4-2018

2018 Abstract Book

Undergraduate and Graduate Research Forum

Undergraduate and Graduate Research Forum

2018 Abstracts

Student Center Ballrooms
A, B, C, & D
April 9, 2018

SIU CARBONDALE
SOUTHERN ILLINOIS UNIVERSITY
VICE CHANCELLOR FOR RESEARCH

2018 SIU Carbondale Student Research Forum

Program and Abstract Guide

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—James Garvey, Interim Vice Chancellor for Research

Undergraduate and Graduate Research Forum
April 9, 2018
Southern Illinois University Carbondale

Held by the Office of the Vice-Chancellor for Research

Program

Poster Judging Sessions: 8:00am-11:00am

Public Viewing Sessions: 11:00am-3:00pm

Award Presentations: 3:00pm

Thank you to all faculty, staff, and graduate students who are sharing time and expertise to serve as judges at the 2018 Undergraduate and Graduate Research Forum.

Faculty:

Last	First	Department
Geisler-Lee	Jane	Plant Biology
Kim	Jun	Public Health & Recreation Professions
Gagnon	Keith	Chemistry & Biochemistry
DiLalla	Lisabeth	Family and Community Medicine
Hummer	Daniel	Geology
Hovatter	Tom	Office of Workforce Innovation and Research
Bu	Lingguo	Math Education
Kolay	Prabir	Civil and Environmental Engineering
Yoh	Taeho	Sports Administration Program
Neubig	Kurt	Plant Biology
Farrish	John	Hospitality and Tourism Administration
Hunter-Johnson	Yvonne	Workforce Education and Development
Nichols	Jane	Rehabilitation Institute
Suni	Ian	Mechanical Engineering & Chem and Biochem
Liu	Yingdi	Physics
Pender	Debra	Counseling, Quantitative Methods, and Special Education
Bender	Kelly	Microbiology
Fisher	Derek	Microbiology
Schimdt	Kathleen	Psychology
Lu	Chao	Electrical and Computer Engineering
Liu	Jia	Civil and Environmental Engineering
Kono	Shintaro	Public Health & Recreation Professions
Ferre	Eric	Geology
Li	Ruopu	Geography & Environmental Resources
Becque	Daniel	Kinesiology
Mullins	Christopher	Criminology and Criminal Justice
Huang	Qian	Architecture
Kohli	Punit	Chemistry & Biochemistry
Young	Matthew	Biochemistry and Molecular Biology

Graduate Students:

Last	First	Department
Jhamb	Sumeet	Management
Hill	Tayler	Chemistry & Biochemistry
Jamnik	Matthew	Brain & Cognitive Sciences

2018
ABSTRACTS

(* represents graduate status)

Agricultural Sciences

***Ibrahima Coulibaly**

Agricultural Sciences

Long -Term relationship between Growth Hormone-fed Beef Consumption and Diet related Chronic Diseases among Black Women

One of the most important diet-related illness we investigate is obesity among African American women. Obesity is also a risk factor for other diseases, such as arthritis, type 2 diabetes. Obesity prevalence in US is about 30 percent and about 57 percent among low-income African American women. According to CDC.gov, eighty-six percent of the nation's $2.7 trillion annual health care expenditures are for people with severe and mental health conditions. Thus, obesity negatively affects present and future earnings for the US worker. The goal of this research is to inform the public health advocates, policymakers, and other stakeholders about the health impacts of hormone-treated food and obesity. This study investigates the long-term impacts of innovative food consumption have on the low income and low education attainment black female weight. In this study, we use secondary data collected from different government and organizational sources over the last 50 years to test the linkages between growth hormones and obesity among African women. The data period is from 1967 through 2016. The main objective is to measure the long-term association of hormone-fed beef consumption and obesity. To accomplish this, we use the Vector Error Correction Mechanism (VECM) models to test for the long run equilibrium between the consumption of food and obesity conditional on the income, education and other variables. The results show, over time that innovations such as hormone beef have long-term negative impacts on obesity giving level income and education of black female are in the models. The overall model is robust with p-value less than 5%. Government assistance towards lower income black female should be focus on increasing the income level, whose policies may help reduced lower income black female obesity problem. In the long run, several factors need to address included educational attainment, income increase, lifestyles changes, and access to healthy food.

References:

CDC.Gov. Adult Obesity Facts. Retrieved, March 9,2018 From https://www.cdc.gov/obesity/data/adult.html

Applied Sciences and Arts

Katherine Boedecker

Fashion Design & Merchandising, SIUC

Fashion & Engineering Collaboration: Visual Attention Prediction Modeling for Fashion Advertisements

Human beings process an extensive amount of visual information everyday [1]. In order to achieve such task, humans tend to minimize their neural resources by using eye, head, and body movement to shift their visual attention and gaze behavior toward more informative image spatial locations. A selective mechanism exists to control human visual and gaze shift patterns [2]. The recent advances in deep features and saliency modeling may leverage the efficiency in the fashion field by automated prediction of the most attentive locations provided in the visual information. In this study, we applied our developed deep features based saliency algorithms to predict vision attentions for visual information from common magazine advertisements and editorials. Eleven pictures including elements of color contrast, centralized focal points, dynamic lines, human models, and vice versa were used for data analysis. Ten saliency models have been used to create saliency maps.

Preliminary results demonstrate that our human visual attention prediction modeling with saliency maps of pictures from each category is capable to show where consumers are likely to focus their visual attention. Based on the results, this study can provide fashion marketing strategies for designers, merchandisers, and forecasters as implications. Further investigation will be done to optimize our deep feature algorithms and modeling with human subjects study.

References:

[1] Borji, Ali, and Laurent Itti. "State-of-the-art in visual attention modeling."IEEE transactions on pattern analysis and machine intelligence, 35.1 (2013): 185-207.

[2] Mahdi, Ali, et al. "A comparison study of saliency models for fixation prediction on infants and adults." IEEE Transactions on Cognitive and Developmental Systems, (2017).

Joshua Gavel, Hillary Parr, Eva Dynes, Dr. Seung-Hee Lee

Architecture, Fashion Design and Merchandising

Ethical Consumerism: How Corporate Fashion Ethics Affect Millennial Buying Patterns.

Ethics, both in definition and in practice, are subjective and often murky. This subjective tendency means that what is considered "ethical" in one industry may not be so in another. Within the fashion industry ethical components often reflect how corporations examine situations dealing with labor practices, animal welfare, environmental impact and sustainability, as well as, material sourcing, intellectual and creative property ownership, and diversity. Each corporation follows guidelines created within laws both locally, nationally, and globally but after meeting the standards set forth by lawmakers, corporations can choose how to best further their image and agenda. This project examines the consciousness of American millennials have to the ethical business practices of fashion corporations and how those business practices affect their consumer behavior. By examining preexisting research on the correlation on millennial consumer spending and ethical business practices, this project analyzes how implementing ethical business practices can attract greater sales. This study uses journals, magazines, books, and web-based research for its research method. Corporations and growing fashion brands alike can benefit from this research as they can examine how adjusting their business practices can affect their millennial customer base.

Keywords: fashion, ethics, sustainability, animal welfare, labor practices, American millennials

Timothy Hefler and Laura M. Morthland

Architecture

The Dawg House

A "tiny house," according to a proposed amendment to the International Residential Code, is a "…dwelling which is 400 or less square feet (37 m2) in floor area excluding lofts" (Andrew, 2016). The tiny house has surged in popularity since the late 1990's and has been utilized in various ways across the country including veteran and homeless housing as well as senior living (Harlan, 2018; Tiny House Company, 2018). One avenue not readily found in research or built application is the use of the tiny house as a solution for postsecondary student housing. This research examines the feasibility of student built "tiny homes" in lieu of traditional student housing. Cost and size assessments of current housing available in the area were compiled using a five-mile radius from the "core" of the Southern Illinois University Carbondale campus with most data coming from complexes located within one mile of the campus core. Findings thus far have revealed that tiny home dwellings are not currently allowed by Carbondale City Codes; however, code officials expressed interest and were open to discussion (personal communication, September 22, 2017). Additionally, preliminary data collection determined that the calculated average cost for most tiny homes generally exceeded the calculated total cost of typical student housing scenarios. However, closer examination of smaller footprints (<250 square feet) provided financially viable opportunities. This presentation explores the design of an approximately 192 square foot tiny home (based on a standard 8' x 24' pull behind trailer). Through a series of cost assessments and design feature investigations, the "tiny house" model presents a unique opportunity to redefine student housing and lifestyle.

References:

Andrew. (2016, September 5). Proposed Tiny house Code for the 2018 IRC. https://tinyhousebuild.com/proposed-tiny-house-code/

Matthew Maloney and Dr. Shannon Sanders McDonald, AIA

Architecture

ATN (Automated Transit Network) Station Program and Planning Guidelines

This project involves the study of existing driverless transit systems, known as Automated Transit Networks (ATN), around the world and their appropriate application. The goal is to produce a set of Design Guidelines for cities, consultants, and developers to reference if they want to explore implementing an ATN in their area. The research began with collaboration between SIU's graduate Architecture design studio, engineers in San Jose, CA, and engineering students at San Jose State working on a prototypical, elevated system called the Spartan Superway. There are currently five Commercial ATN Systems in existence: The Morgantown PRT (Personal Rapid Transit) has cars that can hold twenty passengers per vehicle, the ParkShuttle Rivium metro-feeder outside Rotterdam which can hold up to 24 passengers per vehicle, the Masdar City PRT in Abu Dhabi can hold between 4 and 6 passengers, the Terminal 5 Shuttle at London Heathrow Airport, and the Nature Park Shuttle in Suncheon Bay, South Korea, which can hold up to six people. The guide also references the San Jose State University Spartan Superway System. All of these different systems are referenced and their characteristics described in the design guide. The guide addresses various aspects throughout related to the design and planning of new ATN stations, such as the history of ATNs, the Existing ATN Systems, the general and specifics characteristics, components, and requirements of the different systems, and different sizing & program requirements for new transit stations. The finished Design Guide will be extensive enough to provide potential users all of the information required to implement a new ATN in their location, including site requirements, station space requirements, track layouts, etc.

Education and Human Services

Chandra Gilliam

Communication Disorders and Sciences

Auditory Processing Disorder: A Survey of Acquired Knowledge Amongst Primary Educators

When it comes to children with auditory processing disorder, primary educators have a crucial role in early identification and management. With primary educators having this pertinent role, the exposure educators have to auditory processing disorder information warranted further exploration. In this study, 134 Southern Illinois primary educators teaching grades kindergarten through eighth grade completed a survey investigating the following: (1) the extent to which Southern Illinois primary educators had acquired APD knowledge in their required degree courses; (2) the identification of specific sources by which primary educators had been informed about APD; (3) identification if correlation between the extent of reported APD coverage in required degree courses and when the educator obtained their education degree was present. Participants were also asked to rate their confidence in their basic understand of auditory processing disorder. In addition to these research objectives, this poster presentation will further discuss the role primary educators have in children with auditory processing disorder, describe the implications of the study's results, and discuss directions for additional research and primary educator APD training in the future.

Erin Koester, Karlie Orozco, M.S. CF-SLP, & Maria Claudia Franca, Ph.D. CCC-SLP

Communication Disorders and Sciences

Vocal Danger Zone in Teaching Education Majors and Singing Majors

The purpose of this study was to investigate indications of vocal risk in Teacher Education majors and Singing majors using the survey "Are you in the Vocal Danger Zone?" available at the Voice-Academy website by the University of Iowa. Results of this study implied that application of the survey yielded promising preliminary data regarding the effects of vocal and lifestyle habits on the voice of future educators and singing professionals. Outcomes revealed aspects that may help clarify the relationship of inappropriate use of voice and how these actions may affect the quality of voice performance. This study resulted in some interesting findings. It was observed, for example, that vocal harmful habits such as drinking alcohol correlated with more occurrences of hoarseness in both populations. On the other hand, outcomes suggested that vocally positive habits such as not raising the voice while teaching correlated with less hoarseness in teaching education. Additionally, results from the singing voice population revealed that only one individual conveyed smoking habits, which may be associated with the population's reportedly reduced occurrence of voice loss and vocal discomfort. These results indicate that taking preventive measures and decreasing the amount of detrimental voice activities may support overall vocal health among pre-professional voice users.

***Olivia O'Donnell B.S, Maria Claudia Franca Ph.D. CCC-SLP, Valerie Boyer Ph.D. CCC-SLP**

Communication Disorders and Sciences

Current Standards on Neuropathic Treatment Dosage: A Literature Review

In regards to communication disorders afflicted by neurological pathologies, research on appropriate treatment dosages is largely understudied (Fox, Ebersbach, & Ramig, 2012) Certain themes persist among professionals. High intensity, functionality, and increased practice throughout treatment seem to be standards by which professionals in the field of speech-language pathology practice. This project examines current literature published on dosage levels in rehabilitation exercising for speech related neuropathic disorders. Although the Academy of Neurologic Communication Disorders and Sciences (ANCDS) has created evidence-based practice guidelines for communication disorders resulting in traumatic brain injury, there is not a generalized treatment method for all neuropathic disorders (Ehlhart et al., 2008). It is the hope of the researcher to address the topic and contribute to fill possible current gaps in current research. This paper is an attempt to highlight the importance of establishing reliable, consistent parameters and measures associated with neuropathic treatment dosage criteria in neurogenic-based speech disorders. Therefore, the primary goal of this presentation is to generate an overall scenario of current dosage considerations for speech rehabilitation exercising.

References

Ehlhardt, L. A., Sohlberg, M. M., Kennedy, M., Coelho, C., Ylvisaker, M., Turkstra, L., & Yorkston, K. (2008). Evidence-based practice guidelines for instructing individuals with neurogenic memory impairments: what have we learned in the past 20 years?. Neuropsychological rehabilitation, 18(3), 300-342.

Fox, C., Ebersbach, G., Ramig, L., & Sapir, S. (2012). LSVT LOUD and LSVT BIG: behavioral treatment programs for speech and body movement in Parkinson disease. Parkinson's Disease, 2012.

Frankie Anderson and Dr. Cynthia Sims

Education and Human Services

First Generation College Students: Exploring the Role of Mentoring and How It Contributes to Undergraduate Persistence

This study explored the impact of mentoring on student persistence among first generation college students (FGCS). Participants responded to semi-structured interview questions that explored their experiences with mentoring in higher education, perceived barriers that hinder their success as FGCS, and factors that contribute to their persistence as FGCS. The results of this study show that FGCS express varying levels of understanding and expectations of mentoring relationships. However, most of the FGCS participating in this study perceived mentoring as an invaluable contributor to their academic success and desire to complete a four-year degree program.

Tierney Rhone

Social Work

Examining Permanence Issues for Children with Disabilities in Foster Care and Adoption Agencies in Illinois

Permanence provides foster children with a legal or relational connection to people who will remain in their lives and can assist in their mental, social, and physical health. Children who are disabled achieve lower levels of permanence throughout foster care. This study examined the preparedness of caseworkers and the systemic barriers to achieving permanence. Research findings will be used to make recommendations to improve both social work practice and policies regarding permanence for children with disabilities in foster care.

Engineering

***Bhavana Talluri[1], Kshitij Amar[2] Farhan Chowdhury[1,2]**

[1]Biomedical Engineering
[2] Mechanical Engineering and Energy Processes

Sox2 Based Genetic Lineage Tracking Reveals Distinct Subpopulations of Tumor Repopulating Cells

Recent studies show that the stem cell-like cancer cells that repopulate tumors [tumor-repopulating cells (TRCs)] play a crucial role in tumorigenesis and are also shown to be responsible for treatment failures and cancer relapses. It is important to understand the genetic and molecular features of these TRCs for potential targeted therapy development. Our previous investigations demonstrate that the self-renewal of TRCs are mediated via Sox2 pathway. Yet, the cell-to-cell variability of Sox2 dependent TRC self-renewal is currently not clear. Accordingly, we generated a transgenic reporter cell line where endogenous Sox2 activity is reported by yellow fluorescent protein (YFP) expression. In this study, we seeded single transgenic Sox2 reporter cells in a soft (90 Pascal stiffness) 3D fibrin gel microenvironment which is known to promote TRC self-renewal and proliferation. We tracked single cells/ colonies in the 3D gel for up to 5 days using a Leica DMi8 epifluorescence microscope. Surprisingly, we identified three distinct subpopulations within the 3D gel. Majority of the spheroids arising single cells increasingly express more YFP over time while a second group of spheroids expressed very little YFP and remained unchanged over time. Moreover, to investigate the influence of physical microenvironment the TRCs with high YFP signals were placed on a rigid dish and tracked further for the next 24 hours at every 4-hour interval. Amazingly, we observed diminishing YPF fluorescence trend over time indicating decreasing endogenous Sox2 activity on the rigid tissue culture dishes. Our results indicate that these tumorigenic cancer cells can turn-on Sox2 based self-renewal pathway based on the physical properties of external microenvironment. The functional relevance of cells with low Sox2 activity remains to be explored in the future.

