spatial and population ecology of northern bobwhites (Colinus virginianus) in Southern Illinois

Northern bobwhite (*Colinus virginianus*) population sizes have declined across its range since the early 1930's due to habitat loss, fragmentation, and degradation. Preserving and restoring habitat is key to the persistence of natural bobwhite populations. This study aims to establish baseline data relating to density, distribution, habitat selection, home range, nest site selection, nest success, and survival of bobwhites in Southern Illinois. Study sites include Burning Star State Wildlife Management Area as the focal area and private land as the reference area. We will trap northern bobwhites and equip them with pendulum-style radio transmitters. We will use radio telemetry to evaluate spatial characteristics and locate nests of bobwhites. We will monitor nests and measure vegetation characteristics to evaluate nest success and nest site selection. We will conduct spring and fall call counts to evaluate density and distribution of bobwhites. We will conduct habitat monitoring to assess the amount of usable habitat for bobwhites. Observed differences in spatial and population characteristics resulting from management practices and restoration efforts will provide insight into mechanisms influencing bobwhite populations.

Ethan Dittmer

Zoology

Evaluating Hunter Surveys at Oakwood Greentree Reservoir in Southern Illinois

Human-dimensions research provides wildlife managers with feedback from the users of sites they manage. These user data can help managers to make informed decisions that aim to reach long-term management goals while addressing users' opinions. Today, with the advent of smartphones and growing internet connectivity, wildlife managers are interested in using online methods to collect feedback from site users. Online surveys are substantially lower cost compared to more traditional, paper or mail-in type surveys. During our first field season, we tested two different methods – online "open-web" surveys and paper "mail-in" surveys – to garner feedback from hunters at Oakwood Bottoms Greentree Reservoir (hereafter Oakwood) in southwestern Illinois. From November 10, 2018 to January 8, 2019, we drove a standardized route at Oakwood every morning to complete 30 days of online surveys and 30 days of paper surveys. Hunters were asked to complete a paper survey if we placed one on their vehicle, and to otherwise complete an online survey (accessible by a URL or QR code on signs at the 10 primary access locations at the site). By surveying all 60 days of the duck-hunting season, we were able to calculate an apparent individual response rate of 20.9% for paper surveys and a 2% response rate for online surveys, demonstrating that online surveys alone will be ineffective for getting feedback from hunters at Oakwood. During the 2019-2020 season we will compare the response rates of surveys placed on vehicles to surveys picked up by hunters from several survey stations on the site. We hope to learn if the survey stations can provide a similar response rate to the actively placed surveys, providing a lower cost option for long-term use by area managers

Nicholas Etter

Zoology

Survey of Native and Invasive Earthworms in the Green Earth Sites Carbondale, Illinois

When humans migrate to new places in the world, they may take with them organisms that appear in their homeland naturally and bring them to places where they are not native. These include species of earthworms, which may be inadvertently transported in potted plants from other countries or used for bait when fishing. There are reports of invasive earthworms from places as far away as Asia being found in the United States. Invasive earthworms can alter soil chemistry and plant communities. I sampled earthworms from several nature preserves (Carbondale Green Earth) in Carbondale, Illinois. Soil samples of approximately one liter in volume were collected from multiple habitats and were sifted in the lab to recover all earthworms. Earthworms were identified using taxonomic keys and abundances of different earthworm species from each sample were recorded. In the future, sequence data for two mitochondrial genes will be collected from each specimen to assist with identifications. I also intend to investigate historical data and natural history collections to describe changes in the local earthworm fauna over time. When we learn about the distribution of earthworms, we can better describe ecological changes that can occur because of these invasive species.

Gage Shepard

Zoology

Estimating Black Bear Occupancy at Jellico Mountain Using Baited Camera Traps

Black bears (*Ursus americanus*) were essentially extirpated from Kentucky by the early 1900s due to habitat loss and unregulated hunting. In the last 20 years, bears have been recolonizing Kentucky as a result of habitat becoming more available, laws being made, and reintroduction programs being put into place. With the range of black bears extending back into Kentucky, the need for conservation and management increases. Accordingly, I conducted a non-invasive survey of black bears using baited camera traps in order to estimate occupancy and detection probability at Jellico Mountain, Kentucky. The mountain, which was surveyed for 8 weeks in 2010 and detected 0 bears, was divided into 18 grids (5x5 km), with one camera placed in each grid. All sites were baited with corn and peanut butter, and each site was checked weekly with bait being added as needed. To assess occupancy, presence/absence data were collected from the pictures, and the data were analyzed using R package "unmarked". Covariates of elevation and burn history were incorporated into the occupancy model to obtain site specific probabilities. Eight of the 18 cameras detected black bears over the course of five weeks. Covariates of elevation and burn history were not good predictors of occupancy. For this reason, the covariates were not included, leaving constant detection and occupancy probabilities across all sites. The predicted occupancy probability was 0.449, and the predicted detection probability across the landscape was 0.326. Modelling results indicate it would take approximately five weeks of camera surveying on Jellico Mountain to reach a 90% chance of detecting a black bear. Collectively, these results indicate that black bears have moved into the study area in the past eight years, occupying about 50%, and they give a better understanding of surveying methods/strategies for future conservation efforts.

