Research Project Title: Hands-only cardiopulmonary resuscitation program peer training yields increased knowledge and familiarity

Student Presenter: Alexis Benisek

Faculty Mentor: Ashish Pachal

Faculty Mentor Department: The Ohio State University Wexner Medical Center for Emergency Medical Services

Research Abstract: The CPR in Schools: University Program has been designed based on the proven high school program from the American Heart Association (AHA) that has trained millions of students within the U.S.. It is unclear if the methodologies used at the high school level will be as effective for a university population. One of the primary limitations to administering bystander CPR is lack of knowledge about the process and reasoning behind the methodology. Once individuals have been properly trained in Hands-Only CPR, they are more likely to be confident enough to assist a cardiac arrest victim and understand details about the methodology.

During this academic year, 119 undergraduate students (age ≥ 18 years old) on OSU’s Main Campus were trained using the AHA - Training in Schools Program. Of the students trained, 14 were disqualified due to refusal to complete the survey or based on prior CPR training. Before the training program was initiated, a pre-survey was given which covered demographic information, knowledge about CPR, and willingness to perform bystander CPR. After a 30-40 minute training, which included both lecture and hands-on experience, the participants were given a post survey to complete. The post survey is a duplicate of the pre-survey questions to gage their increase in CPR knowledge and willingness to perform bystander CPR due to the training they received.

Based on the data collected, a significant increase was seen in both knowledge about CPR and personal willingness to perform CPR after peer-to-peer trainings. Of the five hands-only CPR knowledge questions asked, the data shows an average increase of 33.48% in correct responses demonstrating an increased factual understanding of hands-only CPR. Willingness to help also increased significantly with 86.67% of respondents indicating they would be very comfortable/somewhat comfortable performing CPR in contrast to the 20.95% that responded the same way in the pre-test.

The pre-survey and post survey comparison allows for evaluation of the American Heart Association - Training in Schools Program. The results can be used to gage areas where the participants did not gain the appropriate knowledge and to improve future programs.
Research Project Title: Students' perceptions of the academic impact of mental illness: Comparing two cohorts across time

Student Presenter: Kristen Hehman

Faculty Mentor: Jill Clutter

Faculty Mentor Department: Health Sciences

Research Abstract: An apparent mental health crisis is occurring in the United States and is especially noticeable on college campuses. College students are a particularly susceptible population for mental health problems as they experience a more demanding and abruptly different lifestyle than they have known. The actual change in prevalence of mental illness on college campuses and the demographics of this change have not been well-studied thus far. The purpose of this study was to assess how mental health trends and students’ perceptions regarding the effect of mental illness on their academic performance have changed in different cohorts of college students across time. Self-reports of mental illness and the perceived effect on academic performance were analyzed from the American College Health Association National College Health Assessment (ACHA-NCHA), a national survey given each year since 2000 on college student health issues. Preliminary results from this study indicate an increase in both the prevalence of mental health problems and the perceived effect on academic achievement. Results of this study will support the development of prevention and treatment interventions targeting student populations most vulnerable to mental illness.
Research Project Title: Self-assessment of ergonomics among dental hygiene students utilizing photography and immediate feedback

Student Presenter: Sahro Elmi

Faculty Mentor: Brian Partido

Faculty Mentor Department: Dental Hygiene

Research Abstract: Due to postural demands, dental professionals are at higher risk for developing work-related musculoskeletal disorders (WMSDs). The identification of ergonomic interventions has been suggested to help reduce the prevalence of WMSD’s. However, the interventions must overcome dental clinicians’ unsatisfactory ergonomic awareness and clinical application of recommendations. One way to improve ergonomic awareness is through self-assessment (SA).

Objectives: The purpose of this study was to determine whether ergonomic scores and accuracy of ergonomic self-assessments among dental hygiene students improve as a result of feedback involving photography, self-assessment, and immediate feedback.

Methods: Upon IRB approval (#2017H0343), the study involved a randomized control design and subjects were assigned into one of two groups. All subjects were photographed and completed ergonomic self-evaluations with immediate feedback, using a Modified-Dental Operator Posture Assessment Instrument (M-DOPAI), at weeks 1 and 4 without viewing the photographs. During weeks 2 and 3, all subjects completed ergonomic self-assessments using the M-DOPAI but the intervention group used photographs to aid with their ergonomic self-assessments and received immediate feedback. The student subjects’ pre-test and post-test photographs were evaluated for ergonomic scores using dental hygiene faculty evaluators.

Results: A mixed-design ANOVA was calculated to measure the effects of the training on student self-assessment and rater scores. Student self-assessment in the control group and faculty evaluations of the training group showed significant improvement in ergonomic scores over time (F(1,60)=4.25, p<0.05). In addition, a mixed-design ANOVA of Kappa coefficient values between student and rater scores was calculated to measure the effects on the accuracy of student self-assessments. The accuracy of self-assessment significantly improved for students in the training group (F(1,30)=8.29, p<0.01).

Conclusion: Self-assessment utilizing photographs resulted in improvements in ergonomic scores and increased accuracy of ergonomic self-assessments. Any improvement in ergonomic score or awareness can help reduce the risks for WMSD’s, especially among dental clinicians.
Research Project Title: Dietetic education: effectiveness of an experiential workshop with standardized patients for assessment of malnutrition

Student Presenter: Jessica Gregory

Faculty Mentor: Marcia Nahikian-Nelms

Faculty Mentor Department: Medical Dietetics

Research Abstract: Introduction/Background:

Malnutrition is prevalent in the hospital setting and research has demonstrated its relationship to complications such as extended length of stay, decreased wound healing, and increased mortality. The Nutrition Focused Physical Exam (NFPE) is an assessment of malnutrition risk and has been recently added to the education guidelines for dietetic students. However, there is inconsistency in the teaching of the NFPE and in most dietetic programs the process is simply taught from a standard lecture. The purpose of this study is to evaluate the effectiveness of using an educational workshop with standardized patients for identification and diagnosis of malnutrition.

Methods:

Dietetic students attending the Ohio State University (n=39) participated in the workshop where they were taught the process and interpretation of the NFPE. The students had the opportunity to see two separate standardized patients with feedback by evaluators between cases. Prior to receiving feedback, students completed their assessment and provided it to the evaluator.

Results:

When comparing the accuracy of the student's diagnosis between the first and second standardized patients, there was an 18% increase in correct etiology diagnosis. Concerning the determination of diagnosis severity, there was a 5% increase in accuracy after receiving feedback. Each of the cases presented a different etiology of malnutrition. The case that highlighted acute illness-related malnutrition was correctly diagnosed 100% of the time regardless of feedback. The case that highlighted malnutrition in relation to a chronic illness increased from 88.9% to 91.7% accuracy after feedback. The case regarding socioeconomic etiology showed improvement from 37.5% to 60% accuracy.