***Ranjit Bhandari and Ajay Kalra**

Civil and Environmental Engineering

Effects of Changing Land Use and Land Cover on Streamflow of Pajaro River

Sustainable water resource management is important in present day world for achieving adequate water demand for now and the future. Land use and land cover have direct influence on watershed hydrologic components like surface runoff, evapotranspiration, groundwater, streamflow and sediment yield. A change in land use activity tends to change the imperviousness of the surface. Increase in impervious area is often associated with urbanization. This study utilizes the capabilities of a physical model - Soil and Water Assessment Tool (SWAT) to assess the effects of changing land use and land cover on the streamflow in a watershed at regional scale. The SWAT model is auto-calibrated using SWAT-Calibration and Uncertainty Procedures (SWAT-CUP). The Nash-Sutcliffe efficiency and the coefficient of determination are used as the objective function to determine the model efficiency. The study intends in analyze the sensitivity of annual streamflow in response to changing land use and land cover scenario. Acquiring an understanding of how land use and land cover change influence the hydrology in a watershed would assist in formulation of strategies to avoid undesirable effects of future change in land use patterns.

***Swastik Bhandari and Ajay Kalra**

Civil and Environmental Engineering

Singular Value Decomposition Analysis on Large-scale Climate Variability and Regional Streamflow of the United States

The effects of climate change on regional hydrological cycle have become a serious issue as quality and quantity of available water resources are altering over the recent decades. The current research focuses on the interrelationship between regional streamflow of the United States and large-scale climate variability of the Pacific and the Atlantic Ocean. The correlations between streamflow of six different geographical regions divided by United States Environmental Protection Agency and sea surface temperature (SST), 500-mbar geopotential height (Z500), 500-mbar specific humidity (SH500), and 500-mbar east-west wind (U500) of the oceans are determined using singular value decomposition (SVD) method. Streamflow from April to August are correlated with both September to November and December to February climate data creating two lead-time periods of one month and four months respectively. SVD is applied initially with streamflow and SST and that spatial-temporal correlation is later correlated with Z500, SH500, and U500 separately to evaluate the interconnections between climate variables. SVD analysis showed that streamflow variability in the Great Plains, Midwest, and Southwest region is strongly associated with SST of small equatorial band in the western Pacific Ocean. However, for Northeast and Southeast region, U500 and SH500 were strongly correlated with streamflow as compared to the SST of the Pacific Ocean. Identification of several teleconnected regions of the climate variables and the association with the streamflow can be helpful to improve long-term prediction of streamflow resulting in better management of water resources in the regional scale.

***Sandeep G. Burra and Prabir K. Kolay**

Civil and Environmental Engineering

Effect of Lime Sludge, Polypropylene Fiber on Unconfined Compressive Strength and Shrinkage Behavior of Kaolinite Clay

This study presents the results of a comprehensive investigation on the utilization of lime sludge (a waste material from water treatment plant) and polypropylene fiber on unconfined compressive strength (UCS) and shrinkage behavior of commercially available kaolinite clay. Effects of adding various quantities of fiber i.e., 0%, 0.5%, 1.0% and 1.5% and lime sludge i.e., 2%, 4%, 6% and 8% were investigated and evaluated. Both fiber and sludge samples were added to kaolinite clay by dry weight of the kaolinite soil. The UCS samples were prepared at optimum moisture content (OMC) and corresponding maximum dry unit weight from standard Proctor compaction test results. With the addition of fibers, lime sludge resulted in significant influence on engineering properties with curing periods. Scanning electron microscopy (SEM) analysis were conducted on the samples after shearing, improved mechanisms with fiber and lime sludge were discussed and explained. Results show that with the increase in lime sludge content, UCS value initially increased, followed by a slight decrease. An increase in curing period resulted in an increase in unconfined compressive strength. On the other hand an increase in lime sludge content, led to a reduction in shrinkage potential. Increase in fiber content increased the UCS value, which mainly depends on initial moisture content and dry unit weight. Also an increased shrinkage potential was observed with the increase in fiber content. Based on SEM analysis, addition of fiber created a physical interaction between fiber and clay. Whereas, the use of lime sludge induced a chemical reaction between the clay and lime to change the soil fabric significantly.

Key words: Kaolinite, Lime sludge, Polypropylene fiber, Compaction, Shrinkage, UCS, SEM

Marissa Campobasso and Dr. Lui

Civil and Environmental Engineering

Effects of Ag and ZnO Nanoparticles on Microbial Communities in Aqueous Systems

Ag and ZnO are two of the most prevalent nanoparticles (NPs) used in commercial products, however, there is a growing concern of their potential adverse impact on humans and the environment. To truly understand the impact of NPs, this study focused on adding environmentally relevant concentrations of Ag0 (1 µg/L), ZnO (0.1 µg/L), and Ag0+ZnO (1 µg/L+0.1 µg/L) to water collected from where the Carbondale Southeast Wastewater Treatment Plant effluent mixes with the Crab Orchard Creek, IL. NP-spiked-samples were withdrawn immediately and after 72 h for Dynamic Light Scattering (DLS) analysis, and optical density analysis by UV-Vis spectroscopy. DNA extraction, PCR/qPCR analysis, and subsequent sequencing were also conducted. Cloud Point Extraction was performed followed by Inductively Coupled Plasma Mass Spectrometry (ICP-MS) analysis to indicate the NP concentrations. However, the minuscule concentration of NPs were mostly beyond the limit of quantification of the ICP-MS, and the DLS results did not show significant change in the mass fractions of the NPs over time. The UV results suggested that the addition of ZnO NPs significantly decreased the microbial biomass throughout the three days while the Ag0 had a slight negative impact. However, when used in combination (Ag0+ZnO), there was little effect. The qPCR results confirmed the adverse effect of Ag0 NPs, however, the results suggested that ZnO and Ag0+ZnO NPs had a positive effect. Further study is needed to clarify the difference. The relative abundance of the bacterial population affected the most by the addition of NPs include the following phyla: Firmicutes, Cyanobacteria, Actinobacteria, Bacteroidetes, and Proteobacteria. This study demonstrated the response of microbial communities to increased concentrations of NPs present in the environment in a short period of time. The result will provide information that may aid in the preparation of guidance or regulations related to NPs.

***Neekita Joshi and Ajay Kalra**

Civil and Environmental Engineering

Numerical Modeling of Sediment Transport in Mississippi River at Thebes

The Mississippi River is North America's largest river, flowing over 2,300 miles through America's core to the Gulf of Mexico. Sedimentation is one of the pressing problems in Mississippi River and its tributaries. Among several human induced sediment yield, land cover and land use changes is one of the reason in changing dynamics of sediment along the river reach. Intense rainfall, steep slopes and high erosion in less vegetative area leads to higher sediment loss. The study aims in assessing the transportation of sediments at Mississippi River which can help in sustainable planning of physical infrastructures and management of current spurs, barriers etc. The numerical model HEC-RAS 5.1 for simulation of sediment transport module intended for formulated scenarios proposes suitable measures of sediment handling at upstream location of Mississippi River at Thebes, Illinois. The geometric data were generated from 1/3 arc second resolution of Digital Elevation Model (DEM) using HEC-GeoRAS extension in ArcGIS. Calibration and validation of this model were done by applying various sediment transport functions and Manning's Roughness Coefficient. The model output indicates the bed change pattern as well as it conform to aggradation and degradation; this helps in designing sediment control measures and locating the areas of sedimentation. From the results obtained as the estimation of sediment transport and hydraulic flow variables it can be used by water managers for the flow management to downstream users.

***Narayan Nyaupane and Ajay Kalra**

Civil and Environmental Engineering

Flooding Impacts on Carson River Under Changing Climate

More than half of the global population lives in urban areas. Urbanization has increased the surface flow by reducing infiltration as well as reducing the time of concentration. The climate change has increased the extremities such as peak precipitation as well as droughts. This makes the urban life, which is residing nearby water sources more vulnerable. A non-stationarity approach was implemented to estimate the future flood using climate model projections. This study has analyzed Coupled Model Intercomparison Project Phase 5 (CMIP5) streamflow using statistical tools to quantify the future changes in streamflow of Carson River at Carson City, NV. HEC-RAS model of the study area was prepared, and existing design flood and future flood were routed. The comparison between the existing floodplain and future floodplain provides the extent of increase in flooding area due to climate change. The result indicates the increase in streamflow and floodplain. This might affect the urban life with a flood on the residential area and most of the agricultural area. The findings from the study help city planner to foresee the nearest future and supports to prevent the imminent threat.

***Ranjan Parajuli and Ajay Kalra**

Civil and Environmental Engineering

Water Supply and Demand Analysis in Las Vegas Valley Using Climate Models

Climate change has led to the uncertainties in the availability of water while change in population has created changes in demand. Drying climate with growing population has resulted in decreasing supply while increasing demand of water in Las Vegas Valley (LVV). Current study predicts the future status of water supply and demand in LVV using climate models. System dynamics was used to model the relationship of supply and demand with climate change and population growth. Supply in terms of elevation of Lake Mead, the main water supplier to LVV, was used in the study. Key conservation practices, currently in use under Southern Nevada Water Authority (SNWA), were employed in the model in generating future demand. Population forecasts from Center for Business and Economic Research were used to model change in population. Climate and hydrological projections were obtained from 16 Global Climate Models (GCMs) of Coupled Model Intercomparison Project phase 3 (CMIP3) model ensemble and that from 37 GCMs of CMIP5 model ensemble. Mean Lake Mead elevation for the future period of study (2013-20049) was predicted to go up to 21.8% lower than that of the historical period (1989-2012). Of 97 projections of CMIP5 model ensembles, 59 indicated that future mean elevation would be lower than the historical mean whereas 27 of 48 projections of CMIP3 model ensembles indicated the same. Demand forecasts from this study showed that the 2009 demand goal set by SNWA for 2035 could be met under current conservation practices. Such study may be used by water managers and planners to analyze supply and demand in the future using climate projections.

***Balbhadra Thakur1 and Ajay Kalra1**

Civil and Environmental Engineering

Utilizing Nearest Neighbor Approach to Improve Seasonal Streamflow Forecast of San Joaquin Watershed

With the global climate change and growing water demand in California, water has become an essential commodity in the region. Early predictions of seasonal streamflow volume in the rivers and streams can aid water managers in water management issues. The current study adds to the previous researches on streamflow forecasts utilizing multiple large scale climate information (sea surface temperature (SST), geopotential heights corresponding to 500 mbar pressure regimes (Z500), specific humidity and U-wind at an altitude of Z500) of both Pacific and Atlantic Oceans. To analyze the spatiotemporal relations among aforementioned climate information and seasonal streamflow volume singular valued decomposition (SVD) is utilized to yield eight independent SVD relations as temporal expansion series (TES). The TES combination to predict seasonal streamflow was then obtained nonparametrically with continuous exceedance probability curves. Finally, the best TES combination were used as an input in K-nearest neighbor (KNN) regression model to obtain seasonal streamflow forecast. This approach was tested in San Joaquin watershed of northern California for five streamflow stations during 1962 to 2016. The forecasts made with KNN were skillful and may help in future water management policies.

***Wisam Subhi Al-Dayyeni, and Jun Qin**

Electrical and Computer Engineering

Comparison of New Metrics for Assessment of Risks of Occupational Noise

Noise induced hearing loss (NIHL) is one of the most common occupational related health problems worldwide. Exposure to excessive noise is the major avoidable cause of permanent hearing loss. The conventional metrics for noise evaluation cannot accurately assess the exposure risks to high-level complex noise, which commonly occurs in many industrial and military fields. Recently, two advanced models, an adaptive weighting (F-weighting) and a complex velocity level (CVL) auditory fatigue model, were developed to evaluate the risks of occupational noise. In this study, we compared performances of five noise assessment metrics, including F-weighted sound pressure level (SPL) LFeq, CVL model based SPL LCVL, equivalent SPL Leq, A-weighted SPL LAeq, and C-weighted SPL LCeq, using animal experimental data. The animal data includes 22 groups of chinchillas exposed to different types of noise (e.g., Gaussian and non-Gaussian noises). Linear regression analysis is applied to evaluate the correlations between the five noise metrics and the chinchillas' NIHL data. The results show that both developed F-weighting and CVL models have high corrections with animal hearing loss data compared with the conventional noise metrics (i.e., Leq, LAeq and LCeq). It indicates that both developed models could provide accurate assessment of risks of high-level occupational noise in military and industrial applications. The results also suggest that the CVL model is more accurate than the F-weighting model on assessment of occupational noise.

Key words: Noise induced hearing loss; A-weighting; C-weighting; and fatigue model.

***Ali Mahdi, and Jun Qin**

Electrical and Computer Engineering

DeepFeat: A Deep Features Based Saliency Model To Predict Where Do People Look

A large number of studies have been focused to leverage understanding of the human visual attention. Such studies aim to predict the areas in an image or scene that attracts the human fixations. Despite the outstanding performance such studies achieved, their predictions rely on a few number of off-the-shelf features. In the last few years, deep learning achieved an astonishing advances in a variety of computer vision areas including saliency prediction. The main category of deep learning saliency models trained a neural network in an end-to-end manner. However, these models suffer a variety of bottlenecks including insufficient amount of data to train, very long training times, and the requirement of expensive hardware. Some of these bottlenecks have been solved using transfer-learning paradigms where a deep neural network is trained over 1.3 images for object classifications and the extracted deep features are fine-tuned on small datasets to train a saliency models. Although such transfer learning saliency models achieves astonishing results, some of the challenges remain unsolved. In addition to that, the intuitions of the deep features remain unclear. In this study, we present our recently developed deep feature based saliency model for study of human visual attention. The proposed model codenames as DeepFeat, which aim to provide an intuitive interpretation of deep features of deep neural networks using a transfer-learning framework without any further learning. The DeepFeat saliency model incorporates a biological mechanism and a memory-driven mechanism in a fast robust manner. To evaluate the performance of the proposed model, we exploit a publically available dataset that includes 1003 images and the corresponding eye fixations recorded from human observers. The agreement between the model prediction and the human ground-truth is measured using three standard evaluation metrics. Through out the evaluation, we compare four implementations of the proposed model using a variety of deep features selected from state-of-the-art deep neural networks. Moreover, performance of the DeepFeat model is compared to 9 state-of-theart saliency models. The experimental results indicate that the deep features learned for object classification could be a viable solution for saliency prediction. In addition to that, the performance of the proposed model in comparison to the 9 state-of-the-art saliency models indicate the proposed framework achieves at a comparable level of prediction.

***Kshitij Amar, Ian Suni, and Farhan Chowdhury**

Mechanical Engineering

A Quartz Crystal Microbalance Based Study Unveils Integrin-RGD Dynamics during Early Cell Adhesion Events

It is well established that mechanical environment impacts cellular behavior and fate determination. Such cellular interactions with the mechanical microenvironment are crucial for understanding disease and development. In the last couple of decades, multiple techniques like AFM, optical tweezers, and micropipette aspiration have been widely used to quantify ligand-receptor bond dynamics in in vitro settings. These studies provided a plethora of information regarding molecular loading and unloading features. The molecular bond dynamics have been shown to be heavily dependent on the rate of force application. Yet, the most physiologically relevant rate of force application by the living cells still remains unknown. In this study, using a quartz crystal microbalance (QCM), we developed a bulk force sensing platform to detect the rate of cellular force application during early stages of cell adhesion and spreading. Self-assembled monolayers are used to immobilize cyclo-RGDfK peptides that can interact with the αvβ3 integrins on cell membranes atop a gold bonded quartz crystal. The QCM detects the changes in resonant frequency of the vibrating crystal due to the cellular activity/ probing (force application) on the QCM surface. The corresponding changes in mass on the surface and subsequent changes in force which arise from the cellular interactions with the functionalized surface were calculated. The rate of change of force application by living cells was found to be between 60-100 pN/s. Furthermore, we identified distinct phases of cell adhesion and spreading which were not evident earlier. Collectively, our results revealed fundamental features of cell adhesion and spreading, thus providing valuable information regarding cellular interactions with the extracellular matrix. Future investigations will study other ligand-receptor interactions of living cells.

***Suddarsun Shivakumar and Pikam Pun**

Mechanical Engineering

Machine-Insect Interface: Spatial Navigation of a Mobile Robot by a Drosophila Name

Machine-insect interfaces have been studied in detail in the past few decades. Animalmachine interfaces have been developed in various ways. In our study, we develop a machine-insect interface wherein an untethered Drosophila spatially navigates using a mobile robot. We integrate the Active Omni-directional Treadmill (AOT) model on top of the mobile robot to create the interface between the robot and the Drosophila. In this system, the fly is allowed to walk on top of a transparent ball. As the fly tries to walk on the ball, we track the position of the fly using the dark field imaging technique. The displacement of the fly will be balanced out by a counter-displacement of the clear ball, which is actuated by the omnidirectional wheels, to keep the fly at the same position on the ball. Then the mobile robot spatially navigates based on the fly movements. The mobile robot is modular so the base of the setup can be designed to easily fit on the surface of the mobile robot. The threedimensional design tool (SOLIDWORKS) allows us to visualize the setup before the prototyping process. Once the design of the setup is complete, we will be fabricating it. The fabrication includes purchasing the required materials and preparing them for assembly. This study will help in investigating the spatial navigation capabilities under different situations such as the response of the fly to a physical or virtual stimulus. The future scope of this project will include imaging the brain activity on the Drosophila as it spatially navigates towards a stimulus.