Christopher R. Smaga and Dr. Agustín Jiménez (REACH)

Zoology

Estimation of Prevalence and Infection Load of Snake Fungal Disease in Southern Illinois

Fungal infectious diseases such as Chytridiomycosis and White Nose Syndrome have caused drastic impacts and declines on wildlife species. Recently, a new potential threat, termed Snake Fungal Disease (SFD), has emerged. Although nowhere near the severity of the latter diseases, SFD causes lesions, ulcers, abnormal behavior, increased ecdysis, and various other symptoms in infected snakes, and can also persist without these symptoms. Caused by the fungus *Ophidiomyces ophiodiicola*, SFD is largely unknown and its impact on snake populations is currently being understood. In the present study, we look at prevalence and infection load of SFD at a site in Southern Illinois. We take multiple swabs of all wild snakes encountered and record the date and length, mass, and location of each specimen. Using known concentrations of fungal standards, we conduct qPCR to determine presence and number of gene copies of fungal DNA in each sample. Our results can be used to draw connections between infection intensity and time of year, snake species and ecology, and habitat location. Preliminary results from visual observations show that although SFD does not seem to be widespread at our site, it has caused major damage to some specimens.

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Effect of the invasive allelopath Lonicera maackii (Amur honeysuckle) on terrestrial gastropod abundance and diversity

Lonicera maackii is an invasive plant that has been proposed to give off chemicals that may be harmful to other plant species, amphibians and herbivorous insects. *L. maackii* can grow rapidly into dense thickets, thus forming a non-native monoculture habitat for other organisms, including land snails. We hypothesized that allelopathic compounds produced by *L. maackii* would have a negative impact on land snail diversity and abundance in close proximity to the plant. To test this hypothesis, we conducted timed searches for large land snails and collected soil samples (for small snails, <3 mm in diameter) both inside stands of *L. maackii* and from similarly sized areas at a two- and four-meter mark outside of the *L. maackii* stands. In this study, four different sites were visited, and eight different stands were studied. At each site, two different stand sizes were studied, at approximately four and eight square meters, to determine whether larger stands would have a larger impact on snail populations. Snails were identified morphologically and by comparisons of "DNA barcode" sequences from two mitochondrial genes with publicly available data. We found higher numbers of snails within *L. maackii* stands than outside stands, but snail abundances at the two- and four-meter mark outside of the stands were similar to one another. There were only about four species of large (>3 mm) land snails were found, and each sample taken in and around *L. maackii* stands had individuals representing each of these species. Our findings suggest that *L. maackii* does not have a negative impact on either land snail abundance or diversity.

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Effects of Strip Mine Reclamation Practices on Terrestrial Snail Communities

Many parts of Illinois (>200,000 acres) have been strip-mined, and reclaiming those sites is critical to restoring habitat connectivity and biodiversity. Impacts of mining and mine reclamation may be particularly severe for small, flightless animals like land snails. To assess the impact of mine reclamation practices on land snails, we surveyed four sites: a reclamation performed using pre-SMCRA (Surface Mine Control and Reclamation Act of 1977) rules where no special care was taken to restore soil to its pre-mining state, a post-SMCRA reclamation where soil horizons were separated and stored to allow the soil to be restored to its pre-mining state, and two relatively undisturbed areas, each near their corresponding reclaimed site. We hypothesized that habitats of higher complexity (higher floristic quality indices) would be higher quality and thus support higher land snail abundances and diversities. At each site, on two separate occasions, twelve $1m^2$ quadrats were searched for 10 minutes to find land snails, six 100mL soil samples were collected to be searched for small snails (<5mm diameter), plants were identified, and coordinates with elevations were recorded for each sample site. Extra soil was collected for chemical analysis. Two mitochondrial genes were analyzed to aid identifications. Our hypothesis was not supported; much higher snail abundance was recorded at the least complex site (pre-SMCRA reclamation), which was heavily infested with non-native plant species and had very shallow topsoil. However, soil at the site also had high pH, calcium, and sulfur, all factors known to be positively associated with land snail abundance and diversity. This suggests soil chemistry is a stronger determinant of terrestrial snail diversity and abundance than habitat complexity. The dominance at this site of *Lespedeza cuneata* (Chinese bush-clover) and its heavy mats of dead stems and leaves suggests soil moisture is important and should be investigated in future studies. This study may provide ideas to consider in future reclamation projects.