Conclusions:

Regardless of the case, the student's ability to accurately assess and diagnose malnutrition increased with hands on practice and directed feedback. These findings highlight the impact of an experiential workshop on the teaching of the NFPE and provide direction for future educational design.
Research Project Title: Dietetic education: assessment of consistency of skill use among dietetics students participating in an experiential workshop on malnutrition and the NFPE with standardized patients

Student Presenter: Danny Gilmore

Faculty Mentor: Marcia Nahikian-Nelms

Faculty Mentor Department: Academic Affairs

Research Abstract: Background

Malnutrition is a prevalent issue in the hospital setting, and is associated with negative patient outcomes. Registered Dietitians now include nutrition focused physical assessment to assist with the prompt diagnosis of malnutrition and this is a required component of dietetic education.

Methods

The purpose of this study was to evaluate dietetics students’ consistency of skill use during an educational workshop. After attending a classroom lecture on assessing malnutrition the previous week, OSU Medical Dietetics students (n = 37) participated in a training workshop which included: 1) four 15-minute break out sessions on conducting the NFPE, 2) practice of the NFPE with faculty verbal guidance, and 3) application of the NFPE and malnutrition diagnosis to two simulated case scenarios using trained actors. Instructors provided feedback following each simulation. Students assessed two of three potential cases and documented criteria that supported malnutrition diagnosis.

Results

The criteria used most often were: case 1- history of weight loss, muscle wasting, and fat loss; Case 2-fluid accumulation, energy intake, and weight loss; Case 3-energy intake, muscle loss, and fat loss. Notably, students used energy intake to support their diagnosis for every case. Weight loss as a criteria increased for cases 1 and 2 with feedback, but decreased by 33% after feedback for case 3. Muscle wasting was used less often as a criteria following feedback for cases 1 and 2. Fat loss was used less often following feedback for cases 1 and 3. Functional assessment was used less often for cases 1 and 3 following feedback.

Conclusions

Differences in assessment may indicate that students feel less confident in assessing muscle/fat stores and functional assessment. Feedback appeared to impact student decision making. This information may assist with developing future education with improvement of content and pedagogy. Limitations include the potential variation in patient actors and evaluators providing feedback.
Research Project Title: The evolution of implicit bias among health sciences students in a hybrid service learning course

Student Presenter: Kara Kopan

Faculty Mentor: Crystal Dunlevy

Faculty Mentor Department: Health & Rehabilitation Sciences

Research Abstract: Introduction: Activities aimed at reducing the implicit bias of healthcare professionals have been shown to be effective, at least in the short term. Students studying healthcare disparities over the course of a semester would ideally become more empathetic and exhibit less bias as learning progresses. A new course developed to prepare students to work in vulnerable communities combined participation-based classroom activities with service-learning. The course was offered for the first time in Spring 2017. Methods: Twenty-five students completed Implicit Association Tests (IAT) for European-American/African-American preference, heterosexual/homosexual preference, and gender/career-family preference, and the Toronto Empathy Questionnaire (TEQ) at weeks one and 15. Scores will be compared using Student’s paired t-tests, with p < 0.05 considered to be statistically significant. Students completed weekly journal reflections that will be coded for themes by three independent researchers. Results: Data has been collected, and will be analyzed by March 9, 2018. Conclusions: Pending results.
Research Project Title: Whole slide imaging challenges and opportunities at OSU Wexner Medical Center: an interview study with 11 pathologists

Student Presenter: Lauren Mansour

Faculty Mentor: Emily Patterson

Faculty Mentor Department: School of Health and Rehabilitation

Research Abstract: Introduction/Background:

There is growing interest in implementing whole-slide imaging (WSI) for primary diagnosis now that regulatory hurdles have been overcome for clinical use. At the OSU Wexner Medical Center, we interviewed pathologists about their perspectives on barriers and challenges immediately prior to the implementation of WSI for primary diagnosis.

Methods:

Eleven subspecialized pathologists (2-39 years of experience) participated from diverse subspecialty areas. Relevant semi-structured interview questions included image quality, workflow, and usability during clinical use.

Results:

Analysis of the interview data revealed that WSI implementation would raise some concerns: 1) delaying turn-around time for preliminary diagnoses as well as final reports, 2) delaying access to order ancillary tests, which could impact scheduling for some patients for follow-on surgery, 3) making it hard to track what has been reviewed and at what level of magnification, 4) potentially increase wrist pain from using a mouse or neck pain while viewing the monitor, and 5) increase vulnerability when a computer, monitor, or network goes down.

However, WSI implementation would enable 1) increased flexibility for slide access remotely during nights, weekends, and work trips, 2) easier consults among peers and with mentors, 3) easier detection and recovery when images are routed to the wrong person, 4) creating digital libraries, including previous slides from a current patient, and 5) giving greater access to images for presentations, publications, and to other clinical personnel.

Conclusions:

Implementing digital slides and associated workflow will introduce many challenges and barriers. Studies such as the current one are much needed to explore the pathologist's perspective on these workflow and implementation challenges prior to and during the installation of the digital pathology systems. These perspectives are important to understand in order to improve the experience of the pathologists and lab personnel as they interact with these systems.

These findings have implications for supporting hospital-level, department-level, and individual level of experimentation to optimize the implementation of WSI in the short term and the long term. Much has already been learnt by the current studies and future studies will be designed to further improve these systems.
Research Project Title: Changes in perceived knowledge and self-efficacy of NFPE and malnutrition diagnosis after dietetic students participate in an educational workshop with standardized patients.

Student Presenter: Kelly Ritchey

Faculty Mentor: Marcia Nahikian-Nelms

Faculty Mentor Department: Medical Dietetics

Research Abstract: Background: Malnutrition is prevalent among hospitalized patients and is associated with greater lengths of stay, poor outcomes, and increased costs. Recently, the nutrition focused physical exam (NFPE), was added to the practice of Registered Dietitians (RD). The NFPE and application of newly published diagnostic criteria support the early identification of malnutrition. It is essential for dietetic students to receive this training during their education.

Objective: The purpose of this study was to evaluate the impact of an educational workshop on students’ perceived knowledge of the malnutrition diagnostic criteria and their confidence in performing the NFPE.

Methods: OSU Medical Dietetics students (n = 37) participated in the program. The workshop included lectures, breakout sessions on conducting the practice performing the NFPE, practicing on a partner with verbal guidance from an instructor, and an application of the NFPE and malnutrition diagnosis with two simulated case scenarios using trained actors. Instructors provided feedback to the students following each simulation. Students (n = 32) completed pretest and posttest surveys designed to assess perceived knowledge of diagnostic criteria for malnutrition and confidence in ability to apply the NFPE.

Results: A paired T test was used to determine if there were significant changes. Each item, except for functional assessment, demonstrated a significant improvement (p= &lt; .001) in knowledge after participation in the workshop. Students more than doubled their confidence to perform the NFPE and saw a 51.8% increase in confidence to apply malnutrition diagnostic criteria.