***Tiffany Simmons[1], Tasnim Shireen[1], Farhan Chowdhury[1,2]**

[1]Mechanical Engineering and Energy Processes

[2]Biomedical Engineering Program

Simulation of Micro-Channel Shear Flow Based Isolation of Tumor Repopulating Cells By Three Dimensional Finite Element Modeling

Label-free mechanical isolation of tumor repopulating cells (TRCs) from a heterogeneous cell population requires technically challenging 3D culture in soft fibrin gel. Recently, we identified a unique biophysical feature of suppressed cell spreading of TRCs. Based on this finding, we postulated that a shear flow can selectively remove TRCs because of higher profile drag compared to well spread and low profile non-TRCs. In this study, we subjected TRCs and nonTRCs to a micro-channel shear flow in a 3D finite element model. We successfully designed a computer generated model of multiple B16F1 melanoma parent cells and their 3D fibrin derived TRCs in an enclosed chamber with specific geometric dimensions for the purpose of modeling a fluid flow through this control volume to analyze the acting forces on the cells and the resulting shear stress at every point. The shear stress on the B16F1 parent cells was found to be much lower than that of the TRCs primarily due to the geometry of the cells. The geometry of the TRCs was spherical in shape which gives it a greater vertical height, while the B16F1 cells had a much more flat and spread-out shape. This difference played a vital role in generating higher shear stress at the base of TRCs and caused the TRCs to selectively detach from the surface. We also investigated the fluid flow velocity that initiates TRC detachment but not B16F1 parent cells. With increasing fluid velocity a greater shear stress was generated on the TRCs causing them to detach. This ensures the TRCs to detach first and leaving the B16F1 parent cells still attached to the surface. Our results confirmed the feasibility of isolating TRCs from a heterogeneous mixture of cell populations. Future investigations will be aimed towards developing a chip specifically designed for rapid and high-throughput TRC isolation.

Patrick Dudczyk and Dr. Garth V. Crosby

Technology

Implementing a Lab-Intensive Course Online

The Science, Technology, Engineering, and Mathematics (STEM) academia has demonstrated through prior research and projects that lab activities can be delivered online. However, very few lab intensive STEM programs are offered in its entirety online. To increase accessibility for working adults and members of the military, the Department of Technology has recently launched a new lab-intensive online Electrical Engineering Technology (EET) program. Several studies were done in order to assess the pedagogical effectiveness of the lab-intensive online program. In this paper, the results of assessing one of the courses are presented. The course is Digital Fundamentals, a 200-level curriculum core requirement, which focuses on the principles of digital electronics such as logic gates, sequential circuits, Karnaugh map, and hardware description language. To ensure that students were receiving an education equivalent to their on-campus counterparts, certain guidelines needed to be closely followed. The objective was to determine the feasibility and effectiveness of distance-based laboratory experiences in an Electrical Engineering Technology course. Once the semester was concluded, data from both the online and on-campus sections were analyzed to determine the effectiveness of lab-intensive education. The results indicated that if lab activities (experiments) are properly designed, then the online students will perform at least as good as the on-campus students in conducting the experiments. Properly designed distance education lab experiences should include the following: i.) students use miniaturized and portable lab kits and electronic testing instruments, ii.) real-time interaction with lab instructor is facilitated, iii.) experiment are well documented and iv.) collaboration among students are encouraged and facilitated.

***Andres Womac, Kshitij Amar, and Dr. Farhan Chowdhury**

Engineering and Energy Process

FEM Femur Bone Analysis

In the last few decades with the advent of Finite element analysis (FEA) and Computer aided designing (CAD), post-surgical analysis of human bones has gained traction. Design of models for post-fracture are important but with our project we were trying to gain a better understanding of post-surgical removal of these screws from the proximal and distal ends of a human femur and their impact on the development of new crack initiation sites which can be disastrous. With our model, we are trying to optimize the best physiological location for placing these screws to reduce the stress concentration on the periphery of these holes, to avoid any crack propagation, after primary cracks are healed. For our model, we used the static analysis conditions in ANSYS; the mechanical APDL launcher helped us design 3 kN load conditions on the proximal end where the distal end was fixed. We also took into consideration the variability of the diameter of the holes in our optimization problem. By performing Compression, Torsion and 3- point bending tests, we tried to replicate three primary physical human movement conditions with the Femur. Our results clearly highlight the problem with current models and thus we designed our own optimization model, with which we intend to develop better models with the conditions applied for our optimization problem.

Liberal Arts

Hannah Ward and Briar Beck

Center for Archaeological Investigations- Anthropology

In the Footsteps of Lewis and Clark: A Geophysical and Archaeological Investigation at Ft. Kaskaskia State Park

Ft. Kaskaskia State Park is a historic site in Randolph County, Illinois that centrally features the remains of the earthen fort that overlooked the town of Kaskaskia. The fort, built around 1760, was constructed by the French to protect the town of Kaskaskia, which sat under the fort in the Mississippi River floodplain. The fort was abandoned in the early 1760s before construction was completed and rediscovered by the British later. It was initially thought that the fort was rebuilt in 1803 by the American Army, however, our archaeological investigation has uncovered the presence of a second fort. This American fort is located at the Garrison Hill site. In 1803 Meriwether Lewis and William Clark visited the American fort on November 29th to recruit 11 men for their expedition of the American west. Key expedition members such as, Patrick Gass, John Ordway, and Richard Windsor were recruited from the fort. Despite being on the Eastern Heritage Route of the Lewis and Clark expedition, Fort Kaskaskia, and the surrounding area, has received little attention from historians. Little is known about the fort and its complicated history. Limited archaeological investigations were performed by SIU in 1975 and various remote sensing projects have been performed since then. Both sites, Fort Kaskaskia and Garrison Hill, underwent basic excavations. Many artifacts found offer glimpses into the lives of the people living inside the forts. Some of the artifacts found include: military clothing accessories, ceramic, butchered faunal remains, and lithic materials. More excavation and other non-invasive archaeological investigations are planned.

***Eman Hadadi**

Applied Linguistics

Sentential Negation variety in Standard Arabic and Arabic Dialects

Negation in Standard Arabic (SA) and colloquial Arabic dialects is expressed in diverse ways that have led to its being studied extensively by many linguists (e.g., Al-momani 2011; Al-tamari 2001; Benmamoun 2000; Eid 1991; Harrama 1983). This paper explores the extent to which a unified analysis is possible and details those phenomena that resist a unified account by presenting some examples from corpora and previous studies of negative expressions in SA and Arabic dialects in past, present, and future tense. Benmamoun (2000) and Ouhalla and Shlonsky (2002) identify five negative elements in SA: maa, la, lam, lan, and laysa. In this context, the focus will be on the negative particle maa due to its variant usage in Arabic dialects. According to Aoun, Choueiri, and Benmamoun (2010), colloquial Arabic dialects show two types of sentential negation, "depending on whether the negative is hosted by the verb or whether it is realized independently." Moutaouakil (1993:80–81) illustrated a variety of contexts of the particle maa in SA.This proposal highlights the varied syntactic structures of sentential negation in SA and other Arabic dialects. The negative marker maa is from SA, while ʃ developed from the word ʃayʔ, which means 'thing' (Ouhalla 2002). Benmamoun (2000) stated that ʃ seems to have evolved relatively recently to reinforce the negative maa. This two-negation elements pattern maa and -ʃ does not exist in SA.

Norrell, P., Smith, A., Holden, R., Niemet, P., Hite, N., Sanislo, N., Hylin, M.

Languages, Cultures, and International Studies

Unilateral versus Bilateral Craniotomy and Enriched Environment Housing with CCI Traumatic Brain Injury

Traumatic Brain Injury (TBI) is the leading cause of death and disability in adolescents under the age of 15. Although this population is affected by the highest mortality rate of TBI, there is a small body of research regarding therapeutic care of these individuals. The aim of this study is to establish a therapeutic paradigm for moderate to severe TBI using Sprague-Dawley rats and Enriched Environment housing. The animals were injured using an electromagnetic controlled cortical impact (CCI) device, with either a single 6mm craniotomy over the right parietal cortex, or a bilateral craniotomy 1mm on either side of the sagittal midline. A single impact injury was created over the right parietal cortex at a maximum velocity of 5.5 m/sec and a maximum depth of 2mm. Animals were then tested on a battery of behavioral tests analyzing memory and fear responses. Histological analyses of the collected tissue were conducted to evaluate hippocampal volume and inflammation present in the brain. We expect the bilateral animals to differ histologically from the unilateral animals, and the EE animals to offer an improvement over the standard laboratory housed animals.

Taylor Dunning

Music Education

Modifications to Saxophone Functionality: Investigation of Cost Effective Technical Improvements

This research looks at the modern version of the instrument invented in 1840 by Adolphe Sax in the context of current K-12 instrumental music programs The purpose is to identify problems with the average beginner saxophone and develop a cost-efficient method of improvements and repairs. This research draws upon the primary sources of United States patents, instruction manuals, and repair manuals specific to the E-flat alto saxophone. The instrument will be measured and examined in its original state to ensure as many problems are identified, and solved, as possible. It also includes a more a specified purpose as to how low budgeted instrumental programs can make instruments cost effective and function better in its own mechanics.

Rachel Bond

Psychology

The Effect of the Fitbit Charge 2™ Guided Breathing on State Anxiety

Anxiety is a response to threatening stimuli and is defined as a temporary worry or fear, which is normally healthy and adaptive. People with anxiety disorders, however, experience additional symptoms such as irritability, fatigue and hyper vigilance (National Institute of Mental Health, 2016). Techniques such as meditation (Toneatto & Nguyen, 2007), and breathing exercises (Paul, Elam, & Verhulst, 2007) have been used to attempt to reduce anxiety. The Fitbit Charge 2™ has a personalized feature called Guided Breathing which is promoted to reduce anxiety. However, there is a gap in the literature regarding the ability of the Fitbit Charge 2™'s feature as a means to reduce anxiety. Undergraduate participants from an introductory psychology class will be recruited and asked to fill out several questionnaires online via Qualtrics. They will take the questionnaires before watching an anxiety induction video online, after watching the anxiety induction, and after they use the Fitbit Charge 2™'s Guided Breathing feature. Of the questionnaires, these data were collected from the State-Trait Anxiety Inventory (Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983; STAI). While the data has not been collected yet, a repeated-measures ANOVA will be conducted to observe differences across the STAI for each part of the study. Our hypothesis is that the Fitbit Charge 2™ Guided Breathing will significantly reduce state anxiety. With these data, the implications for practice could be very beneficial. If the Fitbit Charge 2™ Guided Breathing feature significantly reduces state anxiety, then clinicians could recommend it to help their clients manage their anxiety.

Jacqueline Chavez

Psychology

The Transition and Challenges of Deaf Students from High School to College

The college graduation rate for the hearing population is 12.8% whereas, for Deaf and Hard of Hearing students the rate is 5.1% (Blanchfield, Feldman, & Dunbar, 2001). Deaf students can get lost in the transition process from high school to college because of a lack of academic preparation, campus accommodations, and social support (Garay, 2003). The current study was based on a pilot study in which Deaf students were interviewed to understand the nature of their transition process and explore institutions of higher education can provide support during that transition. The transition process from high school to higher education was compared between Deaf student who transitioned to a "hearing" college and Deaf students who transitioned to a Deaf university. The students completed a survey that consisted of a demographic sheet, the Resources: Academic Work Scale for Deaf Students, the Classroom Participation Questionnaire (CPQ), and were asked a series of questions about their background, challenges, support systems, and campus resources. Results to date will be presented. MANOVA will be used to analyze the quantitative data. The qualitative data will be transcribed, coded, and analyzed for thematic consistency and perceptions related to college transitions as reported by the student participants. Deaf students who went to a Deaf University are expected to report a smoother transition than Deaf students who went to a hearing college/university. Findings from this study will provide a better understanding of the Deaf student's transition experience and provide institutions information with which to better assist Deaf students during their transition to college.

Keywords: transition, deaf students, challenges, benefit

Heather Duzan

Psychology

Incidental vs. Integral Sadness in Mock Jurors' Legal Judgements

Jurors are often faced with emotional evidence (e.g., children testifying about a traumatic event) that can influence their verdicts. Sadness is an understudied emotion in jury contexts, although it has the potential to shape jurors' verdicts in two ways. First, sadness results in more thoughtful judgments and could therefore lead to better recall of evidence and more informed verdicts than neutral emotional states. Second, however, sadness in reaction to a victim's testimony can bias verdicts by motivating jurors to focus on incriminating evidence. To distinguish between these two effects, we induced sadness either independently (through a pre-trial, unrelated sad video) or as part of the evidence (through a child's emotional testimony) in a hit-and-run trial where the victim was the child's mother. We had a third, neutral-emotion control condition. We also tested whether jurors' gender interacted with the sadness manipulation to influence their emotions, verdicts, and memory for case facts, reasoning that the emotional conditions would exacerbate pro-victim gender effects. There were no effects of the sadness manipulation on our dependent variables. Women were more likely than men to convict the driver, especially in the two sadness conditions, although men reported feeling sadder than women overall. Finally, women scored higher than men on a memory test for case facts, regardless of the sadness manipulation. Surprisingly, sadness was not significantly correlated with confidence in conviction and it was negatively correlated with memory scores—jurors remembered fewer case facts correctly when they felt sadder.

Carlesha Hines

Psychology

The Potential Benefits of the Z-BDDA Compound on Behavioral Tasks Following TBI

Preliminary research on the effects of estrogen and estrogenic compounds on brain injury continues to be examined. While it has been found that estrogen and other sex steroids have neuroprotective properties; there it remains to be shown what impact the effects of estrogen have upon behavior. Therefore, further analysis is needed to demonstrate estrogen is a possible treatment for patients following some brain injury (e.g. traumatic brain injury, stroke). Z-Bisdehyrdrodoisynolic acid (Z-BDDA) is a compound that is primarily comprised of estrogen. Recent studies on the Z-BDDA compound have shown that Z-BDDA reduces behavioral deficits and alleviates cortical swelling and cell apoptosis. Therefore, the present study hypothesized that Z-BDDA would be successful in enhancing cognitive behavior in the rodent model of traumatic brain injury. In the present study, the hypothesis was tested through the use of the visual-spatial learning and memory task (Morris water maze) and fear conditioning. Both male and female mice were either injected with Z-BDDA or a vehicle treatment of peanut oil following the injury. A third category of mice (both females and males) received no injury and no injection (shams). All surgical procedures were performed two weeks prior to behavioral testing. The results of the present study to date, indicated that cognitive behavior was enhanced in female mice that had either been treated with the vehicle or with Z-BDDA than in male mice treated with Z-BDDA in Morris water maze testing. Descriptive statistics indicated an overall increase of freezing behavior in all mice on the second day of context fear conditioning (habitual context).

Kathleen Kelly, Keith P. Klein, M.A., Moselle Campbell, M.A., & Sarah J. Kertz, Ph.D.

Psychology

The Effects of Preservative Thinking on Physiological Activation in Response to Stress

Cardiovascular disease causes one in four deaths in the United States (CDC & NCHS, 2013). Stress is an important factor in the development and maintenance of cardiovascular disease (Pieper et al., 2005). Further, perseverative cognition is one factor that is posited to prolong physiological responses to stress, such as heart rate (HR) and heart rate variability (HRV; Pieper et al. (2006). Results from one study demonstrated that participants exhibit greater HR and lower HRV when perseverative thoughts about anticipated stressors were present; however, they relied on naturally occurring stress (Brosschot et al., 2006). This lack of control limits the understanding of stress-cognition relationships (Pieper et al., 2007). Therefore, the current study aims to examine the effect of perseverative cognition on the relationship between anxiety and stress recovery. This study will utilize a laboratory paradigm to induce stress, which controls the intensity and duration of the stressor. We hypothesize that trait anxiety will predict longer stress recovery over a 24-hour period. Further, we hypothesize that trait perseverative cognition will have an indirect effect on the relationship between trait anxiety and stress recovery. Participants will be recruited from a large, Midwestern university and data collection is ongoing. Participants will complete the State-Trait Anxiety Inventory (Spielberger, 1968) and the Perseverative Thinking Questionnaire (Ehring, et al., 2011). Participants will perform a modified version of the Trier Social Stress Task to induce stress and an estimate of HR (at baseline, during, and after the stressor). Participants will be informed that they will receive feedback when they return in 24-hours. Fitbits will be distributed to every participant to track heart rate at four different time points over the 24-hour period. Stress recovery time will be estimated by calculating the number of hours necessary for the participant to return to their baseline HR. To test our hypotheses, the PROCESS macro for SPSS will be used. The macro simultaneously tests the direct relationship between trait anxiety and stress recovery time, as well as the indirect effect of perseverative cognition on the link between trait anxiety and stress recovery time. If our hypotheses are supported, results from this study will further provide evidence that perseverative cognitions influence the relationship between trait anxiety and stress recovery. Further, by controlling exposure intensity and duration, the current study will address an important gap in the literature.

Lisa Logterman

Psychology

Does Defendant Religious Affiliation Influence Verdicts for Religiously-Motivated Crimes?