School of Medicine

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The use of social robots to enhance sensory integration and social communication in children with autism spectrum disorders (ASDs)

In children with autism spectrum disorder (ASDs) it is thought that ineffective sensory integration, such as speech, plays a role in decreased social functioning. In children with ASD, it has been found that social skills have improved with the use of social robots for communication therapy. Currently in the study, our hypothesis is that a humanoid robot may be effective for children with ASD to comprehend because of its basic vocal and facial expressions that allow for a more simplified version of a human interaction. To test this, we observed how robotic vs human audiovisual stimuli were perceived by children with ASD compared to typically developing (TD) children. Our prediction was that in response to human stimuli, children with ASD would present with larger temporal binding windows (TBWs), which is a measurement of sensory integration acuity. This prediction is based on previous studies that showed children with ASD have difficulty integrating audiovisual stimuli. Since human interactions can be overwhelming in individuals with ASD, we further speculated that children with ASD would present with narrower TBWs, or enhanced audiovisual integration, for the humanoid robot compared to the human stimuli. These hypotheses are supported with our preliminary data. For the robotic stimuli, children with ASD did present with narrower TBWs when compared to the human stimuli. This finding in children with ASD was found to be similar to that of TD children for both the robotic and human stimuli. This suggests that children with ASD may process sensory information from robots in a similar way as TD children process sensory information from robotic or human stimuli. These studies can be used to improve the therapeutic benefits of social robots and in turn, improve human social communication in children with ASD.

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ERG1a Abundance Varies by Skeletal Muscle in Mice

Skeletal muscle atrophy is defined as a 5% or greater loss of skeletal muscle mass that results from an imbalance of protein degradation and synthesis resulting in net protein loss. It occurs naturally with aging as well as with diseases such as cancer and diabetes. It has been shown that the ERG1a potassium channel is upregulated in atrophying muscle and that atrophy occurs when ERG1a is expressed in healthy muscle; however, the mechanism by which ERG1a induces atrophy is not understood. More research is necessary to understand its role. For this, it is necessary to understand better the model we choose to study. Thus, we have explored ERG1a expression in mouse muscle fibers to learn if ERG1a expression is fiber type specific. First, we worked with the *Soleus* (*SOL*) and the *Extensor digitorum longus* (*EDL*) muscles each of which is nearly slow or fast type fiber homogeneous, respectively, based upon myosin heavy chain (MHC) composition. We cryo-sectioned these muscles (20 □m) and co-immunostained them for ERG1a and either fast or slow MHC. We found ERG1a to be more abundant in the *SOL*, suggesting that it is more abundant in slow-type fibers. However, because each of these muscles is indeed nearly homogeneous, we were not able to compare the ratio of ERG1a fluorescence in fast versus slow fibers within a single muscle. Thus, we co-immunostained sections from the mixed fiber *Gastrocnemius* muscles of mice and co-immunostained them for ERG1a and either fast or slow fiber type markers. Finally, we measured ERG1a fluorescence in each fiber type. The data suggest that there could be a difference in ERG1a expression between fiber types; however, additional data from on-going studies are needed to confirm this. Further research into this process could potentially lead to new therapies and treatments for those suffering from atrophy.

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Localization of SMI-32-immunoreactive neurons in the brain of the naked mole-rat (Heterocephalus glaber)

Naked mole-rats (NMR; *Heterocephalus glaber*) are a unique species of eusocial burrowing rodents. As such, they are highly adapted for life underground, with an absence of visual cues. NMRs have evolved to use their tactile body hairs and their large, moveable lower incisors to provide information about life in their tunnels. As interest in using NMRs as a model system grows- including increasing use as a mammalian model for cancer and aging studies- there is demand for more information about their neuroanatomy, including brain chemoarchitecture. Herein, we describe the location of neurons found to be SMI-32-immunoreactive in the normal, adult NMR brain. Expression was found in the cerebral cortex, hippocampus, basal ganglia, thalamus, brainstem, cerebellum, and many other brain regions. Detailed comparisons of SMI-32-immunoreactivity with that found in laboratory rats (*Rattus* sp.) will be presented on the poster, including many of the similarities and differences noted between the two species. Interpretation of these differences will also be presented.