Conclusion: Students not only feel confident in assessing for malnutrition, but also in diagnosing malnutrition. It appears that the pedagogy used in this workshop is effective in the preparation of future practitioners to confidently complete necessary assessments and use evidence-based guidelines for clinical diagnosis. This data may help guide other universities to create similar programs that prepare students to assess and diagnose malnutrition confidently prior to entering clinical practice.
Research Project Title: Assessing the association of critical thinking and academic performance

Student Presenter: Ivanna Soto

Faculty Mentor: Brian Partido

Faculty Mentor Department: Dental Hygiene

Research Abstract: Introduction: Critical thinking is a key element of complex problem-solving that fosters better clinical practice and professionalism. It involves the process of analyzing and developing a deeper understanding of information. However, no research exists that shows whether an association exists between critical thinking and academic performance among dental hygiene students.

Objective: The purpose of this study was to investigate whether associations exist between critical thinking skills and academic performance among dental hygiene students. Methods: Upon IRB approval (2017E0255), a cross-sectional research method was conducted using the Health Science Reasoning Test with Numeracy (HSRT-N) and the California Critical Thinking Disposition Inventory (CCTDI) of dental hygiene students at The Ohio State University.

Results: Simple linear regression was calculated to predict clinical performance based on critical thinking. A significant regression equation was found (F(3,39)=3.389, p<.05), with an R2 of .207. Another simple linear regression was calculated to predict clinical performance based on critical thinking. A significant regression equation was found (F(3,39)=3.687, p<.05), with an R2 of .212.

Conclusion: The components of CCTST-N and CCTDI were found to be predictors of clinical performance. More attention on the development of critical thinking may lead to improved academic and especially clinical performance among undergraduate dental hygiene students.
Research Project Title: The evolution of implicit bias among health sciences students in a hybrid service learning course

Student Presenter: Emma Siegel

Faculty Mentor: Crystal Dunlevy

Faculty Mentor Department: Health & Rehabilitation Sciences

Research Abstract: Introduction: Activities aimed at reducing the implicit bias of healthcare professionals have been shown to be effective, at least in the short term. Students studying healthcare disparities over the course of a semester would ideally become more empathetic and exhibit less bias as learning progresses. A new course developed to prepare students to work in vulnerable communities combined participation-based classroom activities with service-learning. The course was offered for the first time in Spring 2017. Methods: Twenty-five students completed Implicit Association Tests (IAT) for European-American/African-American preference, heterosexual/homosexual preference, and gender/career-family preference, and the Toronto Empathy Questionnaire (TEQ) at weeks one and 15. Scores will be compared using Student’s paired t-tests, with p < 0.05 considered to be statistically significant. Students completed weekly journal reflections that will be coded for themes by three independent researchers. Results: Data has been collected, and will be analyzed by March 9, 2018. Conclusions: Pending results.
Research Project Title: Behavioral spillover across health and environmental domains

Student Presenter: Emma Tippett

Faculty Mentor: Robyn Wilson

Faculty Mentor Department: School of Environment and natural Resources

Research Abstract: Existing research on behavioral spillover reveals that an intervention targeting one behavior has the potential to increase or decrease the motivation to engage in other related behaviors. Given the focus of prior spillover research is largely within one domain (e.g., environmental behaviors), it is not known if behavioral spillover occurs between health behaviors and environmental behaviors. Our research focuses on documenting positive spillover between these two domains, - which will open up an opportunity to promote environmental behaviors through health-based interventions (or vice versa). In an attempt to mend this gap in existing behavioral research, a Qualtrics survey has been developed and administered to Ohio State Undergraduate students to study the relationship between environmental and health behaviors and the existence of shared motivations that may lead to positive spillover. Specifically, we propose that positive spillover between the two behavioral domains will occur for easy behaviors when the individual has strong and positive attitudes toward both the environment and personal health behaviors. Data collection and analysis is ongoing. This research has significant implications for society at large because individual health frames resonate for most people as a reason to act to address environmental issues. If we can document ways to establish positive spillover between health and environmental behaviors, this would help us understand how to better promote change in the environmental domain. Specifically, we could then increase pro-environmental behaviors by promoting healthy behaviors more generally, increasing- positive, collective environmental outcomes in addition to personal health outcomes.
Research Project Title: Cardiopulmonary resuscitation training by peer to peer trainers yields bystanders trained to provide high quality CPR

Student Presenter: Rachel VanScoy

Faculty Mentor: Ashish Panchal

Faculty Mentor Department: Wexner Medical Center: Center for Emergency Medical Services

Research Abstract: The quality of bystander CPR training is known in the United States. One major mechanism of this training is through the American Heart Association’s CPR in Schools Program. However, the quality of CPR provision following this training has not been assessed. The objective of this study was to evaluate the effectiveness of CPR training (depth and rate of chest compressions) of lay bystanders following training through the CPR in Schools: University Program.

During the 2017 academic year, the effectiveness of teaching lay bystanders Hands-only CPR, through the CPR in Schools’ University Training Program, was examined. 120 undergraduate students (without prior CPR training) from The Ohio State University receiving AHA Hands-Only CPR training. Following training, students were given two minutes to perform CPR on Laerdal Little Anne CPR Training manikins where data was collected on performance. Data was collected using Laerdal Skillreporter software on the quality of their compressions, including rate and depth. Data was evaluated in STATA 12 for descriptive statistics.

The training began in September 2017. Interns held group trainings where the participants received instruction in small groups on CPR. 120 people were trained, and all but 104 participants were disqualified from the study based on past education in CPR, failure to give contact information, etc. After training, preliminary data was collected using the Laerdal Skillreporter on CPR rate, depth and compression fraction. On the preliminary analysis, a mean CPR rate of 108.126 compressions per minute, mean depth of 52.359 millimeters, and a mean compression fraction of 64.136% was observed.

The University Program training method can be adapted to train individuals in higher quality CPR using the preliminary analysis alongside additional data analysis to gage where the instruction has neglected specific skills. Specifically, the analysis will determine whether the University Program lacks inadequate training of rate, depth, or compression fraction. Future work in the coming months will be directed at examining retention of knowledge over time.
Research Project Title: A user experience study on rover technology

Student Presenter: Lindsey Welch

Faculty Mentor: Jacqueline Loversidge

Faculty Mentor Department: College of Nursing

Research Abstract: Introduction/Background:

This study seeks to understand usability of Rover technology by staff nurses at a large Midwest academic medical center. Nurses use Rover, a hand-held device, to facilitate patient care. This study explores nurses’ perceptions of advantages and disadvantages of Rover, and about what facilitates or hinders use. Findings can be used to guide administrators in helping nurses make best use of the technology, and for working with the vendor to improve the technology.

Methods:

The sample consisted of fourteen registered nurses from high- and low-Rover-use hospital units. Nurses were recruited through their nurse managers and were approached by the researcher to participate in the study, which was conducted over a six-month period.