In court, defense attorneys highlight defendants' religiosity, assuming that people associate religiosity with positive character traits. Mock jury experimental research supports this strategy: Jurors perceive religious (vs. non-religious) Christian defendants as more moral, and in turn they are less likely to convict. But can religion also result in harsher judgments when used as a justification in court? Highly mediatized crimes committed by Muslims contribute to public views of religious Muslims as fanatical and predisposed to violence. Thus, the exact same information—the defendant committed a crime because of his religious beliefs—can result in positive inferences and lenient judgments for Christian defendants, but negative inferences and punitive judgments for Muslim defendants. This is particularly likely for Christian jurors, due to people's tendency to favor in-group (vs. out-group) members. In a vignette mock-juror study, we manipulated defendants' religion (Christian, Muslim) and motivation for destroying a public statue of a naked woman (religious, non-religious). We coded jurors' religious affiliation: Christian/non-Christian. Participants indicated their confidence in the defendant's guilt and made open-ended recommendations for fines and jail time. Christian jurors were more punitive toward the Muslim (vs. Christian) defendant, while the opposite was true for non-Christian jurors. Christian jurors were as lenient (verdicts) or more lenient (fine amount) toward the Christian defendant when his crime was religiously motivated, but they were harsher toward the Muslim defendant (the harshest judgments across all conditions) when his crime was religiously motivated. In contrast, non-Christian jurors were harshest toward the Christian defendant whose crime was religiously motivated.

Grace Lyons and Dr. Chad E. Drake

Psychology

Examining the Act Matrix as a One-Time Psychotherapeutic Intervention

Psychological distress presents itself in many forms and often requires professional treatment. One problem with obtaining psychotherapy is the extended amounts of time and money it may require, leading many people to terminate treatment prematurely or to avoid seeking any treatment at all. To address this, the current study explored the ACT Matrix, a simplified yet comprehensive version of Acceptance and Commitment Therapy (ACT), as a one-time intervention. Although ACT is a well-established treatment for a variety of psychological problems, the efficacy of the ACT Matrix has received very little empirical attention. College undergraduate students were assigned to one of two conditions; one experimental group was walked through the ACT Matrix for 20-30 minutes and then received text message reminders during the one-week follow-up period while the control group was engaged in an interview-style discussion about their likes and dislikes. Students were emailed a follow-up questionnaire that was compared to pre-intervention responses to assess changes in psychological distress, quality of life, and psychological flexibility (the target construct of ACT). Students in the ACT Matrix condition were expected to exhibit a decrease in symptom distress, an increase in quality of life, and increases in psychological flexibility, while the control group were not expected to exhibit any significant changes in these constructs. Results to date will be presented. A 2x4 MANOVA will serve as the primary analysis. If the results are insignificant, a post-hoc MANCOVA will be used to assess for baseline differences between groups. Implications for primary care and clinical settings in which clients with limited time and/or resources for more prolonged treatment will be discussed.

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Psychology

An Analysis of Bilateral Tripart Hippocampal Volume and Its Relationship to Spatial Processing In a Middle Childhood Sample

Throughout the years, animal research has unearthed that certain cells in the hippocampus contribute to spatial processing, which involves an animal's recognition of its environmental layout and directionality. In order to apply this work to children, we will identify whether hippocampal volume is related to spatial processing, including identifying which section(s) of the hippocampus seem to be more related to processing layouts versus directionality. Based on previous literature, we predict there will be a relationship between bilateral posterior and middle hippocampal regions and spatial processing, such that decreased hippocampal volume will correspond with worse spatial processing. Data collection is complete. This project includes structural magnetic resonance images (MRI) from 136 children (8-12 years old) with the neurodevelopmental disorders of Attention-deficit/Hyperactivity Disorder (ADHD), Reading Disability (RD) and comorbid ADHD/RD, as well as typically developing controls. Analyze software was used for tracing the hippocampus on these images and for segmenting bilateral hippocampal volume into three subregions (head, body, and tail). Spatial processing was assessed with WISC Block Design, DTVMI, NEPSY Visual Attention, and NEPSY Design Fluency. Linear regression will be used to predict spatial processing from bilateral anterior, middle, and posterior hippocampal volumes. The relationship between hippocampal volume and various aspects of spatial processing will be presented, as well as implications of our results and future directions.

Alicia Reed and Dr. Mary Louise Cashel

Psychology

Race and Gender Differences in Bullying among Middle School Students in Southern Illinois

Researchers suggest that racial minorities are at higher risk of being bullied and there is variability across different genders, but few researchers have examined these bullying issues in rural settings. This study looked at race and gender differences in bullying at demographically diverse middle schools. Comparisons were also made between the largest and smallest racial groups as defined by enrollment numbers. To assess variables, the School Climate Survey was administered to 4-12th grade students throughout various middle schools in Southern Illinois. This study used archival data collected in spring of 2017 from 7th and 8th grade students from a Midwest Middle School. It was hypothesized that, (1) male students would experience more physical bullying than female students; (2) female students would experience more verbal bullying than male students; (3) female students would experience cyberbullying more than male students; (4) students in demographic groups with less percentages of enrollment in the school (the minority) would report more bullying than students with greater percentages of enrollment (the majority in enrollment); at Midwest Middle School, Hispanic/Latino and White students would report more bullying than Black/African American students; and (5) Black/African American students would perceive less support from teachers and administrators in relation to bullying than the other racial groups. The findings and implications for future research will be discussed.

Harleigh Williams and Dr. Stephanie Clancy Dollinger

Pscyhology

Relations between Knowledge of Deaf Culture and Opinions of Deaf Capabilities

With the widespread use of social media and the encouragement of mainstream schooling, studies are needed to examine the impact of d/Deaf perceptions. Many hearing individuals are unaware of the culture surrounding d/Deafness. The current study explores how the knowledge of Deaf culture influences the opinions hearing individuals hold regarding the capabilities of d/Deaf individuals. People generally have a more positive view about deafness if they have attended Sign Language or Deaf culture classes (Nikolaraizi & Makri, 2004) or have consistent contact with d/Deaf individuals (Strong & Shaver, 1991). The researchers used the Opinions about Deaf People (ODP) scale (Berkay, 1995) and a questionnaire measuring Deaf culture developed specifically for the current study based on a previously developed study guide about Deaf culture (Vicars, 2017). The opinions of deaf capabilities are expected to relate to the understanding of Deaf culture. Scores are quantified for each of the variables presented, and the researchers will run a simple linear regression analysis. Individuals with greater and more accurate knowledge of Deaf culture are expected to have more positively related opinions of the capabilities of deaf individuals. Data is currently being collected, and results will be presented to date.

Amanda Zayas-Scott and Dr. Karla Feh

Psychology

Ability to Produce Problem Solving Strategies in Aggressive and Withdrawn Children

One of the most vital lessons young children can learn is how to solve problems within their environments. This learned skill is easy or difficult depending on the child. The current study examines aggressive and withdrawn children to explore if aggressive or withdrawn behaviors are preferable when it comes to the ability to produce problem-solving strategies. This study used archival data from Fehr's (2017) ongoing longitudinal study on pretend play, coping, and problem solving. This study includes children ranging from four to five years of age. The measures include the Behavior Assessment System for Children, Second Edition (BASC-2), which is helpful for gaining information on child behavior in a natural setting, based on parent report. The Preschool Interpersonal Problem-Solving Test (PIPS), in which children were given an age appropriate task and asked to generate as many ideas as possible to solve the provided problem, was also administered. The current study examined 66 children between four and five years of age. The variables included 1) Gender of the child 2) Aggression level based on a parent rated child behavior scale 3) Withdrawn level based off a parent rated child behavior scale and 4) Number of novel problem-solving strategies produced. The first hypothesis tests if aggressive and withdrawn behaviors individually indicated a relationship with problem solving capabilities. The second hypothesis of the current study tested if males present as more aggressive than females in the current sample. The final hypothesis for this study states that gender can impact aggression levels, therefore gender can impact problem solving abilities.

Mass Communication & Media Arts

Kelechi Agwucha

Cinema and Photography

Albinism Stigma Across African Contexts: A Conceptual Framework of Affirming Identity through Cinema

This research is designed to explore and review the social stigmas associated with people with albinism (PWA). In identifying the stigmas, in particular ones impinging upon PWA in entertainment and Africa, the film in pre-production, Mkpöchi, will properly represent and raise awareness of the unique plight of PWA. Mkpöchi is a pseudo-documentary and experimental film about a hearing impaired young man with albinism who journeys to replace a mysteriously destroyed and fervently cherished soccer ball. The ball first appeared at childhood in an oil field amidst the Biafran civil war in Nigeria. A masquerade is echoed throughout the film as an emblem for the spirit of his mother, who has died from the conflict. Reviewing three independent films produced outside of the United States, whose lead character has albinism, the strengths and weaknesses of portrayal were analyzed. Moreover, an interview with the Albino Foundation Lagos chapter in Nigeria -- the region in which Mkpöchi will be filmed -- addressed the sensitivities and prejudice of PWA in relation to entertainment's and African's misconceptions. How people perceive the albinistic identity is affirmed through cinema's construction of their lives and narratives. Proper albinistic representation being exhibited through cinema and images is a basis for authentic representation. PWA are tokenized as immoral in Anak Araw, Noi the Albino, and Albino. Although the films are inclusive and focus on PWA, they add to a trend of marginalization and social tension in accordance with the narratives portrayed in each. Utilizing research, unmanufactured PWA characters promotes understanding them as more than the "other". Mkpochi, sustains this by recognizing the social differences experienced by a PWA in relation to the post-traumatic stress, systematic cultural targeting, and isolation suffered during a post-civil war era.

Science

Lulu M. Abou-Jabal, Maria Stacy, M.A, Michelle Y. Kibby, PhD.

Biological Sciences

Anterior Hippocampal Volume and Non-Relational Memory

Multiple studies have shown the anterior hippocampus is involved in associative, episodic, verbal and visual memory (e.g., Kuchinke, et al, 2012; Zeidman, et al, 2015; Zeidman & Maguire, 2017). However, only a few studies have examined the anterior hippocampus's involvement in non-relational memory. Caron, Green and Drane (2014) found free recall of word lists was impaired after the anterior hippocampus was surgically removed. Kircher et al. (2008) demonstrated the left anterior hippocampus was active during a non-associative word list task. No studies were found that examined the anterior hippocampus and non-relational memory in children. It was hypothesized that perfor

mance on a word list immediate recall task would predict left anterior hippocampus volume, while visual-spatial immediate memory would predict right anterior hippocampus volume. Data were collected as part of NIH funded studies on a community sample (R03 HD048752, R15 HD065627). Children, ages 8 to 12 years, with reading disability (n=20), ADHD (n=57), both disorders (n=23), or typically developing controls (n=37) were administered Word Lists (WL) and Dot Locations (DL) short-term memory subtests from the Children's Memory Scale, along with other measures. Multiple regressions were performed to predict left, then right, anterior hippocampal volume, with (WL) and (DL) as predictors. The equation predicting left anterior hippocampal volume was not significant: $F(2, 133) = .957$, $p = .387$. While the regression predicting right anterior hippocampal volume only displayed a trend: $F(2, 133) = 2.836$, $p = .062$, DL predicted right anterior hippocampal volume: $\beta = .193$, $t = 2.258$, $p = .026$ but not WL. Our findings suggest right anterior hippocampus volume is related to spatial memory encoding in children; however, anterior hippocampus volume is not significantly correlated with non-relational verbal encoding. It is possible that age affected how anterior hippocampus size is related to verbal non-relational memory.

Paige McCaleb, James Hillard, Rachel Shurtz, Kamal Ibrahim, Carey Krajewski

Biological Sciences

The Frequency and Influence of Multiple-Choice Question Flaws on High-Stakes Exams in an Introductory Biology Course

Multiple-choice question (MCQ) lecture examinations in introductory majors courses are high-stakes assessments for college students. Instructors assume that student performance on such exams accurately reflects learning. However, word choices, phrasing, and idiosyncratic answer options are factors that can introduce construct-irrelevant variance in exam scores. To evaluate the effects of such test-writing flaws on student performance, we analyzed questions and assessment data from BIOL 200A and 200B courses in 2014, 2015 and 2016. We developed a list of 17 common test-writing flaws and trained a team of evaluators to identify them in a random selection of 400 test questions. Our results include the following: (1) the 12 exams we sampled in both courses show very high internal consistency reliability measured by KD20 correlations; (2) the exams contained numerous flawed questions, the frequency of which differed significantly among instructors; (3) positive-bias and negative-bias flaws are correlated as expected with student performance; and (4) there is a negative correlation between performance on flawed questions and the point-biserial correlation measure of question reliability. Understanding the effects that MCQ flaws have on student performance can help instructors improve the reliability of their exams and inform our interpretation of course assessment data.

***Rajesh P Balaraman, Kexin Jiao, Nathalie Becerra-Mora, Katherine Bolte, Md Aswli, Brishty Deb Choudhury, Annie Vargas and 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 with different research interests 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. First, 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 thin PDMS 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. Second, we report a super-resolution microlens based nanoscopy technique that can overcome the diffraction limit of light (~$\lambda/2$) observed in conventional microscopes. This non-invasive microscopy utilizes high refractive index microlenses (n ~1.55-2) for capturing the evanescent waves from the object in close proximity to the microlenses. Muscle sarcomere, 100nm nano-windows (FIB), nano-fluorospheres force-assembled nanopatterns were resolved using a 10x objective (NA 0.25). Third, we have assembled a nano-editor that is capable of writing and erasing nanopatterns using micro-size conical hydrogel pens with a real-time and spatial control over removal and delivery of ink. Nano-size tungsten tip coated with agarose can also be used delivering metal etchants and salts for micro-electronics. Our group utilizes a wide range of analytical tools for characterization including electron and optical microscopy, AFM, and x-ray and optical spectroscopy. Finally, we bio-mimicked super-hydrophobic and -oleophobic surfaces of naturally occurring lotus leaf/rose petal on different substrates by implying organo-silane chemistry and micro-roughness on the surfaces (SHiMMS). The observed water and oil contact angles of these super-hydrophobic surfaces were >150° and ~130° respectively. Overall, we strive to provide tools and resources to local people by driving innovation in materials chemistry with potential applications in life-, bio-, and nano- sciences.

Najiyah Benzabeh, Motahareh, Taki, and Mohtashim H. Shamsi

Chemistry and Biochemistry

Effect of Probe Length on Quantifying Hexanucleotide Repeat Expansion Sequences

Repeat expansion disorders are a growing class of neurological diseases that are currently incurable and estimated to affect 1 in 2,000 individuals worldwide. Amyotrophic lateral sclerosis (ALS) combined with frontotemporal dementia (FTD) is one of such classes, caused by a GGGGCC/CCCCGG repeat expansion in the first intron of a gene C9ORF72. Electrochemical methods have been extensively employed as a rapid and sensitive tool to detect DNA hybridization for matched and mismatched sequences. One important step in the development of a sensitive biosensor is self-assembly of DNA probes onto a surface of an electrode. Maximum signals are obtained when the strands of a target DNA sequence hybridize with the maximum amount of immobilized complementary DNA probes. Higher probe densities may not necessarily lead to higher hybridization efficiency due to the difference in length or size between the surface-bound probe and the incoming target sequence. Therefore, controlling surface density of probe can be helpful to get maximum signal. In this project, we have self-assembled two types of probes having 1 and 3 GGGGCC repeats on gold electrodes and allowed them to hybridize with complementary repeat expansion targets comprising 1, 3, and 6 CCCCGG repeats. Then, target sequences were hybridized with these probes and the change in charge on the surface was measured using chronocoulometry in an absence and presence of ruthenium hexamine complex. The surface densities of the probes and the DNA duplexes were calculated using Tarlov's method1 and statistically compared for probe and target lengths. Surface density of the DNA duplexes on electrode surface plays a critical role in biosensor sensitivity, and the results of this project will help in developing optimized probe length and surface density for repeat expansion targets.

***Li Fan and Ian I. Suni**

Chemistry and Biochemistry

Cathodic Electrodeposition of WS2, and Anodic Electrodeposition of Element S Thin Films

Polycrystalline WS2 thin films were fabricated by electrodeposition onto ITO from an electrolyte containing 4 mM (NH4)2WS4 + 0.1 M LiClO4 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 WS2 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 Na2S4 in dimethyl sulfoxide (DMSO), with either 0.10 M KClO4 or LiClO4 as the supporting electrolyte.

Madison Funneman, Narges Asefifeyzabadi, and Mohtashim Shamsi

Chemistry and Biochemistry

Development and Characterization of Inkjet Printable Graphene

Graphene, a one-atom-thick honeycomb structure made of carbon atoms, is known for its exceptional electronic and optoelectronic properties. Developing inkjet printable graphene ink with high conductivity is promising for the low-cost and high throughput fabrication of sensors, thin film transistors, and supercapacitors. Harsh conditions, such as probe sonication, involved in separation of graphene sheets during ink formation have been bottle-neck problem because such conditions can break the honey-comb structure. In this work, we have developed graphene inks of various compositions (1.5%, 2.4%, 3%, 3.5%) using a mild bath sonication procedure. This ink was printed and tested on different substrates, i.e. silicon, glass, polyethylene terephthalate, and polyimide materials. The graphene ink was characterized by transmission electron microscopy (TEM), uv-visible spectroscopy, and infrared spectroscopy. Conductivity tests were performed on the printed lines of 100, 200, 300, 400 µm widths. It was found that the electrical conductivity of the printed patterns depend on the widths of the printed lines, concentration of the ink, annealing temperature, and annealing time. Significant increase in conductivity (decrease in resistivity) was observed with respect to increase in these variables. For example, on flexible polyimide substrate, the resistivity of 100 µm line with 1 h annealing at 325 oC was 250 ± 0.93 KΩm, which decreased to 150 ± 0.19 KΩm as a result of 4 h annealing. And the resistivity of 400 µm line at 4 h annealing on top of hot plate at the same temperature measured 50 ± 0.52 KΩm. We propose that this study will be a milestone toward easy and low-cost fabrication of printed electronics on demand using desktop printers.