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The Effect of Erg1a Expression on Caspace Enzyme Activity in C_2C_{12} Myotubes

Skeletal muscle atrophy occurs with injury, disease, starvation, and with natural aging, contributing to human morbidity and mortality. Muscle atrophy occurs when muscle protein degradation and synthesis are not appropriately balanced to maintain muscle mass. It has been suggested that caspace enzymes contribute to muscle loss by degrading muscle anchor proteins, allowing the contractile proteins to be degraded by the ubiquitin proteasome pathway (UPP). Because the ERG1a potassium channel increases UPP proteolysis in skeletal muscle, we hypothesized that ERG1a increases the activity of the caspace-3 enzyme known to cause the release of contractile proteins. We tested this hypothesis by expressing mouse *Erg1a* plasmid in left *Gastrocnemius* muscles of 40 mice and control plasmid in the right. We harvested *Gastrocnemius* muscle from 5 mice per day at days 0 through 7 after electro-transfer and assayed these muscles for combined caspace-3 and 7 activity. We determined the ratio of activity in the *Erg1a* treated left leg to that in the control treated right leg and compared this ratio at day 0 to those measured at each day 1-7. We also performed immunohistochemistry (IHC) to test for the presence of specific caspace-3 cleavage product. Data reveal that combined caspace-3,7 activity increased significantly ($p<0.05$) in ERG1a treated muscles: by 1.9-fold at day 3, 2.6-fold at day 4, and 2.9-fold at day 5; however, IHC demonstrated there was no increase in caspace-3 cleavage product. Thus, we conclude that the noted ERG1a-induced caspace activity must result from increased caspace-7 activity. It is hoped that our work will contribute to eventual development of improved atrophy therapies.

Brian Evans, Caitlyn E. Stallings and Dr. Buffy S. Ellsworth

Physiology

Characterization of ASIC2 ion channels in Anterior Pituitary Hormone Releasing Cells

The pituitary gland serves as the major hormone secreting gland in the body and is composed of many different hormone releasing cells. Gonadotrophs, somatotrophs, corticotrophs, lactotrophs, and thyrotrophs, are found here and release the homeostatically important hormones follicle stimulating hormone and luteinizing hormone, growth hormone, adrenocorticotropic hormone, prolactin, and thyroid stimulating hormone, respectively. These cells are excitatory, meaning they release hormones after some sort of initiation. ASIC2 is an acid sensing ion channel that is expressed in the brain and ovaries of mice and the brain of humans. ASIC2 may play a role in the excitatory qualities of these cells and is being studied in our laboratory because of its correlation with the transcription factor FOXO1. RT-PCRs done in our laboratory shows that Asic2expression increases in Foxo1and Foxo3 double knockout (dko) mice. RNA sequencing was done on single knockout Foxo1 mice and showed a decrease in Asic2 expression. I have observed the presence of ASIC2 in the pituitary gland using immunohistochemistry (IHC) staining and performed IHC stains on dko mice in order to measure the fluorescence with ImageJ and get an idea of protein expression in dko mice. Interestingly, I found a decrease from wild type to dko mice. I have also begun observing ASIC2 expression through different timepoints in the mouse life cycle. I am specifically interested in the ages between six and nine week old mice because I have noticed a difference in ASIC2 immunoreactivity between these time points. ASIC2 may play a vital role in hormone secretion and thus, a properly functioning pituitary gland. Understanding its role and the physiology of its functions could lead to new treatments for people suffering from hormone deficiencies or over abundances.

John Lawless, Shanshan Wang, and Dr. Zhengui Zheng

Physiology

Methyltestosterone is sufficient to induce tubular urethra and penile formation in female mice

Previous studies suggested that genital tubercle before sexual differentiation had bisexual potential, exposure to androgen especially dihydrotestosterone (DHT) could drive to masculinization and penile formation. Through comparison the effect of DHT and methyltestosterone (MT) on penile formation in female mice, we found DHT treated female mice failed to induce tubular urethra and penile formation, but same dose of MT treated female mice formed penises (100%) with all characteristics the male penis has, at the weaning time. We further revealed that only prenatal MT is required for induction of penis formation in females. As DHT has more potential binding androgen receptors than testosterone, we treated prenatal mice with DHT in different concentration groups, and found that the penile development had no obvious effect in F1 males, but enlarged clitoris in F1 females, interestingly, the urethra of all treated F1 females were open and form female hypospadias in all the treatment groups (100%) except for the highest dose (10mg/kg), which can induce penile formation in females, but some pups showed bloody testis at birth. We further revealed MT treatment failed to induce penile formation in aromatase knockout female mice. In order to understand how endogenous estrogen at prenatal stage contributes to female penile formation, we observed external genital development on MT treated estrogen receptor alpha (ERα) and estrogen receptor beta (ERβ) knockout mice, surprisingly, MT treated ERα mutant female mice formed penises similar to controls. MT treated ERβ mutant female mice also formed closed urethra and penis structure, but the penile size was significantly reduced. Interestingly, a transmembrane receptor Gpr30 was found expressed in urethra closing area of E16.5 male genital tubercle, but not in females, suggesting Gpr30 may play a role on tubular urethra formation in males. Our data suggest that 0.5-5mg/kg prenatal MT is sufficient to induce tubular urethra and penile formation in female mice, aromatization and endogenous estrogen at prenatal stage may play a role in MT induced penile formation in females, MT induced tubular urethra formation was not through ERα and ERβ, and Gpr30 may play a role on tubular urethra formation in males.