Nurses completed a demographic survey; individual data was coded, and location of practice reported as frequencies. Nurses were interviewed by a single researcher using a semi-structured interview guide that asked questions about their use of the Rover technology. Interviews were transcribed and coded for overarching themes.

Preliminary Findings:

Rover features beneficial to participants’ work included accessibility to basic flowsheets, the Medication Administration Record, and the camera feature and similarities to standard smart phones. Features participants indicated could use improvement included overall physical design, lack of flowsheets for in-depth charting, and IT connectivity issues. Participants also identified additional features to enhance Rover usage. Transferability of our findings is limited by sample size, and that Rover was the only proprietary brand studied.

Conclusions:

Nurses found Rover a useful adjunct to their work, and were satisfied with certain features. However, certain features are less useful, could be improved, or could be changed. Nursing leadership anticipates using these findings for 1) working with sales representatives to modify the technology and 2) facilitating greater efficiencies between technology and nursing work.
Research Project Title: Evidence-based nutrition guidelines for head and neck cancers: assessment of clinician awareness and knowledge

Student Presenter: Olivia Qi Hui Wong

Faculty Mentor: Colleen Spees

Faculty Mentor Department: Medical Dietetics

Research Abstract: Background: It is estimated that 35%-70% of all cancers are attributed to suboptimal dietary and physical activity patterns; thus, evidence-based (EB) guidelines for overall cancer prevention and prevention of cancer subtypes have been developed by several organizations, including the World Cancer Research Fund/American Institute for Cancer Research (WCRF/AICR) and American Cancer Society (ACS). Head and neck cancers (HNC) are the seventh most prevalent cancer worldwide and have high recurrence and mortality rates as well as significant treatment-related morbidities. It is critical that HNC clinicians, including registered dietitians nutritionists (RDNs) are aware, and consistently implementing, EB recommendations.

Objective: Study objectives include: 1) evaluate current knowledge and practices of oncology RDNs related to EB recommendations and specific HNC guidelines; 2) assess whether oncology primary care providers are aware of the EB nutrition guidelines.

Methods: An IRB approved online Qualtrics survey was distributed to oncology RDNs at Comprehensive Cancer Centers (CCCs). Email addresses were obtained from national CCC websites and social media was utilized. The 16-question survey includes questions regarding clinical practices, familiarity with EB nutrition and HNC guidelines, and perceptions of clinicians’ awareness of the guidelines.

Results and Predicted Findings: Data collection is ongoing and will end 3/10/18. To date, 19 RDNs have responded. Of these, 95% reported knowledge of general EB guidelines, 50% correctly answered specific questions related to EB guidelines, yet only 38% were aware of HNC guidelines. Seventy-four percent reported familiarity with ACS guidelines, 69% were familiar with AICR guidelines, and 58% with the Academy’s Evidence Analysis Library. RDNs also reported perceptions that 56% of oncology clinicians at their facilities appear unaware of the EB nutrition guidelines.

Conclusions: Although data collection is ongoing, our current data suggest that the majority of RDNs will be knowledgeable of general EB nutrition guidelines for cancer but lack knowledge pertaining to specific HNC recommendations. We also predict that the perception of most oncology RDN’s is that clinicians are unaware of HNC nutrition guidelines.
Research Project Title: Undergraduate cardiac arrest internship program leads to well-trained peer-to-peer instructors and increased community CPR training

Student Presenter: Samantha Beck

Faculty Mentor: Ashish Panchal

Faculty Mentor Department: Emergency Medicine

Research Abstract: Despite advances in prevention and acute care, cardiac arrest remains a public health risk and leading cause of death in the United States. Bystander CPR is provided at low rates throughout the US, which provides a substantial need to address this issue. Many states have developed programs and legislation for CPR instruction in high schools; however, programming lacks in the collegiate setting. The objective of this study was to describe an undergraduate Cardiac Arrest Internship Program that was designed to train peer-to-peer CPR instructors, increase CPR instruction in the community, increase bystander CPR rates, and provide students with a structured experience in resuscitation science.

Undergraduate students applied for volunteer internship positions with a minimum commitment of 10 hours/month. With support from the Center for EMS at OSU and the American Heart Association, interns were provided BLS certification along with monthly didactics on resuscitation science, training in public speaking and CPR instruction, and 16 hours of shadowing experiences in the emergency department and with emergency medical services. For the first 2 months, interns were assessed, and trained, on their community CPR training skills. Following confirmation of proficiency, interns began independent CPR training on campus and in the surrounding community.

The Cardiac Arrest Internship Program was launched in June 2016 with 15 undergraduate students selected, and grew to 25 interns for 2017. Intern training was conducted with all achieving BLS certification and passing their training evaluations, confirming their ability to teach community CPR. Interns planned programs, taught classes, and facilitated community outreach by developing a website and a social media presence (https://cprohiostate.com/). Since 2016, 106 CPR classes were planned and conducted, including both campus and community settings (67 and 39, respectively). The total number of bystanders trained in CPR was 3,206, of which 57% (1,843) were undergraduate students trained on campus.

Development of the Cardiac Arrest Internship Program led to undergraduate students who were well-trained in community CPR instruction and a more educated community. Future work will focus on evaluating the effectiveness of peer-to-peer CPR training through measurement of CPR quality metrics.
Research Project Title: Elucidating the epidemic of stem cell tourism: a survey of attitudes and experiences of U.S. academic neurologists dealing with patient's questions regarding stem cell tourism in the outpatient setting

Student Presenter: Nicholas Yuhasz

Faculty Mentor: Jaime Imitola

Faculty Mentor Department: Neurology

Research Abstract: "Stem cell tourism" is the unethical practice of offering unproven cellular preparations to patients. This phenomenon is rising in neurology as patients are requesting treatment with experimental stem cell therapies for incurable conditions such as multiple sclerosis (MS). Stem cell tourism exploits the therapeutic hope of patients with incurable diseases and can put in danger the legitimacy of stem cell research as a whole. Previously, we have identified the need for physician education (Bowman et al JAMA 2015). However, it is unknown the extent of their experiences in the outpatient setting.

We are performing a survey of attitudes and experiences of U.S. Academic Neurologists dealing with patients' questions regarding Stem Cell Tourism in the outpatient setting from 135 Academic programs. Our IRB-approved survey instrument consisted of 25 questions from demographics, exposure to patients that have received or asked about stem cell tourism, patient and educational tools, and complications.

95.83% of these clinicians stated that they had been asked about stem cell treatments in the past year. 82.76% indicated that they had been approached about stem cell tourism by patients and 57.89% had a patient that received stem cell injections. 93.11% answered that evidence-based educational tools on stem cells would be helpful for patient education. 62.07% disagreed and discouraged stem cell tourism. Notably, 37.93% either agreed or were indifferent to these treatments. 96.55% of these patients were seeking general information, 34.48% were requesting permission, and 13.79% had already undergone unapproved stem cell injections. A majority of these patients requesting permission or information had ALS, MS, or other neuromuscular disorders. Notably, 30.30% of clinicians had particular cases in which these patients exhibited malignancies, MS relapses, and severe demyelination.