Michael Lay and Matthew J. Young, Ph.D.

Chemistry and Biochemistry

Effects of Ciprofloxacin Exposure on Hepatic Cell Viability and Mitochondrial DNA Maintenance

HepaRG is a proliferative human hepatoma-derived cell line that can be differentiated into hepatocyte-like and biliary-like cells. HepaRG cells maintain key hepatic functions including drug transporters and xenobiotic-metabolizing enzymes at levels comparable to primary hepatocytes. The fluoroquinolone (FQ) ciprofloxacin (CIP) is an inhibitor of bacterial type II topoisomerase and has been reported to induce double-strand mitochondrial DNA (mtDNA) breaks when mouse cells are exposed to CIP. To determine if differentiated HepaRG cells are sensitive to FQs, cells were grown under standard tissue culture conditions and separately exposed to CIP and vehicle for 14 days. After 7 and 14 days, cellular viability was assessed using the trypan blue exclusion method. Additionally, cells were harvested at both time points and whole cell DNA was extracted. When cells were treated with CIP, 1.3- and 1.5-fold decreases in total live cell counts were observed relative to untreated cells on days 7 and 14 respectively. Next, we wish to investigate the effect of CIP on mtDNA maintenance. We developed non-radioactive mtDNA and nuclear DNA (nDNA) probes for Southern blotting. Regions of human mtDNA and nDNA were amplified using the polymerase chain reaction and cloned separately into plasmids. These plasmids served as DNA templates for synthesis of digoxigenin-labeled probes. Restriction enzyme mapping and Southern blot analysis will be carried out to determine if CIP effects mtDNA maintenance by acting as an off-target inhibitor of the mtDNA replication machinery. These studies are important to gain an understanding of the implications of antibiotics on human mtDNA maintenance.

***P Madhavi and Ian.I.Suni**

Chemistry and Biochemistry

Disulfide Bond (S-S) Breakage at Antibody Hinge Region for A Thin Sensing Layer, And Au Nanoparticle Conjugation to Amplify the Signal, During Small Molecule Biosensing by Electrochemical Impedance Spectroscopy (EIS)

3-Phenoxy benzoic acid (3-PBA) is an endocrine disrupting chemical (EDC), found as a pesticide metabolite in food products. To detect 3PBA in contaminated samples, we fabricated a sandwich immunosensor as our research project by breaking the disulfide bondage(S-S) in the 3-PBA antibody hinge region, thereby allowing fragmented 3-PBA antibody to form Au-S bonds directly to the Au surface, yielding a thinner sensing film relative to the usual antibody plus linker chemistry. This sensor fabrication includes an extra step of analyte (3-PBA) monolayer formation between polyclonal antibody and bacteriophage layers to study antibody/antigen interaction effectively. Introduction of phage sample atop an antibody-coated surface improves biosensor sensitivity by increasing the contrast between electron tunneling through the polymer-protein film before and after antigen binding, as measured by the charge transfer resistance (Rct) obtained from electrochemical impedance spectroscopy (EIS). Preliminary results yield a detection limit ~30% lower. A second research project involves to fabricating a sensor to detect hydrocortisone-3(Ocarboxymethyl) oxime by incorporating amino (NH2) terminated Au-nanoparticles conjugation to amplify the EIS signal. These modified Au nanoparticles form covalent amide bonds with carboxylate groups in the cortisol analyte. The charge transfer resistance (Rct) impedance values are measured as a function of analyte concentration, and are expected to follow the Langmuir absorption isotherm. The relationship between Au nanoparticle size, analyte concentration, and EIS sensitivity will be discussed

Evan McDermott

Chemistry and Biochemistry

ß-Estradiol in Carbondale Wastewater: A Cross-Comparison Study

Natural estrogens are endocrine disrupting compounds and common pollutants in municipal wastewater. The concentration of ß-estradiol was monitored in effluent from both the southeast and northwest Carbondale wastewater treatment plants and their receiving waters for nine weeks. The analysis was performed using tandem GC/MS and an internal standard of 3-methyl estrone. Recoveries were 60±3.9%, and significant degradation of analyte was found after storage > 1 week. The northwest effluent (NWE) had higher levels on average of 7.1-31.9ng/L than the southeast effluent (SEE) between Below Detection Limits (BDL)-28.5ng/L. River water had very similar concentrations of ß-estradiol to the effluent despite dilution, which suggest the analyte was carried with colloidal organic particulates. This also explains the elevated levels in NWE. The university exhibited no measurable effect on B-estradiol levels, when samples from in-session were compared with samples from out-of-session. Future ecological studies are recommended to determine the effect of estrogenic pollution on fish populations of receiving waters.

Madison H. McMinn, Lee Elliott, Gary R. Kinsel

Chemistry and Biochemistry

Thermodynamic Studies of Gas-Phase Equilibrium in MALDI-MS

The goal of this research is to determine whether a correlation exists between the gas-phase thermodynamic properties of amino acids and their relative signal intensities in MALDI-MS mass spectra. Our group has previously reported a linear correlation between the protonated amino acid peak area over the matrix peak area (ln[AAH+/M+]) as a function of the gas-phase basicity (GB) of the amino acid. This correlation strongly supported a mechanism of analyte ion formation via gas-phase matrix-to-analyte proton transfer. However, this previous study involved the grinding of solid samples together and then affixing these samples to the MALDI target. Since the method of sample preparation could lead to a bias towards gas-phase analyte ion formation, there is a compelling interest to repeat these studies using the conventional dried droplet MALDI sample preparation approach, as well as to compare the two methods. In initial studies, alanine, isoleucine, valine, and phenylalanine were co-crystallized as well as ground together with the MALDI matrix 4-hydroxy-3,5-dimethoxycinnamic acid (sinapic acid), both individually and in mixtures. This study aims to expand upon initial studies through the use of sinapic acid in a variety of matrix to amino acid molar ratios. Initial results support the proposed proton-transfer ionization process model. Other data have also been extracted, such as the effective temperature of the reaction and trends between the effective temperature of the reaction and the matrix to amino acid mole-to-mole ratio.

Helen Mihm, Kushal J. Rohilla, and Keith T. Gagnon

Chemistry and Biochemistry

Discovering Broad Spectrum Anti-Venom Aptamers

It is estimated that at least 420,000 people around the world are bitten by venomous snakes each year. About 20,000 die from these bites, with the majority occurring in India, Asia, and Africa. Current anti-venom is costly to produce, must be kept cold, and has a limited shelf life. Aptamers are nucleic acid-based molecules that may be able to address the current shortcomings of antibody-based anti-venoms. Research has primarily focused on identification of aptamers that bind specific venom molecules, such as a neurotoxin in krait and a cardiotoxin in cobra venom. However, the focus on individual toxins is tedious and overlooks many other sources of toxicity in venom, many of which have not been characterized. To identify a broader spectrum of potential anti-venom aptamers and better characterize venom toxins, we have developed an aptamer selection process that targets whole venom instead of individual toxins. No prior knowledge of venom source or composition is required. A custom aptamer library is incubated with whole venom and sequences that bind to venom molecules are selected. We used hemotoxic venom from the Eastern and Western Diamond rattlesnake and neurotoxic venom from the Egyptian cobra. This will allow us to compare aptamers against hemotoxic and neurotoxic venoms. Aptamers are currently being selected and PCR-amplified for for next-generation sequencing. This approach should identify families of aptamers that could neutralize multiple toxins. Results should provide lead candidate aptamers for anti-venom development as well as methods to better characterize toxic venom molecules.

Garrett Murry

Chemistry and Biochemistry

Investigation into the Set1 complex subunits Bre2 and Sdc1

Post-translational modifications of chromatin are important for the regulation of gene expression. The methylation of histone 3 lysine-4 (H3K4) correlates with elevated gene expression, in part by recruiting proteins that specifically recognize and bind to the methylated H3K4 chromatin. There is one multi-subunit H3K4 methyltransferase in S. cerevisiae, the Set1 complex (COMPASS). Humans have six H3K4 methyltransferases that are homologous to the yeast enzyme. Several studies have found that mutations of the human Set1 complex (MLL1-4) results in dysregulation of H3K4 methylation and is associated with cancers, such as leukemia. We are investigating the function of Bre2 and Sdc1, two subunits within the Set1 complex that are required for the higher level di- and tri-methylation of H3K4. We are also currently looking at areas of saturation along the chromosome. Meaning other areas along the chromosome where these sub units are present.

Gabriel Parker, Ahmad Z. Qamar, Mohtashim H. Shamsi

Chemistry and Biochemistry

Flow Dynamics of Biological Samples in Wax Patterned Microfluidic Channels

Microfluidic systems are popular because of their ability to manipulate ultra-low volume of liquids in low-cost miniaturized platforms. There are three main categories of microfluidic systems; paper-based, channel-based, and digital microfluidics. To fabricate inexpensive microfluidic devices, solid wax printing has recently become a norm to construct microfluidic channels on paper substrates. Despite the advantage paper-based devices have their own limitations such as the requirement of large channels and liquid volumes to flow. We are developing wax printed microfluidic systems on flexible plastic substrates. Microfluidic flow depends on the viscosity, density, length of channel, and height of the channel. These parameters were used to calculate the Reynold number. Viscosity and density of simulated urine, glucose doped simulated urine, and milk were used to determine the Reynolds number. The Reynolds number is an important parameter to understand the type of flow in microfluidics. The Reynolds number allows for determination of laminar or turbulent flow of a liquid. 0.25 µl of each sample was passed through microchannels (LWH 1.5 cm x 400 µm x 10 µm). Flow of these samples was monitored by a high-resolution video camera. Effect of viscosity on flow velocity was evaluated by calculating time at different intervals of distance. The data shows that as the density of a fluid increases the time for each sample to pass through the channel increases, displaying a direct relationship between density and time. Milk was found to be slowest liquid in the race with the flow velocity of 1.15 x 10-4 m/s and the densest with 1.0011 g/ml among the biological samples. The Reynolds number for the samples was calculated as simulated urine (0.00478), glucose urine X (0.00391), and milk (0.00224). Since these numbers are much lesser than 1, laminar flow was displayed through the channels. Investigation of these parameters demonstrated microfluidics flow which can open new explorations of biochemical/biomedical application.

Tanner Smith

Chemistry and Biochemistry

The Effects of Metal-Organic Frameworks on Dye-Sensitized Solar Cell Efficiency

The detrimental effects of fossil fuels on our global environment has lead to increased pressure on the development of clean energy. Solar energy has shown significant potential as a solution to our clean energy demands. However, more research is needed in order to increase the efficiency of solar cells, the primary source of solar energy, while decreasing the cost of these materials. The purpose of this experiment is to test a relatively cheap type of solar cell, a dye-sensitized solar cell, that could potentially offer increased energy efficiency over comparable solar cells while maintaining a low manufacturing cost. This study will test solar cells that utilize a relatively new type of chemical compound, called a Metal-Organic Framework. Preliminary studies have shown this kind of material to maintain properties that would make it efficient in harvesting solar energy, and thus could play a significant role in sustainable energy. For this experiment, we will test the power efficiency of solar cells utilizing NU-902, a Metal-Organic Framework that has been the focus of recent research efforts. This will be done by placing the solar cells in the presence of an artificial light that accurately mimics natural sunlight. We will then measure the electrical energy that is generated and calculate the overall efficiency of the cell. From the results we hope to determine how these types of solar cells compare with other solar cells in terms of how efficiently they convert sunlight into electrical energy. Overall, we expect to see that our Metal-Organic Framework-based solar cells demonstrate an energy efficiency that is competitive amongst similar dye-sensitized solar cells. This result could lead to further studies on the applications of metal-organic frameworks in solar cell devices.

***Joel H. Wheeler and Matthew J. Young, Ph.D.**

Chemistry and Biochemistry

Determining Effects of 2',3'-dideoxycytidine on Human Mitochondrial DNA Replication

Mitochondrial toxicity has been established to occur in HIV-infected patients treated with nucleoside reverse transcriptase inhibitors (NRTIs) such as 2',3'-dideoxycytidine (ddC). Incorporation of metabolically active ddC into elongating DNA strands causes chain termination due to the lack of a 3' hydroxyl group. Recently, NRTI off-target effects have been proposed to kill cancer cells that rely on mitochondrial oxidative phosphorylation. The aim of this work is to determine if ddC can be used to disrupt mitochondrial DNA (mtDNA) maintenance in a hepatoma-derived cell line, HepaRG. Non-radioactive probes specific for both mtDNA and nuclear (nDNA) were developed using PCR amplified fragments cloned separately into the pCR 2.1-TOPO vector. These plasmids served as DNA templates for in vitro synthesis of digoxigenin-labeled probes. Initial restriction endonuclease mapping and Southern blotting results are consistent with expected molecular weights of mitochondrial and nuclear gene fragments. The HepaRG cell line will be grown under standard tissue culture conditions and exposed to either ddC or vehicle for two weeks. On days 7 and 14 cellular viability will be determined using the trypan blue exclusion method and cells will be harvested to extract DNA. MtDNA levels will be compared relative to nDNA levels using Southern blotting. This study will provide information regarding the use of ddC to kill a cell line derived from a human hepatoma.

***L.J. Costello, J. Filiberto, S.L. Potter-McIntyre, J.R. Crandall, S.P. Schwenzer, and D.R. Hummer.**

Geology

Alteration and Oxidiation of an Olivine Lamprophyre Dike from Southern Utah, USA: An Analog for Mars

The physical and chemical weathering of iron and magnesium silicates can provide important insights into the overall alteration and oxidation of the host rock, and can be indicative of the environment to which the rock was exposed [1,2]. The process of iron alteration and oxidation may be more prevalent on Mars because Martian basalts usually contain more iron than terrestrial basalts [3,4]. These processes may be more prominent during the Noachian, when the atmosphere was likely warmer and wetter and where liquid water could exist to drive alteration and redox reactions [5,6]. We investigate the change from a relatively fresh to an altered mafic intrusion in an Earth analog on the Colorado Plateau to constrain the mineralogical changes associated with oxidation as applicable to the alteration of the Martian crust [7]. There are four main zones of oxidation along the intrusion that can be generally characterized by the difference in color in the field and in hand sample. The 'freshest' sample found in the northwest section of the dike is dark black in color. Moving to the southwest, the dike exhibits a yellow-green color, followed by a section of purple coloration, before the most oxidized, red section of dike. Initial results from VNIR spectroscopy show iron oxidation minerals, including hematite and goethite, present throughout the intrusion. However, hematite and goethite occur in greater concentration in the more oxidized samples. On Mars, global mineralogical mapping from OMEGA of the Martian surface shows similar mineralogy (Fe/Mg and Al smectite clays) to the oxidized dike system [7]. CRISM spectroscopy also indicates hydrated minerals on Mars [8]. Therefore, our ongoing investigation of the oxidation and alteration process of iron and magnesium silicates in a terrestrial basalt will provide a better foundation for understanding the conditions of formation of these alteration products on Mars.

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Magmatic Intrusions into the Sulfur-Rich Carmel Formation on the Colorado Plateau, USA: Implications for the Mars 2020 Mission, 1, 1259

Magmatism is a critical process throughout the geological history of Earth and Mars, and one of the few processes capable of producing significant changes in the Martian surface and subsurface past the Noachian. The interaction between mafic magmatism and host rock has the potential to contribute to the surface volatile species, key among which is sulfur. On Earth, mafic magmas intruding sulfur-rich sediments are uncommon; in contrast, sulfur–rich soils exist with a near global extent on Mars, and ample evidence exists for ancient mafic magmatism. The intrusion of mafic magmas into sulfur-rich sediments is therefore expected on Mars, and is especially pertinent concerning proposed landing sites for NASA Mars 2020 and the ESA ExoMars missions, both of which contain a potential volcanic capping unit in direct contact with sulfate bearing sediments. The NASA Mars 2020 landing site, Jezero Crater, hosts Syrtis Major volcanics overlying sulfate material, while the ExoMars landing site, Mawrth Vallis, includes a magmatic flow that covers sediments hosting sulfate minerals such as jarosite. However, the interaction between sulfur-bearing sediments and mafic volcanism on Mars has yet to be studied in depth, which is now timely through its presence at Jezero Crater, Northeast Syrtis Major, and Mawrth Vallis. This study aims to fill this gap in our scientific knowledge pertaining to the mineralogy, alteration, and hydrothermal system of mafic volcanics intruding sulfur-rich sediments. Here we investigate an analog of this process; a mafic dike intruding the sulfur-rich Jurassic Carmel Formation of the San Rafael Group. Approximately 200 dikes, sills, and breccias can be found in proximity to the San Rafael Swell in Utah, and represent an Earth analog for a scenario of mafic magma intruding sulfur-rich sediments.