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Revealing the Role of Short Chain and Polyunsaturated Fatty Acids as Regulators of Metabolic Activity and Gene Expression in Ovarian Cancer

With nearly 22,000 new cases each year, and 14,000 of those cases leading to death, epithelial ovarian cancer is the most lethal among all other gynecologic malignancies. Ovarian cancer usually reaches stage 3 or 4 by the time it is diagnosed due to insufficient screening mechanisms and lack of symptoms early in the disease, therefore, making prevention the best form of treatment for ovarian cancer. In order to research possible preventions for ovarian cancer, we use the chicken model, which is the only accessible animal model that resembles the human disease. Laying hens have the ability to spontaneously develop epithelial ovarian cancer and, in two years to ovulate nearly the same number of times as a perimenopausal, giving us the opportunity to conduct large scale dietary intervention studies. Our previous research has provided evidence that a flaxseed-supplemented diet decreases both the severity and the incidence of ovarian cancer. Omega-3 (OM3) polyunsaturated fatty acids (PUFA), in addition to omega-6 (OM6) PUFA are known as essential fatty acids because they must be consumed by the diet, and are significant due to their inhibitory effects on prostaglandins, thereby inhibiting oxidative stress, inflammation, angiogenesis, and proliferation. Flaxseed acts as a source for omega-3 (OM3) PUFA, particularly α-Linoleic acid (ALA), and phytoestrogen lignan, secoisolaricisresinol diglucoside (SDG). ALA is converted into other longer chain OM3s, eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA). SDG is converted into enterodiol (ED) and enterolactone (EL), which have anti-estrogenic and antioxidant properties. The dietary fiber component of flaxseed can be fermented in the gut to produce short chain fatty acids (SCFA). Butyric acid, a commonly studied SCFA, has been shown be an important metabolic regulator by acting as a histone deacetylase (HDAC) inhibitor, a transcriptional modulator, as well as an anti-inflammatory molecule. This research study was conducted to determine whether or not SCFA, specifically butyric acid, and PUFA are upregulated in the chicken ovaries by flaxseed supplementation, and if so, whether or not this contributes to the ability of flaxseed to regulate metabolism. To quantify the concentration of both SCFA and PUFA in each sample, a simple organic extraction was performed followed by fatty acid methylester (FAME) preparation. Gas chromatography was then performed and the amount of fatty acids in each sample were normalized to total protein content. Hens on a flaxseed-supplemented diet displayed a significant increase in the ratio of OM3:OM6 PUFA when compared to the control diet. Likewise, the concentrations of SCFA were increased in ovaries of cancerous hens on a flaxseed-supplemented diet in comparison to hens that were fed a control diet. These observations give us insight into the possible role of flaxseed in modulating metabolic activity through an upregulation of SCFA and PUFA in the ovaries.

Lynon Smith, Caitlin E. Stallings, Stacey McGee, Bella Weymer, and Dr. Buffy S. Ellsworth

Physiology

Is Prox1 a Novel Candidate Gene for Hypopituitarism?

Hypopituitarism can present with growth defects, delayed or absent puberty, infertility, and metabolic abnormalities. Mutations in several transcription factors are known to cause hypopituitarism, but the majority of cases have unknown etiology. Thus, it is important to identify genes that contribute to pituitary gland development and function. Prospero homeobox 1 (*Prox1*) is a transcription factor that is essential for development of the lymphatic vasculature, heart, pancreas, lens, liver, and skeletal muscle differentiation. *Prox1* expression has been detected in the developing pituitary gland, but its role there has not been investigated. We find that PROX1 is present in a subset of somatotropes and thyrotropes. To determine the requirement for PROX1 in pituitary gland development and function, we are currently evaluating a loss of function mouse model. In light of these data we suggest that *Prox1* may represent a novel candidate gene for hypopituitarism.

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