This is the first survey of neurologists across the U.S. determining the readiness of physicians to respond to the epidemic of stem cell tourism. Our results suggest the need for an urgent approach and more effective measures to combat this growing public health threat. We intend to use this research for education about stem cell tourism for academic societies and legislative action to prevent further morbidities and mortality in these vulnerable patient populations.
Research Project Title: Reflections on stress, resilience, mindfulness, and student plans for the future: the impact of an honors resilience course on undergraduate students

Student Presenter: Roshini Srinivasan

Faculty Mentor: Maryanna Klatt

Faculty Mentor Department: Department of Family Medicine

Research Abstract: Introduction/Background: Following their undergraduate years, many honors students move on to graduate and/or professional school and eventually occupy leadership roles where stress is prevalent. Burnout in high-powered occupations is common, with physically and emotionally deleterious consequences. In response, an honors resilience course was offered at the University to assist students in cultivating evidence-based strategies for stress reduction and resilience - and may have important implications for student future plans. This study sought to determine the impact of the Honors course “Mindful Resilience: From Individuals to the Organization” on undergraduates who enrolled in spring 2016 and 2017 semesters. Outcomes of interest included perceptions of stress, resilience, and mindfulness, and the course’s impact on daily life and future plans, assessed by an open-ended qualitative survey.

Methods: A Google Forms survey was emailed to the two groups of undergraduate students (n = 32) who completed the course. Data from student responses (n = 15) were analyzed for emergent themes.

Results: Most students were attracted to the course by an interest in mindfulness and motivation to develop resilience skills. While respondents were split between describing unchanged versus decreased stress levels after the course, it was consistently noted that perceptions of stress had been altered to understanding stress as a motivator, rather than an obstacle. Many students reported shifts in personal resilience in conjunction with their perceptions of it, noting that resilience strategies were skills that could be developed. In addition, all respondents described increased mindfulness after the course; of particular mention was an increased understanding of the applicability of mindfulness practices to everyday life. Students also described implementing strategies learned in the course in their daily lives, mentioning increased self-care and mindfulness practices, and heightened self-awareness of stress reactivity. Many described a shift of perspective to a “growth mindset” in the face of stress as they embark upon their future endeavors.

Conclusions: This honors undergraduate resilience course contributed to shifts in students’ perceptions of stress, mindfulness, and resilience. In addition, it served to inspire mindfulness practice and continued resilience development, offering practical strategies with which students could approach the present and future.
Research Project Title: Survey of The Ohio State University respiratory therapy alumni: research related competencies and skills

Student Presenter: Cyndall Slemp

Faculty Mentor: Varekojis No

Faculty Mentor Department: Sarah

Research Abstract: The respiratory therapy field is at a turning point in academic progression. Research suggests competencies valued by RT managers are more evident amongst bachelorâ€™s prepared therapists. Such competencies include leadership, evidence based medicine, and research. Evaluation is needed to determine the value and benefit of incorporating research related skills and competencies in respiratory therapy curriculum. The purpose of this study was to determine the research-related competencies and skills respiratory therapists with a bachelorâ€™s degree have utilized during their career. Methods: A one-shot case study was conducted using a descriptive survey to obtain data for analysis. An online survey using the Qualtrics platform was emailed to alumni of the The Ohio State University Respiratory Therapy Program. A link to the survey was sent in an email that invites the alumni to participate. Participants were asked about current and past job history and responsibilities, how often they utilize research-related skills and competencies, how valuable the research-related skills and competencies have been in relation to career development, and how beneficial their senior research project experience was in relation to career development. Research-related skills and competencies included teamwork, using and evaluating evidence-based medicine, written and verbal communication, leadership, organization, creativity, and problem-solving. Preliminary results indicate participants believe many of the research-related skills and competencies have been beneficial in career development, and that the senior research experience specifically allowed the development of valuable skills. Data collection is ongoing. It is anticipated that results will support the continued inclusion of research-related skills and competencies in an undergraduate respiratory therapy program curriculum.
Research Project Title: A descriptive study on communication skills of first year undergraduate respiratory therapy students

Student Presenter: Connor Divens

Faculty Mentor: Oppermann Yes

Faculty Mentor Department: Rebecca

Research Abstract: The age old adage of “communication is key” holds true for the quality and ability to which healthcare professionals can effectively treat patients and work with healthcare team members. Specifically in respiratory therapy (RT) education, undergraduate students are told of the value of interpersonal communication skills and how those skills translate to successful health outcomes. However, there exists little formal training in communication skills, which brings about a lack of standardization in how team members work together. This can cause multiple issues and result in potential lag time when a RT has to learn communication protocols post-graduation. The purpose of this study is to describe the impact of evaluation and feedback on face-to-face communication skills in undergraduate RT students. First-year RT students enrolled at The Ohio State University self-evaluated their communication skill performance using a standardized interpersonal communication skills inventory. Skill competency check offs were completed throughout the student’s first semester in preparation for clinical rotations and graded by a faculty member. The final evaluation was completed by clinical preceptors. Together these surveys will provide a rich dataset allowing for tracking a student’s communication skills performance from the time of entering the program until ICU clinical rotations. Preliminary results indicate communication skills as assessed by faculty may not change, but that self-assessed communication skills and communication skills assessed by clinical preceptors may improve. Data collection is ongoing. It is anticipated that results will support inclusion of communication skills training in an undergraduate respiratory therapy program curriculum.
Research Project Title:

Student Presenter: Liya Gebru

Faculty Mentor: Patterson No

Faculty Mentor Department: Emily

Research Abstract: Perspectives on Continuous Monitoring in Hospitals: A Survey Study
Research Project Title: Neural correlates of emotion (dys)regulation in multiple sclerosis

Student Presenter: Bryce Boron

Faculty Mentor: Ruchika Prakash

Faculty Mentor Department: Psychology

Research Abstract: Cognitive reappraisal - an emotion regulation strategy involving reinterpreting negatively valenced stimuli - is associated with emotion regulation success, decreased negative affect, and increased positive experiences. Studies investigating the neural correlates of cognitive reappraisal in healthy adults have implicated increased recruitment of the ventral anterior cingulate, ventromedial prefrontal cortices, and the lateral fronto-parietal cortices, along with reduced activation in emotion-generating brain regions such as the amygdala and ventral striatum. However, there are very few neuroimaging studies examining the neural correlates of emotion regulation in populations with chronic medical illnesses, who often experience increased stress and higher levels of emotional distress. Multiple Sclerosis (MS) is one such chronic illness where individuals diagnosed with the condition experience greater difficulties with regulating emotions, and subsequently higher rates of depression than the general population. This study investigated the neural correlates of cognitive reappraisal in individuals with MS and the relation between cortical activation during the reappraisal task and symptoms of depression as assessed by the Beck Depression Inventory-II (BDI). Thirty-seven participants (ages 30-59) diagnosed with relapsing-remitting MS completed an emotion regulation task in the MRI scanner. During the task, they were asked to either regulate their emotions using reappraisal or simply observe while viewing negative affect or neutral images. Activation patterns during regulation vs. observe trials (affect regulate &gt; neutral observe + affect observe) were consistent with those observed in previous studies of healthy adults and included ventral anterior cingulate and lateral fronto-parietal clusters. BDI scores included as a whole-brain regressor were negatively associated with recruitment of lateral prefrontal regions during regulation. These results suggest that when faced with negative images, individuals with MS who reported fewer symptoms of depression exhibited greater recruitment of prefrontal regions, which has been linked to greater regulation success in previous studies.
Research Project Title: The relationship between socioeconomic factors and behavioral preferences in children