Morrighan O'Connell

Geology

Hydrothermal Fluids in the Southern Illinois Basin and their Role in Producing Natural Resources

Geological resources have the ability to provide materials to industries across the country. The Southern Illinois Basin is host to sedimentary rocks that contain significant amounts of natural resources such as oil and gas accumulations, ore deposits, and rare element deposits. Paleofluid movement has played a key role in the accumulation and distribution of these resources in the Southern Illinois Basin. This study has provided one of the first isotopic data sets for the Mississippian age rocks in this region. Calcite and Dolomite were both analyzed for their stable Carbon and Oxygen isotope values, and this analysis has shown a variety of very light 13C and 18O isotopes ranging throughout the six samples tested. These very light oxygen isotope values indicate that calcite precipitated out of very high temperature fluids, while very light carbon isotopes indicate hydrocarbons in the system. This combination of hot fluids in the system and carbon from organic matter being present is a strong indication that oil and gas resources are likely to be present in this area. Furthermore, the six samples were also analyzed with cathodoluminescence microscopy, which uncovered information relating to each rocks porosity. This porosity information can help us pinpoint which rocks are more likely to house natural resources, depending how easily fluid can move through the rocks. The cathodoluminescence microscopy also uncovered that each sample contains multiple generations of calcite cement, implying that each layer was laid down at individual events. This information leaves the door open for further pinpointed isotopic analysis on each individual generation of carbonate cement.

Katrina M. Beaver and Derek J. Fisher

Microbiology

Analysis of Gene Expression throughout the Developmental Cycle of Chlamydia trachomatis

Chlamydia trachomatis is the leading cause of infectious blindness and reportable, bacterial sexually transmitted infections. These obligate intracellular Gram negative pathogens parasitize cells lining the mucosal epithelium leading to tissue damage from immunopathology. For a successful infection, the bacterium must transition between the infectious elementary body form (EB) and the non-infectious, replicative reticulate body form. This development process progresses through an early, middle, and late stage with concomitant changes in gene expression and protein profiles. In addition, certain stressors can alter development leading to a form of persistence accompanied by alterations in gene expression patterns. Our lab hypothesizes that a subset of genes encoding proteins involved in protein-phosphorylation and protein-folding pathways regulate development and stress responses. Our short-term goal was to map expression of these genes during normal development. We mapped the expression of fourteen genes throughout normal development using qRT-PCR with RNA samples harvested from infected HeLa cells at 0, 8, 16, 24, 30, and 40 hours post-infection. Transcript levels were normalized using genomic DNA isolated at each respective RNA-sample time point. Chlamydial protein levels and EB production were also measured. Collectively, our data provides a baseline for gene expression during normal growth and will facilitate our long-term goals of assessing how stress impacts gene expression and how genetic manipulation of these genes impacts development and stress responses. Understanding chlamydial development at the molecular level is crucial for discovering novel methods to prevent and treat infections.

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Characterization of the Two ClpP Isoforms of Chlamydia Trachomatis

Chlamydia trachomatis is an obligate intracellular bacterial pathogen responsible for sexually transmitted infections and the ocular infection trachoma. Chlamydia undergo a distinctive developmental cycle transitioning between the infectious elementary body form and the replicative reticulate body form. Each developmental form has a distinct proteome reflecting its different physiological needs. We are interested in studying how protein degradation impacts proteomic patterns throughout the developmental cycle. Chlamydia encode a pan-bacterial Clp protease system consisting of five genes: clpX, clpC, two clpP paralogs (P1 and P2), and clpB. ClpX and ClpC are chaperone proteins that unfold protein substrates and feed them into the oligomeric ClpP protease; ClpB is a deaggregase. We hypothesize that the Clp protease system plays an essential role in proteomic turnover between the developmental forms. As a first test of our hypothesis, we initially sought to confirm and characterize the protease activity of the putative ClpP paralogs. Escherichia coli was used to produce the chlamydial ClpP1 and ClpP2 proteins with C-terminal 6x His-tags. Proteins were then purified using immobilized metal (cobalt) affinity chromatography. Function was assessed through analysis of oligomerization along with testing of protease activity using casein and fluorescent-peptide substrates. We also explored the effects of ClpP-binding small-molecule compounds on in vitro ClpP1/2 activity and growth of C. trachomatis in a cell culture infection model. Our results indicate that ClpP2, but not ClpP1, is able to form a mature oligomer and possesses protease activity under the in vitro conditions tested. In addition, ClpP2 activity was stimulated in the presence of various ClpP-binding molecules and these molecules reduced growth of C. trachomatis in cells. Collectively, our findings support the presence of a functional Clp protease system in Chlamydia and suggest that the system is essential for growth making it an intriguing target for the development of novel anti-chlamydial drugs.

***J.S. Miller and K.S. Bender**

Microbiology

Characterization of the Desulfovibrio sRNA SIC2

Desulfovibrio vulgaris Hildenborough (DvH) is a gram-negative anaerobic sulfate-reducing bacterium (SRB). SRB are capable of using sulfate as a terminal electron acceptor resulting in the production of hydrogen sulfide as an end product. Not only can SRB raise the environmental pH through their production of bicarbonate, but they can also assist in the precipitation of toxic metal ions through their production of hydrogen sulfide and direct transfer of electrons to oxidized forms of toxic heavy metals such as uranium and chromium. With metabolic capabilities such as these, DvH is considered as a potential organism for bioremediation and sulfur cycling. However, very little is known about the regulation of these metabolisms. Our lab focuses on small regulatory RNAs (sRNA), a form of regulation in which little is known about in Desulfovibrio. Previous work in our lab led to the discovery of a sRNA candidate (SIC2) with computational algorithms predicting two mRNAs encoding products involved in hydrogenase formation (hypA and hypD) as targets. Hydrogenases are vital enzymes for hydrogen metabolism and are responsible for the oxidation of molecular hydrogen into free protons and electrons (reversible). DvH contains six hydrogenases and while the role of these enzymes are somewhat debatable, several studies have shown that they play a role in the cellular response to oxidative stress. Thus our lab focused on the oxidative agents nitrate, nitrite, acetone, and hydrogen peroxide to elucidate the role of SIC2 and its predicted mRNA targets. Our initial qRT-PCR data suggest an up-regulation of SIC2 in the presence of acetone and nitrate, while down-regulation of its targets hypA and hypD. Although further studies are needed, this data suggests that SIC2 acts as a negative regulator of hydrogenase formation. With decreased hydrogenase production, we hypothesize that reducing equivalents are re-routed to help detoxify oxidative agents.

Francesca Sanchez and Dr. Vjollca Konjufca

Microbiology

Induction of Antibody Responses in the Female Reproductive Tract by Per-Oral Administration of High Dose Soluble Protein Antigen

Sexually transmitted infections (STIs), including Chlamydia are estimated to have around 20 million new occurrences annually in the United States. No effective mucosal vaccines exist to target STIs, with the exception of the HPV vaccine, which is administered as an intra-muscular injection. IgG antibodies are abundantly found in serum, and are the most protective against pathogens. In contrast, mucosal surfaces of the gut, respiratory, and the reproductive tracts secrete predominantly IgA antibodies which prevent colonization of mucosal surfaces by pathogens. Previously Howe and Konjufca showed that per-oral (PO) priming followed by a sub-cutaneous (SC) boosting (PO-SC) with ovalbumin-conjugated to nanoparticles (NP-Ova) induced high levels of serum IgG1, IgG2c, as well as mucosal IgA and IgG antibodies. Unlike PO-PO immunization, antibody titers induced with PO-SC immunization remained unchanged for over a year, signifying strong immune memory. Howe and Konjufca also showed that feeding mice with high dose of soluble antigen Ova induced serum IgG1 and IgG2c, as well as mucosal IgA. Interestingly, when these mice were boosted SC with Ova secretion of IgA at mucosal surfaces was completely abrogated and serum IgG titers were not boosted. In this work we tested whether PO-PO immunization with high dose of soluble Ova would induce long-lasting mucosal and systemic immune responses. Interestingly, we found that PO administration of Ova induces serum IgG1 and most importantly IgA and IgG1 secretion in the gastro-intestinal (GI) and the female reproductive tract (FRT). The IgA response appears to be T cell independent since measurable titers are induced within a week of Ova feeding and decline significantly within two weeks. Interestingly, following PO boosting with Ova 1) IgA and IgG titers are comparable in the GI tract and in the FRT and 2) Both IgA and IgG titers at these sites are abrogated only 3 months after first Ova administration. These findings indicate that GI mucosa is a site for induction of immunity in the FRT and can potentially be used for vaccinations against sexually-transmitted pathogens such as Chlamydia spp. This work will be important for developing mucosal vaccines to target sexually-transmitted pathogens such as Chlamydia spp. and HIV.

***Nita Shillova, Laura Berger, Francesca Sanchez, and Vjollca Konjufca**

Microbiology

Systemic and Mucosal Antibody Responses of Mice Per-Orally Infected With Chlamydia Muridarum

Chlamydia spp. is the most common sexually-transmitted bacterial pathogen. Chlamydia infect the epithelium of mucosal surfaces of the respiratory and genital tracts. During female reproductive tract (FRT) infections, Chlamydia ascend to the uterus and ovaries, causing pathologies like pelvic inflammatory disease, infertility and ectopic pregnancy. It was shown that following FRT infections, Chlamydia infect gastro-intestinal (GI) tracts where they persist for prolonged time without causing pathology. GI tract Chlamydia resists anti-microbial therapies and serves as a reservoir for re-infecting the FRT. Currently, no effective vaccines exist to target these infections. Resolution of chlamydial infections require development of cellular and humoral immune responses. Systemic immunizations induce serum antibodies which are important for resolving chlamydial infections, but do not elicit mucosal immune responses, and are thus ineffective against mucosal infections. To induce antibodies in the GI tract, per-oral (PO) immunization is essential. To better understand Chlamydia pathogenesis in the GI tract we use the murine model of infection with Chlamydia muridarum. We examined systemic and mucosal antibody responses following 1) PO infection with live C. muridarum and 2) PO infection followed by sub-cutaneous boosting (PO-SC) with C. muridarum antigen. We show that PO infections or PO-SC boosting with C. muridarum result in high titers of serum IgG2c and intestinal IgA antibodies. Induction of serum IgG2c antibodies is typical for Th1 mediated immune responses that are thought to protect against Chlamydia. Unlike IgG1, IgG2c antibodies are never secreted at mucosal surfaces and are ineffective against mucosal Chlamydia. In addition, induced mucosal IgA does not eliminate GI tract Chlamydia. We hypothesize that immunization strategies that induce high mucosal and serum IgG1 titers will be effective at targeting this pathogen. We are using antigen delivery via nanoparticles to test our hypothesis. Our findings will be important for understanding Chlamydia pathogenesis and designing effective mucosal vaccines.

***Nicole J. Szczepanik and Kelly S. Bender**

Microbiology

Unique Regulation of the Methionine Biosynthesis Pathway in a Model Sulfate-Reducing Bacterium: A Tale of a Dual-Functioning RNA Molecule and a Small Protein

In bacteria, central metabolic pathways must be tightly regulated to permit optimal growth, especially when cells encounter suboptimal conditions. One of these pathways, the methionine cycle, is responsible for the production of both the amino acid methionine and s-adenosyl methionine (SAM), which functions as a methyl donor in numerous cellular reactions. The donation of a methyl group by SAM yields s-adenosyl homocysteine (SAH), which must be recycled to homocysteine to prevent feedback inhibition. In E. coli, tight control of the methionine cycle has been shown to be essential for survival under various stress conditions. Regulation in this organism is protein based. In contrast, the model sulfate and toxic metal-reducing organism Desulfovibrio vulgaris Hildenborough (DvH) appears to regulate the methionine cycle in a different manner. This regulation involves a dualfunction SAM-1 riboswitch- SIC19. Binding of SAM to SIC19 results in formation of a terminator, with the truncated small RNA predicted to bind to sahR (DVU0606), which codes for a transcriptional factor that regulates the DvH methionine cycle. Alternatively, lack of SAM binding results in the formation of an anti-terminator, which permits the expression of a small open reading frame (DVU1170). Though currently uncharacterized and unique to Desulfovibrio, we hypothesize that DVU1170 plays a role in the methionine cycle and the B12 synthesis pathway. Using expression analyses of a DVU1170 mutant, we have determined that loss of DVU1170 disrupts differential expression of genes regulated by B12 riboswitches and decreases overall transcript levels for genes regulated by SahR. This data suggests that DVU1170 plays a role in the methionine cycle through interactions with B12-riboswitches. Understanding the mechanisms by which DvH regulates methionine and B12 synthesis may provide key information regarding the ability of DvH to survive under hostile conditions essential to maximizing its environmental potential.

***Rui Xiao, Ciara Murabito, Bethany Rader**

Microbiology

Symbiont Regulated Host DNA Methylation in Euprymna Scolopes – Vibrio Fischeri Symbiosis

Advancement in the study of the host-microbe interactions has shown that microbes can regulate long lasting changes in gene expression in host cells to facilitate beneficial symbiosis. through changes in methylation of the host's genomic DNA. The beneficial symbiosis between Hawaiian Bobtail squid, Euprymna scolopes and gram negative bioluminescent bacteria Vibrio fischeri provides an excellent system for studying beneficial microbes' effect on host DNA methylation. The symbiosis is highly specific, in that only V. fischeri colonizes the squid's symbiotic organ from a background of 106 diverse bacteria per ml of sea water. We hypothesize that V. fischeri plays an important role in regulating host DNA methylation during both juvenile and adult stage. To start to address this hypothesis, our specific aims are 1) Validate that E. scolopes methylates its genomic DNA. 2) Identify and quantify DNA methylation machinery genes in squid at transcript level 3) Identify and analyze squid DNA methylation level at both genome level as well as gene specific level. Using methylation restriction PCR, bisulfite sequencing as well as methylation specific PCR, we have confirmed DNA methylation in our squid, and identified differential methylation in response to symbiosis. We identified 3 putative E. scolopes DNA methyltransferases, 1 DNA demethylase, and 3 methylation binding genes, and confirmed that both DNA methyltransferase and DNA demethylase activity in native squid nuclear protein extract. By using both publicly available RNASeq databases and qRT-PCR, we observed that the methylation machinery genes are differentially expressed based on presence of V. fischeri. Finally, using High Performance Liquid Chromatography based whole genome nucleotide profiling, we have observed differential DNA methylation profile between aposymbiotic and symbiotic animals for both juveniles and adults. These data will help us better understand the how beneficial microbes are able to influence host biology through regulating host DNA methylation.

Sean Goff, Justin D. Ramsey, Ahmed Al-Asadi, Milinda Wasala, and Saikat Talapatra

Physics

Synthesis and Characterization of Aluminum-Zinc Based Layered Double Hydroxides for Electrochemical Energy Storage Applications

Recently, Layered Double Hydroxides (LDH) such as Al-Zn based LDH have shown promise in several energy related applications including electrochemical energy storage applications. In this study we will report on the synthesis and characterization of Aluminum and Zinc based LDH (Al:Zn LDH) grown directly on thin foils of aluminum using a chemical bath deposition (CBD) technique. A detailed structural and compositional analysis of these materials will be presented. We will also report on the electrochemical properties of these materials in order to determine the utility of these materials in the development of electrochemical double layer capacitiors.

Jessica Jurak, *Christopher Mandrell, and P. Sivakumar

Physics

Laser Ablation-Resonance Enhanced Photoionization Mass Spectrometry (LA-REPMS) of Particle-Based Assays to Improve Early Detection of Cancer.

Early detection of many types of cancer is crucial for successful treatment and therefore increased survival rates. However, for certain cancers, such as epithelial ovarian cancer (EOC), early detection is challenging due to a lack of physical symptoms shown in the patient during the beginning stages. To overcome these challenges and increase the success of cancer treatment, a noninvasive method to improve the detection of specific cancers must be developed. The goal of this research is to develop optical and mass spectrographic techniques to detect EOC and other cancers at the earliest possible stage. To do this, we will detect specific biomolecules within complex media by using Laser Ablation-Resonance Enhanced Photoionization Mass Spectrometry combined with nano- and microparticle immunoassays. Due to the specific needs of this research, we have designed a high vacuum system that combines the emission spectrum obtained through Laser Induced Breakdown Spectroscopy (LIBS) with data from biological and metallic bioconjugate mass spectrometry results. Here, we present an overview of the setup and calibration of the system with a summary of the data acquired to date in preparation for particle-based assays.