Student Presenter: Bethany Cady

Faculty Mentor: Paul Healy

Faculty Mentor Department: Economics

Research Abstract: Behavioral preferences influence choices in a variety of market structures. This study seeks to investigate how social, risk, and other-regarding preferences relate to a child’s family background, with special interest in mother’s education and ordering within the family. The preferences of my subjects, children ages 9-10, are evaluated by their responses to an equal-expectation distribution game, a prisoner’s dilemma with qualitative reasoning, and a binary-choice dictator game. The main finding is that children with mothers that have higher degrees of education are less likely to make decisions to avoid punishment and make envious adjustments. In contrast, mother’s education and the child’s number of older siblings have a significant positive relationship with decision-making to increase payoff.
Research Project Title: The effects of perceptually rich stimuli on pre-algebraic pattern thinking in preschoolers

Student Presenter: Sydney Clark

Faculty Mentor: Vladimir Sloutsky

Faculty Mentor Department: psychology

Research Abstract: Introduction: A human’s ability to recognize patterns in early development is predictive of later mathematic aptitude, which is particularly important given the low levels of national mathematic achievement in the United States. The implementation of pattern and relational training in early education could help improve future mathematical performance, thus warranting further study.

Methods: Little work has explored the advantage of using abstract labels over concrete labels during pattern training. This study involves 4 to 6-year-old children. The goal of the current study is to test (a) how the use of perceptually rich stimuli (i.e. pictures of animals and other everyday objects) compares to the use of more impoverished stimuli and (b) how the use of abstract (i.e. “A-B-A”) vs. concrete (i.e. “cookie-cake-cookie”) labels affect learning. This study utilizes a basic pre-post test design, in which children are trained in either an abstract condition or a concrete condition, followed by measures of post-test, generalization, and transfer.

Results: For the within-experiment analyses, I hypothesize that children who are taught patterns consisting of perceptually rich objects using abstract labels will outperform children who are taught the same perceptually rich patterns using concrete labels. The abstract labels should help children better generalize the stimuli, which is important for pattern recognition and application. Concrete labels, on the other hand, will most likely magnify attention to the objects themselves instead of their relations to each other, thus hindering patterning abilities. For the across experiment analyses, perceptually rich objects (instead of simple shapes) should not be helpful in the case of pattern learning, which relies on the identification of relations among objects, not remembering the details of the objects themselves. Therefore, participants in both label conditions of the perceptually rich experiment should perform poorer than children in both label conditions of the simple shape experiment. Conclusions: Understanding the crucial variables in successful pattern learning can shed light on the importance of being judicious when selecting education materials for young children. This study may suggest the need for educators to go against their instinct to choose learning aids that look engaging, but have extraneous details that hinder comprehension.
Research Project Title: A generalized, Bayesian method for linking structural connectivity to models of functional neural data and behavior.

Student Presenter: Matthew Galdo

Faculty Mentor: Brandon Turner

Faculty Mentor Department: Psychology

Research Abstract: In recent history, there have been two significant non-interacting fields of study in pursuit of understanding cognition. The first, cognitive neuroscience, collects neural data and relates it to behavior, often through correlation studies or machine learning techniques without proposing any formal theoretical cognitive mechanism. The second, cognitive modeling, develops formal theoretical models of cognition using solely behavioral data. In recent years, a reconciling field called model-based cognitive neuroscience has emerged bridging these two lines of work together by establishing frameworks (e.g. joint modeling) for relating both neural and behavioral data to theoretical formulations of cognition. In parallel, a plethora of work from the neuroimaging field suggests a relationship between anatomical connectivity in the brain (e.g. white matter tracts) and functional activity (e.g. BOLD activity). However, little has been done to relate structural connectivity to cognitive processes in a systematic a priori manner. Here we propose a generalized framework for extending joint models of brain activity and cognition through the use of structural connectivity. For this method, we propose using structural connectivity as the basis for informing our inferences about correlations in functional activity across brain regions. We then test a variety of linking functions demonstrating the flexibility and potential of this methodology. Using cross-validation, preliminary results show that models fit using the proposed framework are better predictors of holdout data.
Research Project Title: Hair cortisol as a biomarker of chronic stress

Student Presenter: Elizabeth Gilbert

Faculty Mentor: Catherine Calder

Faculty Mentor Department: Statistics

Research Abstract: Stress has negative impacts on the human body when sustained over time, such as obesity, diabetes, and mental health issues. To mitigate these effects, chronic stress needs to be better understood, which can be accomplished through measuring biomarkers of stress. Cortisol is the primary stress biomarker in humans, and can be measured in blood, saliva, urine, and hair. Hair represents the longest integral of exposure to cortisol over time, however, much about the nature of hair cortisol remains unknown. The primary purpose of this study is to model hair cortisol concentration over length. Additionally, we address a practical issue in hair biomarker data collection. In certain situations, sampled hair is discovered to be too light in weight to assay once it gets to the lab. In order to be able to use these samples, we propose a hair adjustment method to create an adjusted hair cortisol concentration from the underweight sample supplemented by the tail ends of the hair sample. The data used for this study come from 31 participants who took part in The Ohio State College of Nursing Hair Cortisol Study. Each participant provided multiple hair sample and completed a 4-page survey. Descriptive analyses and Rasch modeling were used to understand differences in stress levels across the study participants. We found that the Rasch score of recent stressors is a better predictor of recent reported stress levels ($\beta = 0.3$) than any measured demographic variables. From 26 hair samples, the linear model of hair cortisol concentration shows that hair cortisol concentration in pg/mg decreases over length of hair in cm as expected with $\beta = -0.11$ pg/mg/cm, and $\alpha$ intercepts per subject ranging from 3.5 pg/mg to 15.15 pg/mg. This model predicts the most recent three months of cortisol concentration growth, given the samples of combined past and recent cortisol concentration, along with their weights and lengths. Our descriptive statistics contribute to a better understanding of chronic stress, and we hope that our adjustment method provides a post-collection solution to the issue of lightweight hair samples.
Research Project Title: The relationship between resting heart rate variability and music listening preferences