Samuel N Ramirez[1,2] Rhett Stolte[2] and Karla L. Gage[1,2]

[1]Plant Biology

[2]Plant Soils and Agricultural Systems

Methods for Breaking Seed Dormancy in Amaranthus palmeri

Amaranthus palmeri (Palmer amaranth), is characterized as an aggressively adaptive weed, having the ability to survive in a wide range of environments. If left unmanaged, Palmer amaranth can significantly reduce crop yields. Establishing effective management plans for Palmer amaranth may be hindered by the presence of herbicide-resistant biotypes. Breaking seed dormancy has been problematic for researchers screening recently collected seeds, which have not yet undergone cold stratification treatments. Therefore, this study investigates artificial methods for breaking seed dormancy in Palmer amaranth seed accessions, from Belleville, IL (BRC) and Collinsville, IL (COL), to determine the most effective treatment. Seeds were treated with sulfuric acid (H2SO4) at time intervals of 2-, 5-, 10-, or 45-minute exposure, or a 10-minute exposure to potassium nitrate (KNO3) at a 0.125%, 0.25%, 0.5%, or 1.0% concentration. Seeds were placed on filter paper following exposure to treatment for a total of 8 replications of each combination of treatment. Seeds were allowed to germinate for 21 days while daily counts were taken. A two-way ANOVA showed interactive effects of population and treatment on percentage of germinating seed, indicating the treatments did not affect BRC and COL populations in the same way. The only effective treatment for breaking dormancy in the BRC population was the 2-minute H2SO4 treatment (35%±3.5). In contrast, the treatment causing the greatest percent germination in the COL population was the 10 minute H2O control treatment (33%±7), although this treatment effect was not significantly different than percent germination after exposure to KNO3 at 0.125, 0.2, 0.5, 1.0% or to H20 for 2 minutes. This study demonstrates the complexities of breaking seed dormancy through artificial means.

Ryan Welsh, Karen Renzaglia, and Jessica Lucas

Plant Biology

Analysis of Mucilage in the Fragile Fiber 1 Kinesin Mutant

To live and reproduce in a dynamic environment, most living organisms require an extracellular matrix comprised of complex sugars and proteins. Specific matrix components vary among the major lineages of life. Matrix composition also varies within individuals depending upon cell type, developmental stage, and environmental conditions. Pectin is an abundant polysaccharide in plant cell walls that forms a hydra-gel that affects wall porosity and flexibility. Pectin forms a hydrated mucilage layer around Arabidopsis thaliana seeds that enables seedlings to germinate in soil. Microtubules and FRAGILE FIBER 1, an associated kinesin motor protein, are known to enable pectin secretion into the wall. fragile fiber 1 mutant stems are shorter and more brittle than wild type, and mutant cell walls are smaller and contain less pectin than wildtype (Zhou et al. 2007, Zhu et al. 2015). Here we reveal that fragile fiber 1 mutant seed mucilage significantly differs from wild type when stained with the pectin-specific dye ruthenium red. In contrast to published research that documents smaller cell walls in fragile fiber 1 mutant stems, our data indicate that the mutation affects mucilage structure rather than quantity. No difference was detected between the wild type and fragile fiber 1 mucilage until they were mechanically disturbed. The mutant seed was able to retain significantly more mucilage after agitation. These data further support the role of FRAGILE FIBER in wall integrity. In the future, we will study the morphology of pectin secreting cells by light microscopy, the biochemical characteristics of the mucilage layer using immuno-gold labelling, and the presence of other carbohydrates in the wall with fluorescent dyes.

Andrew Derby and Dr. Michael Lydy

Zoology

Bioaccumulation Potential of the Inland Silverside (Menidia Beryllina) as a Result Of Consuming Permethrin-Dosed Pyrethroid-Resistant Amphipods

Permethrin is a terrestrially-applied pyrethroid insecticide that has widespread urban and agricultural uses, and it has been detected in aquatic ecosystems throughout the world. Permethrin is a neurotoxin, yet some populations of the aquatic amphipod, Hyalella azteca, have become resistant to permethrin by genetic alterations of their voltage gated sodium channels. Therefore, pyrethroid-resistant organisms are able to accumulate significant amounts of permethrin in their tissues without showing ill effects. Permethrin is lipophilic, and has the potential to bioaccumulate in higher trophic organisms, such as the endangered delta smelt (Hypomesus transpacificus). The number of delta smelt over the years has been declining (hypothesized to be due to the introduction of pyrethroids) which is significant because they are a major part of the food chain in the San Francisco Bay-Delta. Furthermore, their diet consists mostly of H. azteca, which when pyrethroids have accumulated in their tissues may have detrimental effects on the delta smelt when consumed. Since toxicological tests cannot be conducted on an endangered species, a known surrogate for the delta smelt, the inland silverside (Menidia beryllina), was used for this experiment. Pyrethroid-resistant H. azteca were exposed to 14C-radiolabeled permethrin in water and then fed to the inland silversides. Results showed that the 14C-radiolabeled permethrin bioaccumulated in the tissues of the inland silverside and reached steady state levels within the fish by the end of the dosing period. Therefore, the potential for bioaccumulation in delta smelt is likely. This exposure can lead to detrimental physical effects in the delta smelt, which is important because it is one of the best indicators of environmental conditions in the San Francisco Bay-Delta, an ecologically important estuary that is a major component of California’s water system.

Arianna N. Szubryt[1], Allison K. Wasiak[1], Katelyn E. Toigo[1], Torrin Kullgren[1], Nicholas Etters[1], Marisa B. Szubryt[2], and Frank E. Anderson[1]

[1]Zoology

[2]Plant Biology

Terrestrial Gastropod Diversity and Abundance in Nature Preserves in Carbondale, Illinois

Land snails are ubiquitous elements of the North American forest fauna, but individual snails have relatively limited dispersal ability, and they are highly sensitive to environmental variation over small spatial scales as well as environmental change over time. For these reasons, land snails can be valuable indicators of forest soil health. The purpose of this study was to analyze the distribution and abundance of land snails across several natural areas in and around Carbondale, Illinois. Land snails have been rarely studied in urban settings, so a study of this nature allows us to assess how human impacts affect land snail abundance and diversity. Numerous environmental variables, including plant diversity, habitat complexity, precipitation, soil chemistry and elevation are known to impact land snail diversity and abundance, and other variables such as nature preserve age and size could also be important in urban settings. Four sites within each of seven natural areas were sampled for land snails in the fall of 2017 using twenty 1-square-meter timed quadrat searches for large snails (>3 mm shell diameter) and four 1-liter leaf litter/soil samples for microsnails (1-3 mm). We also gathered data on dominant plant species and elevation at each site, as well as the ages and sizes of each nature preserve. After snails were picked, sorted and identified, we checked for correlations between land snail diversity and abundance at each site/preserve and plant community composition, elevation and reserve size and age. This is a pilot study for the Students United in Preserving, Exploring, and Researching (SUPERB) Scholarship program, and will serve as a starting point for future investigations of the impact of various biotic and abiotic factors on land snail distributions, diversity and abundance.

School of Medicine

Luke B. Anderson, Joseph Cheatwood, and Amber L. Pond, PhD.

Anatomy

Erg1 Protein is More Abundant in the Soleus Muscle than in the Extensor Digitorum Longus Muscle of both Young and Aged Rats

The ERG1 K+ channel enhances ubiquitin proteasome proteolysis and is significantly more abundant in atrophying skeletal muscle than in control muscle of mice. Because ERG1 is a voltage-gated K+ channel and could affect action potential duration, we conjecture that it might contribute to differences in contraction speed. Specifically, ERG1 could be more abundant in slow muscle fibers where it might inhibit depolarization and generation of action potentials; this could be more obvious in muscle from old rats because muscle contraction slows with age. Therefore, because rat Soleus (Sol) muscles are comprised mainly of slow fibers and rat Extensor Digitorum Longus (EDL) muscles are composed mainly of fast fibers, we hypothesized that ERG1 protein would be more abundant in the Sol than in the EDL muscles of rats. To test our hypothesis, we immunoblotted muscle membrane homogenates from old and young rat Sol and EDL muscles and analyzed optical density (OD) data. We then immuno-stained sections from Sol and EDL muscles of old and young rats for ERG1 and for fast and slow myosin heavy chain proteins. Single point brightness (SPB; 50 points/fiber) was measured within the sarcolemma of complete fibers within each field using ImageJ. Both OD and SPB values were averaged for each muscle and analyzed by ANOVA. Our data show that total ERG1 protein is more abundant in Sol than in EDL muscles of both old (48.3%) and young (24.0%) rats. The fluorescence data indicate that ERG1 abundance is higher in slow fibers of Sol than in fast fibers of EDL in both young (39.4%) and old (36.5%) rats. However, the number of fast fibers in Sol muscle and slow fibers in EDL were too few to measure ERG1 fluorescence. Thus, we can only conclude that ERG1 protein is more abundant in Sol muscle than in EDL muscle.

Brittan Cobb[1], Abhinav Adhikari[2], Nathalie Becerra[3], Punit Kohli[3], Amber Pond, PhD[1] and Judy Davie, PhD[2]

[1]Anatomy

[2]Biochemistry

[3]Chemistry and Biochemistry

The Cytokine Interferon gamma Induces Expression of both IL-6 and CIITA in Mouse Skeletal Muscle

Interleukin 6 (IL-6) is a secreted cytokine that is an important mediator of the immune response in numerous tissues, including skeletal muscle. Interferon-g (IFNγ) is a pro-inflammatory cytokine that cooperates with Tumor Necrosis Factor a (TNF-a) to activate expression of IL-6. In cell culture, we showed that treatment of skeletal muscle cells with 100 units/mL IFNg induced two-fold expression of the IL-6 gene. No activation of IL-6 by TNF-a was observed. We have found that the IFN-g stimulated class II major histocompatibility complex transactivator A (CIITA) mediates many IFN-g effects on skeletal muscle. Therefore, we asked if CIITA could activate IL-6 and found that transient expression of CIITA also upregulates IL-6. However, we cannot assume that what occurs in culture is physiologically relevant. Therefore, we hypothesized that treatment of mice with IFNg would modulate IL-6 and CIITA expression in skeletal muscle. To test our hypothesis, we treated six mice with 1.69x105 units of IFNg: 1.5x105 units encapsulated within the inner aqueous cavity of liposomes which were injected intraperitoneally and 1.9x104 units by tail vein injection. Six mice were treated with vehicle as control. We harvested plasma and Tibialis anterior (TA) muscles after 10 (n=6; 3 each control and IFNg group) and 24 (n=6; 3 each group) hours. ELISA demonstrated that plasma IFNg levels averaged 3560±1167 SEM pg/mL after 10 hours while no IFNg was detected after 24 hours. Quantitative PCR was used to probe for IL-6 and CIITA expression. Data show that 10 hours of IFNg treatment induced a 15-fold increase in CIITA expression and a 2-fold increase in IL-6 expression. At 24 hours after treatment, we detected a 4-fold increase in CIITA expression while IL-6 expression was back to pre-treatment levels. Our work demonstrates that IFNg induces expression of CIITA and IL-6 in skeletal muscle of an animal model.

***Clayton Whitmore[1], Evan Pratt[2], Gregory Hockerman[2], and Amber Pond[1]**

[1]Anatomy

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The Erg1a K+ Channel Increases Intracellular Calcium Concentration and Calpain Activity in Cultured Skeletal Muscle Cells

Calcium activated calpains are known to contribute to protein degradation in atrophic skeletal muscle. The ERG1a K+ channel has been detected in the atrophying skeletal muscle of mice and shown to contribute to protein degradation in this tissue by enhancing ubiquitin proteasome proteolysis (UPP). Because ERG1a is a voltage-gated K+ channel located in the sarcolemmal membrane of skeletal muscle cells, we predicted it would affect calcium influx and ultimately modulate intracellular calcium concentration ([Ca+2]i). Skeletal muscle atrophy occurs in response to disuse, certain diseases (e.g., diabetes, cancer, and sepsis), and with normal aging. Atrophy of skeletal muscle can be debilitating and even cause death. Nonetheless, there are no truly effective pharmacological treatments for atrophy. The best therapy is the combination of a healthy diet and exercise; however, sick and aging individuals are often incapable of participating in the appropriate activity. Exploration of mechanisms contributing to atrophy may lead to the discovery of an effective therapeutic target for atrophy. The ERG1a K+ channel contributes to atrophy by modulation of intracellular calcium ([Ca+2]i) and, thereby, affecting calpain activity. To test our hypothesis C2C12 myotubes were transduced with either a control or HERG-encoded adenovirus and fura 2 dyes were used to measure [Ca+2]i 48 hours later. This resulted in an increase in basal [Ca+2]i. C2C12 myotubes were again transduced with either control or HERG-encoded virus and assayed for combined calpain 1 and 2 activity 48 hours post transduction. Basal calpain activity was significantly increased; however, there was no increased expression of genes encoding calpains, suggesting the increased calpain activity may be solely a result of increased [Ca+2]i. Our studies show that ERG1a expression increases basal [Ca+2]i in C2C12 myotubes and suggests it contributes to an increase in calpain activity.

Brian Evans

Physiology

Characterization of Foxo3 in Mouse Pituitary

Foxo3 is a forkhead transcription factor expressed in bone marrow, fat tissues, the ovaries, and many other tissues in the body. RNA sequencing by GTEx and Illumina Body Map indicates that Foxo3 is present in the pituitary gland. Specific characterization of cells expressing Foxo3 in the pituitary is less studied and is going to be done using a mouse model. A set of stains will be done for FOXO3 in mice at ages of e10.5, 12.5, 14.5, 16.5, and 18.5 in order to identify the first age of expression of Foxo3 in the pituitary gland. Preliminary data obtained from stains for the ages e10.5, 12.5, and 14.5 have been accomplished with a n=2 and indicate FOXO3 is present in the pituitary gland. More stains will be taken to produce an n=3 and an additional age point. Costains will be done against ACTH, GH, TSHB, FSHB, PRL, and LHB to determine colocalization of these hormones and thus, Foxo3's expression in different cell types. Understanding which types of cells host foxo3 is important to understanding factors that go into cell differentiation and development in the pituitary gland. For example, if FOXO3 was found abundantly in somatotrophs, it may mean that Foxo3 is a factor in GH excretion.

Anna Feliciano, Jami Hagemann, Lydia Arbogast Ph.D.

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 for luteinizing hormone (LH) and prolactin (PRL) surges of the rat reproductive cycle. Progesterone is subsequently elevated, but its role in regulating pituitary hormone secretion is not well understood. 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) were injected at 0900h on following day. Blood samples were collected hourly from 1200h to 1700h. Trunk blood was collected at 1900h. Plasma levels of PRL and LH were measured by radioimmunoassay. LH levels were low (0.55-1.03 ng/mL) at 1200h in both vehicle- and progesterone-treated rats. LH was elevated to 4.8 and 11.3 ng/mL at 1600h and 1700h, respectively after progesterone treatment, whereas LH levels were 1.3 and 2.2 ng/mL, respectively, in vehicle-treated rats. At 1900h, LH levels were still elevated to 9.6 ng/mL in progesterone-treated rats and were elevated to 5.2 ng/mL in vehicle-treated rats. PRL levels were low (62-65 ng/mL) at 1200h in both groups. PRL surges were observed in both vehicle- and progesterone-treated rats with peak PRL (346 ng/mL at 1400h in progesterone-treated rats, whereas peak PRL (282 ng/mL) occurred at 1600h in vehicle-treated rats. These data indicate that progesterone advances and enhances both the LH and PRL surges in an estradiol-primed ovariectomized model. This model will be useful to explore progesterone-induced changes in gene expression in the medial basal hypothalamus. This research can enhance the understanding of the physiological effects of progestins during the reproductive cycle, pregnancy, and oral contraceptives.

Muriel L. Hart, Douglas Wallace, Ashley Blackwell, Joseph L. Cheatwood

Physiology

The Use of String Pulling in Rats as a Behavioral Measure of Skilled Forelimb Motor Function in a Middle Cerebral Artery Occlusion Model

This study introduces the use of skilled string pulling as a behavioral task in rats using a unilateral Middle Cerebral Artery Occlusion (MCAO) stroke model. String pulling is a bimanual act of forelimb dexterity that utilizes alternating reach, grasp, and withdraw movements to pull a string into the testing cage in order to obtain a cashew tied to the end. A previous collaborative study examined this task in a unilateral forelimb sensorimotor cortex devascularization stroke model in rats, and found a disruption of topographic and kinematic hand movement characteristics in the stroke group as opposed to the sham control. These disruptions include a loss of contralateral-to-stroke fine motor control with behavioral compensation occurring through changes in ipsilateral-to-stroke movement and increased mouth grasps. We expect our results to be similar, with a significant increase in the number of right hand missed contacts with the string and number of mouth grasps. Fifteen Long Evans male rats were habituated to and trained on the task before undergoing anesthetized surgery, either in a sham control group (n=6) that received the same surgical procedures but did not receive a craniotomy or carotid occlusion, or in a stroke group (n=6) given a MCAO. Animals were tested and recorded on both the string pulling behavioral task and the skilled rung ladder bar walk on Day 3, 7, and 14 following surgery. The bar walk test has been used as a behavioral model in prior stroke studies to assess motor function and recovery, and was repeated to ensure consistent results. Following day 14 of testing, the rats who received strokes were sacrificed and perfused, and their brain tissue cut and stained with cresyl violet for histological evaluation of lesion volume. Behavioral analysis of post-stroke reaching movements and lesion area results will be presented on poster.