Student Presenter: Havovi Desai

Faculty Mentor: Julian Thayer

Faculty Mentor Department: Psychology

Research Abstract: When it comes to daily music-listening, it can be categorized into three main groups, including cognitive/ intellectual, emotional, and background listening. Listening to music can influence brain regions that both perform executive functions and maintain overall well-being. Interestingly, higher resting heart rate variability (HRV) is associated with both overall well-being, cognitive and emotional regulation, and executive brain function. While previous studies have examined the impact of music on HRV, no study has examined the association between one’s resting HRV, as an index of self-regulatory abilities, and their music listening tendencies. Therefore in our current study, we examined this direct correlation in a sample of 81 undergraduate participants (mean age = 20, 42 females). Resting HRV data was collected during a 5-minute baseline period. Participants then answered a set of 15 questionnaires, including the Uses of Music Inventory. Questions on this scale fell into three categories: music listening as it relates to emotion, cognition, and background noise. Participants either answered “True” or “False” to a series of questions relating to the above categories. Lower scores represent more listening on subscales and the total listening scale. Controlling for respiration, age, body mass index, sex, and ethnicity, correlation tests showed that individuals with higher resting HRV reported greater tendency to listen to music in a cognitive way ($r = -.231, p = .048$), but not in an emotion-listening ($r = .025, p = .831$) or background music listening way ($r = -.021, p = .857$). Overall, these data suggest that there is a direct correlation between resting HRV and one’s music listening preferences, particularly when listening in a cognitive way. Future studies should work to better understand this relationship, as well as the lack of association between resting HRV and both emotional and background noise music listening.
Research Project Title: Circumorbital morphology and selection in African colobine monkeys

Student Presenter: Luke Fannin

Faculty Mentor: Scott McGraw

Faculty Mentor Department: Anthropology

Research Abstract: Inflation of the bones forming the orbital rim is a characteristic feature of red colobus (Piliocolobus) crania, but not for closely related black and white colobus (Colobus). Early studies attributed pronounced circumorbital ridging to elevated anterior dental loading and masticatory stress; however, in-vivo bone strain studies suggest this region receives little stress during chewing. The Western red colobus P. badius and King colobus C. polykomos differ in the average toughness of their diets and their oral processing behaviors. Both consume significant quantities of leaves; however, C. polykomos utilizes its anterior dentition more frequently, especially during processing of woody Pentaclethera macrophylla pods. C. polykomos also chews more per ingestive event than does P. badius. We use these feeding differences to investigate interspecific patterns of circumorbital rim variation. We further investigate dimorphism in this feature using a sexual selection framework. Measures of circumorbital ridging in three areas (medial-superior, lateral-superior, lateral) were taken from 77 P. badius and 21 C. polykomos crania collected from naturally deceased individuals in the TaÃ¯ Forest, CÃ´te dÃ©Ivoire. Size-corrected residual means of circumorbital measures were used in paired comparisons within and between species. Results indicate that P. badius possesses significantly larger relative measures of superior circumorbital ridging than C. polykomos. Lateral ridging measures were not significantly different between species. P. badius males possessed relatively larger measures of both superior and lateral circumorbital ridging compared to females; however, C. polykomos males and females did not differ in any circumorbital dimension. These results support previous studies that disassociate circumorbital geometry from masticatory stresses: e.g., circumorbital ridging in C. polykomos is reduced compared to P. badius, despite the formerâ€™s more challenging diet, increased masticatory rate, and greater use of the anterior dentition. We conclude that circumorbital ridging in P. badius is a sexually dimorphic trait whose variation cannot be explained via size or feeding differences. We speculate sexual selection is responsible for shaping this feature, a hypothesis testable with data on female choice and paternity skew.
Research Abstract: Selective attention is used in everyday tasks, where people must filter out irrelevant information to focus on the task at hand. Filtering appears to change across development, with children and older adults being more distracted than younger adults. The primary goal of the study was to examine the development of visual selective attention in children, young adults, and older adults, while participants were instructed to ignore auditory and visual distractors. Based on modality dominance research, it was hypothesized that auditory distractors would be more distracting early in development and visual distractors would be more distracting late in development. A secondary goal was to determine if the Perceptual Load Hypothesis (PLH) could predict which auditory distractors interfere with visual selective attention. Research examining the PLH shows visual flankers are more distracting under low load, however, it is not clear if this hypothesis will predict which auditory stimuli slow down response times.

Eight-year-olds, 19-year-olds, and 77-year-olds were presented with a modified flanker task where they had to quickly identify and respond to a visual target, either a bird or a dog, and ignore the distractor. We manipulated compatibility of distractor (compatible vs. incompatible), load (high vs. low) and modality of distractor (auditory vs. visual). In the auditory distractor conditions, the visual distractors were replaced by bird chirps and dog barks, presented via headphones.

Only auditory distractors attenuated accuracies. Incompatible distractors slowed down response times in children more than young and older adults, and both auditory and visual distractors slowed down children’s responses. In contrast, young and old adults were only affected by the visual distractors. Older adult data were consistent with PLH with visual distractors only slowing down responses in the low load condition. Finally, increased heart rate variability (measure of attentional control) was associated with increased distractibility in children and older adults, and decreased distractibility in adults.

Findings are consistent with auditory dominance with auditory interference being stronger early in development. PLH did not appear to predict auditory distractibility, nor did it predict performance early in development.
Research Project Title: Evaluating sleep measurement in children with Autism Spectrum Disorder: A comparison of actigraphy data and parent report

Student Presenter: Amanda Kenepp

Faculty Mentor: Jill Hollway

Faculty Mentor Department: Psychiatry

Research Abstract: Introduction

Children with autism spectrum disorder (ASD) often present with co-occurring sleep disturbance. The most common measure of sleep in ASD is subjective (i.e., parent report), less commonly used are objective measures, as there are practical issues to implementing these instruments in this population. This study aimed to determine if widely-used parent report methods are reliable and valid in young children with ASD. We compared an objective measure of sleep, actigraphy, with parent report in the form of a sleep diary. We hypothesized that in children with significant sleep disturbance, parent-reported sleep measures would over-estimate sleep problems compared to actigraphy.

Method

We analyzed data collected on 27 children with ASD ages 3 to 9 years. Sleep data were collected for five consecutive days by parent sleep diaries, a parent rated sleep questionnaire, and actigraphy. Measures of sleep onset latency (SOL), minutes awake after sleep onset (WASO), and total sleep duration were evaluated with paired sample t-tests and general linear modeling. All tests were two-tailed and the p-value of .05 was used to determine significance.

Results

Preliminary analyses revealed that of the 27 children included in the pilot study, only 12 tolerated the actigraph. The average age of our sample was 6.42 (SD = 2.2), with an average IQ of 70.3 (SD = 28.3). The sample mainly consisted of male subjects (91.67%) and were primarily white (83.33%). From the Pearson’s correlation, no significant relationships were found between actigraph data and sleep log data for SOL (r(11)=.095, p=.769), duration (r(11)=.270, p=.395), or WASO (r(11)=.239, p=.454). Paired-sample t-tests revealed significant differences between the means of actigraph and sleep diary data of SOL (t(11) = 3.38, p<.01) and WASO (t(11) = -2.54, p<.05) but not duration (t(11) = -1.03, p = .327).