Emma Johns, Justin Porter, Randy Reeder, Thor Lane, and Britt Peyton, and David G. Gilbert, Ph.D

Physiology

Electroencephalogram Quality Control: A BioInformatic Approach to the Artifact Removal and Brain Wave Analysis

Electroencephalograms (EEG) can be used to measure cerebral activity in the form of voltage; however, it has such high sensitivity that other electrical signals are picked up as well. This results in data containing noncerebral activity, such activity includes electrocardiogram (EKG), ocular movement, muscle contractions, and electrode connectivity issues. The focus of this project revolves around identifying these "artifacts" so that the cerebral activity can be assessed, independent of these disturbances. In the N3 study, data was collected from social smokers participating in nicotine patch therapy via an EEG cap. In order for the best results, data must be thoroughly cleaned of irrelevant electrical signals. EEG Pipeline is widely used as an early-stage EEG analysis for the removal of bad channels and references. EEGLAB is an effective tool for artifact removal but remains only an outline for the advanced analysis required. Errors have been found when performing batch analysis with MATLAB EEG PIPELINE, so manual artifact inspection was necessary to produce the best data. Due to the magnitude of data files, this was not a sustainable process. The goal of this sub study was to construct a refined MATLAB script to not only mathematically calculate EEG variant signals, but tag and remove the data point outliers with the efficacy of current manual methods. By changing the parameters and script language to enable use for batch studies, N3 brain wave data can be corrected in a completely automated way. The results of defining such procedures will reduce the amount of time spent cleaning EEG, subsequently improving research design in psychological and neurological fields while propelling it forward.

John Lawless Shanshan Wang & Zhengui Zheng

Physiology

Methyltestosterone but Not Dihydrotestosterone 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, also MT treated female mice (100%) formed penises 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%). 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. Our data suggest that prenatal MT but not DHT 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 ERβ signaling may be required to maintain the MT induced penile size in female mice.

Bella Weymer, Stacey McGee, Caitlin Stallings and Buffy Ellsworth, Ph.D

Physiology

PROX1 Plays a Role in the Development of the Anterior Pituitary Gland

Prospero Homeobox 1, or PROX1, is a transcription factor that plays a role in cell fate determination and embryonic development. It functions as a regulatory protein in neurogenesis and development of the lymphatic system, liver, pancreas, heart, and eye lens, however, little is known about its role in the pituitary gland. The pituitary gland is a small gland that is located in a bony hollow at the base of the brain. The anterior pituitary gland is composed of five different cell types. It contains somatotropes, which produce growth hormone, lactotropes, which produces prolactin, corticotropes, which produce adrenocorticotropic hormone, thyrotropes, which produce thyroid stimulating hormone, and gonadotropes, which produce luteinizing hormone and follicle stimulating hormone. We believe that PROX1 plays a role in the development of some or all of these cell types. In this project, we have performed co-immunohistochemistry using each of the six hormones listed above with PROX1 in order to visualize which pituitary cell types contain PROX1. We find that at embryonic day (e)18.5, PROX1 is produced in over 90% of corticotropes, somatotropes, gonadotropes, and thyrotropes. To determine whether PROX1 is required for differentiation of the hormone-producing pituitary cell types, I will analyze pituitary samples from conditional knockout mice in which the Prox1 gene has been deleted in the pituitary gland. Using these pituitary samples from wild type and Prox1 knockout mice, I will perform immunohistochemistry to mark each of the six hormones listed above. With this data, we will be able to draw conclusions regarding how PROX1 impacts the development of the five cell types of the anterior pituitary gland.

SIU Carbondale Chapter of SIGMA XI

Abstracts

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Magnesium Administration after Experimental Traumatic Brain Injury Improves Decision-Making Skills

After sustaining a traumatic brain injury (TBI), a person's ability to make daily decisions can be affected. Simple tasks such as, deciding what to wear are no longer effortless choices, but are instead difficult decisions. This study examined the effect of a magnesium treatment on decision-making skills in a discrimination task following TBI. Thirty-one male rats were separated into magnesium (MAG)/TBI, vehicle (VEH)/TBI, or VEH/Sham groups. Pre-TBI, rats were trained to dig in the sand for a reinforcer. After establishment of consistent digging behavior rats received a bilateral frontal cortex injury. Rats received either an i.p. injection of 2 mmol/kg magnesium chloride or a control at 4, 24, 72 hours post-surgery. Dig task testing began 7 days post-injury, lasting for 4 weeks. The discriminations included two scent pairings; basil (baited) versus coffee then the reversal and then cocoa (baited) versus cumin then the reversal. The results demonstrated a magnesium treatment to significantly lessen cognitive and motor deficits after TBI.

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Genetic Diversity of Cytauxzoon Felis in Bobcats and Domestic Cats in a Restricted Geographic Area

Cytauxzoon felis in an intraerythrocytic apicomplexan that infects felids in the Midwestern and Southeastern US. In domestic cats, C. felis infection can result in the highly fatal disease cytauxzoonosis. Recently, several studies have identified domestic cats subclinically infected with C. felis. In light of these recent findings, researchers have attempted to identify genetic markers associated with pathogenicity. These efforts have not yet identified a specific genotype (or strain) associated with clinical outcomes. Previous studies on the genetic variability of C. felis have been conducted across large geographic areas usually consisting of multiple states. Our study was conducted in an area of 6,000km2, large enough to detect patterns of genetic structure at fine scale. We grouped samples into 3 "populations:" bobcats, clinically infected domestic cats and subclinically infected domestic cats. We sequenced internal transcribed spacer 1 and 2 (ITS1 and ITS2) from 50 bobcats, 24 clinically infected domestic cats and 20 subclinically infected domestic cats to assess population structure of C. felis in the different hosts. We found no genetic structuring of C. felis in these populations and no particular genotype was associated with increased pathogenicity. Our findings suggest that while there is high genetic diversity of C. felis in both bobcats and domestic cats, there are no barriers to transmission between these populations. Further research should address the genetic variability of infected domestic cats (clinical and subclinical) to determine if host genetics determine clinical onset of disease.

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Species Composition, Diversity, and Environmental Differences in Acid Seeps.

Acid seeps are valued ecosystems within southern Illinois. Since 2008, *Microstegium vimineum (*an exotic grass*)* has invaded several acid seeps of Pope County. These acid seeps have also experienced steam down-cutting. The purpose of research was to use species abundance and environmental data to suggest restoration protocols. Objectives of study were to compare species composition between acid seeps and investigate which diversity indices and environmental variables separate them. Plots were sampled along transects within ten acid seeps. Plant species abundances were recorded in July 2017. Soil samples were collected for soil acidity and conductivity. Canopy cover was measured for each seep, as well as slope and aspect. Photosynthetically active radiation was measured July 2017. Soil moisture was recorded June, July, and August 2017. Environmental variables and several indices of diversity were averaged for each seep. A non-metric multidimensional scaling ordination (NMDS) was constructed for acid seeps and species centroids. Vector analyses determined significant vectors in NMDS. Permutational test of homogeneity of dispersion (PERMDISP) investigated differences in dispersion between acid seeps. Permutational analysis of variance (PERMANOVA) investigated differences between seep centroids.Resulting two-dimensional NMDS displays seeps and species. Only one diversity index, NTI, had a significant relationship with species composition (r^2=0.6611; p=0.026). Soil moisture in June (r^2=0.8074; p=0.005), July (r^2=0.759; p=0.01), and August (r^2=0.7008; p=0.018) and canopy cover (r^2=0.5847; p=0.049) were the only environmental variables significant as vectors. Seep centroids (F_9=4.8465, p=0.01) and dispersion (F_9=2.0244, p=0.39) were significantly different in NMDS. Acid seeps showed differences based on centroids of species composition and plots of individual acid seeps. Canopy cover and soil moisture vectors displayed antagonistic effects on species composition among acid seeps. Acid seeps with more canopy cover had lower soil moisture. NTI values separated species composition of acid seeps along an axis perpendicular to canopy cover and soil moisture vectors.

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Analysis of Landcover Types Associated with Cytauxzooin felis Infections in Domestic Cats

Cytauxzoon felis is a blood parasite infecting bobcats (Lynx rufus) and domestic cats (Felis catus) in the United States. This parasite is transmitted via the lone star tick (Amblyomma americanum) and the American dog tick (Dermacentor variabilis). Infection can result in the highly fatal disease, cytauxzoonosis. Only one study on land cover types and their relation to the prevalence of cytauxzoonosis exists. Our study is the first to compare the habitat types of uninfected and infected domestic cats living in the same geographic area. Samples were obtained from veterinary clinics and screened for the presence of C. felis. Home addresses for the cats were converted to coordinates and using ArcMap 10.4.1, were plotted on a land cover map of Illinois. Buffers of 100m, 250m, 500m, and 1,000m were created around the plotted points. The purpose of testing multiple buffer sizes was to take into account variation in domestic cat home ranges to determine at what scale land cover could impact the likelihood of C. felis infection. The percentage of each land cover type within the buffer was calculated. The land cover data was used to compare the most common land cover of infected and uninfected cats to see if there was any correlation. We can use this information to predict where cytauxzoonosis is likely to occur and inform owners and veterinarians of high-risk areas. We found there was no land cover type associated with C. felis; this is possibly due to the heterogeneous land cover types in the study area.

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Factors Affecting Cytauxzoon Felis Parasitemia Levels in Bobcats (Lynx Rufus)

Cytauxzoon felis is a tick-borne apicomplexan parasite that causes the disease cytauxzoonosis in domestic cats and several wild felid species. In the United States, bobcats (Lynx rufus) are the reservoir host for the species and are infected sub-clinically. Domestic cats (Felis catus) act as an incidental host. At this time, little is known about the variations in the parasitemia of C. felis annually and under varying host conditions such as demographics and host body condition. Bobcats were trapped December through March in 2014-2015, 2015-2016, and 2016-2017 for 72 total captures, including some recaptures (67 unique bobcats). For each capture, blood was taken and the bobcat's demographics, temperature, size, and location were recorded. Three blood films per bobcats were made immediately upon blood collection and were stained with Quick III (Astral Diagnostics). The blood was then screened for the presence of C. felis. Parasitemia was calculated by dividing infected red blood cells (RBCs) by the total RBCs screened, which typically included approximately 1,000 RBCs scattered in 4-5 areas of the slide. To test for the condition of the host as an explanatory factor of parasitemia, we calculated the correlation between parasitemia and age, sex, date of capture, and location. We also tested if air temperature on the day prior to capture and the mean temperature 7 and 14 days prior to capture influenced C. felis parasitemia in the bobcats. Our findings could point to seasonal changes in parasitemia that could indicate increased C. felis replication in chronically infected hosts**.**

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It is Always Worth It to Check it Again: The Examination of Nematodes of Rodents from the Konza Prairie Reveals at least One New Species.

The Konza Prairie Long-Term Ecological Research (LTER) is centered on the 3,487 hectare tallgrass Konza Prairie in eastern Kansas. The area supports 11 common species of rodents, some of which are reservoirs of zoonotic microparasites, including etiological agents for babeiosis and lyme disease. Furthermore, each of the rodent species harbors an array of helminths. No baseline inventories of helminths or microparasites have yet been performed through the tallgrass prairie ecoregion. We captured rodents using Sherman traps, processed them via standard museum methods, and examined for endo parasites. Necropsies were completed on the same day of capture and nematodes collected were fixed and preserved with ethanol. Cleared specimens allowed the characterization of nematodes infecting seven species of mice. These include Protospirura cf. muris found in the stomach of Reithrodontomys megalotis, Microtus ochrogaster, Peromyscus leucopus, and Sigmodon hispidus; Pterygodermatites parkeri from the small intestine of Peromyscus leucopus; Syphacia cf. obvelata collected in the large intestine of Microtus ochrogaster; Trichuris spp. found in the large intestine of Neotoma floridana and Microtus ochrogaster, and finally Vexillata n. sp. from the small intestine of Chaetodipus hispidus. Protospirura cf. muris and Syphacia cf. obvelata appear to be common parasites of voles and mice across North America, however our analyses suggest that these organisms are fairly divergent from specimens assigned to these taxa elsewhere across the Holarctic. A characterization of Vexillata n. sp. will be presented. These parasite biodiversity surveys provide a fundamental first step to understanding evolution, distribution, and pathogen dynamics across spatial and temporal scales.

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Department of Psychology

Examining the Relationship between Altruistic Behavior and Children's Preferences in Aggressive Media

The role of media in the lives of children has become increasingly crucial to examine by researchers. Recent events, such as school shootings, continue to provoke questions from parents and politicians as to the influence of violent media, effects on children's behavior, and proposed regulations. Previous research has found that exposure to violent media, specifically television and video games, may increase aggressive behavior and decrease empathic feelings and helpful behaviors (Anderson et.al, 2010). However, gaps exist as to distinctions between types of aggression, as well as the separate impacts of television and video games. Conversely, altruistic behaviors and social interactions may be improved when children engage in prosocial media (Mares & Woodward, 2005). We hypothesized that children who prefer aggressive media would show less altruistic behavior. The study was conducted using a sample of twin siblings from the Southern Illinois Twins/Triplets and Siblings Study (SITSS) at Southern Illinois University Carbondale. Twins were tested at age 5 and were asked to name their favorite television show or movie, as well as their favorite video game. Researchers then scored these for both physical (physically hurting) and relational (social, verbal, interpersonal) aggression. During testing, the twins were also rated for altruism by being asked to choose whether they should mail a forgotten toy in the lab back to its owner (2 = altruistic) or keep it for themselves (1 = not altruistic). Data analyses revealed that children who preferred relationally aggressive television or movies scored significantly lower on altruism, $t(204) = -2.60$, $p = .025$; this was not true for physically aggressive media, $t(204) = -1.67$, $p = .097$. Similarly, when combining across television/movie and video game preferences, relationally aggressive media preference was related to less altruistic behavior, $t(208) = -2.75$, $p = .006$, but physical aggression was not, $t(208) = -1.52$, $p = .129$. These findings suggest that there is a relationship between altruistic behaviors and preference for relational (social) but not physical aggression in television or movies. Thus, socially aggressive television may have ramifications for children's social behaviors.

Itzel Mendoza, Alexandra Perry, Kristi Wallin, and Breanna Wennberg

The Associations between Parent and Child Positive and Negative Affect

Problem/Major Purpose: Thomassin and Suveg (2014) found that mothers exhibited a greater level of positive and negative emotional affect with children than did fathers. They also found that fathers' positive affect was negatively associated with 7- to 12-year-old children's symptoms of psychopathology, such as internalizing and externalizing difficulties, and social and academic competencies. Carson and Parke (1996) examined the relationship between positive parenting affect and child social functioning in 4- to 5-year-old children. In parent-child interactions, coders analyzed displays of affect, much like the current study. They discovered that higher levels of parental positivity predicted fewer child behavior problems, greater social competence, and more positive social outcome (Carson & Parke, 1996). However, their focus was directed toward school settings such as classrooms, whereas the current study had a broader focus. The current study assessed relations between observed parental and child positive and negative affect. We hypothesized that the degree to which parents exhibited positive and negative affect would predict the degree to which children exhibited similar affect. Procedure: Parents and their 5-year-old children were asked to work on a child puzzle together in a play room and their interactions were recorded for later coding. Each minute of these interactions was coded by trained research assistants for several behaviors. Among those behaviors, positive and negative affect for both the parent and child were rated on a scale of 1 (strong affect) to 4 (no affect). Scores are averaged over 10 minutes for each participant, separately for positive and negative affect. Results: Data were analyzed using two separate multiple regression models to assess the relationship between observed affect for parents and children. Preliminary analyses revealed significant associations between observer-reported parent affect and child affect at age 5, see Table. For preschoolers' positive affect, parental negative ($\beta = .21$, $p = .018$) and positive ($\beta = .39$, $p < .001$) affect were both significantly predictive. However, 5-year-old negative affect was only significantly predicted by parental negative ($\beta = .36$, $p < .001$), not positive ($\beta = -.12$, $p = .178$), affect. Conclusions/Implications: The results of this study show how behaviors observed in parents correlate with behavior observed in children. These findings suggest that parent and child negativity are related, but children who are more positive seem to respond to parent positivity, as well as show resilience to parent negativity.

Juliet Fitzgibbon

Plant Biology

3D Scanning & Printing Collection Specimen

Museum, herbarium, fossil, entomology, and greenhouse specimen face resource challenges that limit specimen preservation and accessibility. Cultural and physical accessibility, geographic distances, and monetary support inhibit the spread of information stored in traditional museums; significant scientific findings may be hidden within the plethora of metadata available in collections. Technology advancements within our lifetime have facilitated 3D and 4D environments which increase our ability to retain the information presented. These advancements also increase accessibility to specimen through traditional spatial barriers (traveling to museums) and physical impairments (sight, hearing, mobility). My research specialized in 3D scanning and 360 video recording to digitally preserve specimen and increase their physical longevity. 3D scanning and 360 video allow us to digitize specimen in collections and bring real world objects into 4D digitized environments. 3D noninvasive laser scanning retains morphological point cloud replications of each specimen that can be used to ask and answer ecological questions. 360 video recording the field sites while specimen are collected provides metadata about the environment that may not be recorded in traditional 2D notes. These 3D files and 360 videos can be overlaid in software like Unity to create 4D digitized ecosystems. Virtual reality environments allow humans to transport beyond physical boundaries to digital worlds, increasing the accessibility of these collections. In preliminary research, more than 100 specimens have been scanned including fossils, pinned insects, mammal bone and fur, live cacti, food, shoes, pawns, cans, and sculptures. 360 videos of prairie burnings, specimen 3D scanning, and ecological lab experiments have been obtained as well. This data will be published online so it is accessible to the public therefore increasing accessibility and preservation of collection specimen. 3D scans and 360 video will be overplayed to create 4D environments that allow us a novel opportunity to explore, enjoy, and learn about ecosystems.