Conclusions

T-tests and correlation analysis found that actigraph and sleep log data were significantly different in SOL and WASO, as parents overestimated SOL and underestimated WASO. These findings suggest that parent-report measures alone may not be valid measures of sleep disturbances in children with ASD. Further research is needed to see if these results are found in a larger, more diverse sample size.
Research Project Title: Differing outcomes of mindfulness-based cognitive therapy in mood dysregulated versus anxious adolescents

Student Presenter: Fatima Khalid

Faculty Mentor: Melissa Delbello

Faculty Mentor Department: UC Department of Psychiatry

Research Abstract: Studies show there is an increased risk of experiencing an anxiety or mood disorder in adolescents who have a parent with bipolar disorder. At present, the most common treatment for adolescent anxiety and mood disorders are the use of pharmaceutical medications. However, increasingly more findings suggest these medications may cause worsening or acceleration of onset of mania or hypomania in addition to other adverse effects in anxious and depressed adolescents. In an effort to explore alternative treatment methods, Mindfulness-Based Cognitive Therapy for Children (MBCT-C), a psychotherapeutic intervention that combines the use of mindfulness meditation exercises with the features of cognitive based therapy, was created. In previous studies using this method, adolescents reported decreased worried feelings as well as improved management of anger at home and at school, and exhibited reduced activation in the amygdala and improved function and connectivity in associated brain regions.

However, few studies exist that compare the effectiveness of mindfulness based therapies for mood dysregulated adolescents versus adolescents experiencing an anxiety disorder. Therefore, we sought to compare the effects of MBCT-C on these two groups. Participants were recruited from a cohort of youth who had at least one biological parent with bipolar disorder and were between the ages of 9-17. Those in the anxious group met inclusion criteria for a pediatric anxiety disorder in DSM-IV and those in the mood dysregulated groups required a score greater than 28 on the Childrenâ€™s Depression Rating Scale â€“ Revised (CDRS-R). Both groups met for 75-minute sessions of MBCT-C for 12 weeks. fMRI were scanned at baseline prior to treatment and upon completion of the last MBCT-C session. In the anxious group, when viewing fearful faces, there was a significant decrease in right amygdala activation. In contrast, the mood dysregulated group showed a significant increase in right amygdala activation following treatment. These variances suggest important differences in disease pathologies and highlight the need for different approaches in the treatment of anxious versus mood dysregulated individuals.
Research Project Title: Hierarchical Bayesian analysis reveals complex neural dynamics of inhibitory control

Student Presenter: Fiona Molloy

Faculty Mentor: Brandon Turner

Faculty Mentor Department: Psychology

Research Abstract: Cognitive control has been of interest to psychologists and neuroscientists because of the insights it has provided to the understanding of individual differences, impulsivity, addiction, and obsessive-compulsive disorder. Two tasks that have been used to test cognitive control are the Go/No-Go task and the Go/Stop task. In the go/no-go task subjects are either given a cue to respond or withhold a response at the beginning of a trial. The Go/stop task extends this basic paradigm by including the possibility that a Go cue may switch to a response-withholding cue. Behavioral and functional magnetic resonance imaging (fMRI) neural data, extracted for twenty-four regions of interest (ROIs), were collected from eleven subjects who completed both the Go/No-Go and Go/Stop tasks. In this study, blood oxygenation level-dependent (BOLD) responses were fit to five increasingly complex models of the trial-wise neural activation to improve the signal-to-noise ratio and explore differences in neural activation between response (Go trials) and response inhibition (No-Go/Stop trials). The models were fit using a hierarchical Bayesian analysis. First, hierarchy was added on a conditional level (Model 2), then on an ROI-level (Model 3), then a subject-level with a variance covariance matrix across subjects (Model 4), and finally on a subject-level with individual variance-covariance matrices (Model 5). Model 1 had no hierarchical component. We found that introducing hierarchy, or adding multiple levels to the model, greatly constrained the predicted BOLD signal by systematically removing outliers. Additionally, increasing model complexity through levels of hierarchy reintroduced some variability absent in the means from the simpler models and elucidated brain regions that played a role solely in carrying out a response (Go trials). We next replicated these results using the more complicated Go/Stop task. We found a similar trend relating increasing complexity and increasing constraint. Additionally, we explored activation in the same twenty-four ROIs with an additional condition—抑制ing a response that has already been initiated (stop-signal). Our results suggest hierarchical modeling is a useful tool in interpreting often messy fMRI data.
Research Project Title: Integrating current and prior information in a social learning game with the drift diffusion model

Student Presenter: Cameron Luther

Faculty Mentor: Ian Krajbich

Faculty Mentor Department: Psychology/Economics

Research Abstract: Introduction: This research investigates what information people infer from observing each other's response times (RT) in social learning situations. In this project we use computational modeling to investigate how participants integrate public choice and decision-time information with their own private information, in order to determine the true state of the world. We model this as an integration of current (private) and prior (public) information. Specifically, we investigate whether people update information gradually, while observing others' behavior, or instead update all at once at decision time.

Methods: Subjects played an information cascade game. In every round, subjects are ordered 1-8, and then asked to make predictions about the state of the world, A or B. Both states of the world are equally likely. Subjects also receive a signal at the start of their turn (a or b) with probability conditional of the state of the world P(a|A)=P(b|B)=2/3. After receiving their signal, subjects have 10 seconds to guess the true state.

Once the decider's time is up, their decision is revealed to all the other players. Once all subjects press a continue button, the next player starts their turn. This process continues until all subjects have made a guess about the state of the world. The true state of the world is then revealed and subjects who guess correctly receive $1.

Subjects played the game in two different conditions. In the no-RT condition, the game proceeded as described above. In the RT condition, subjects were also shown others' RT, namely how long previous subjects took to make their guesses.

Results: We hypothesized that subjects might be forming a belief about the state of the world prior to their turn, and that this would be revealed by the time they took on the continue screens. We did find evidence for subjects forming prior beliefs, but only in the RT condition. Surprisingly, we did not find evidence for an influence of time spent on the continue screen.

Conclusion: Our results indicate that the availability of RT information causes subjects to pay more attention to others' behavior and form beliefs prior to their turn.
Research Project Title: The effects of hearing loss and age on driving performance

Student Presenter: Nathanael Miller

Faculty Mentor: Christina Roup

Faculty Mentor Department: Audiology

Research Abstract: The relationship between hearing impairment and driving performance is an area not extensively researched. The few previous studies in this area do not effectively separate the effect of aging from the effects of hearing impairment. A lack of knowledge and understanding of these relationships puts the entire driving population at risk from potential dangers due to the negative impacts of hearing impairment and age on a driver’s ability to maintain optimal levels of sensory processing, situational awareness, and fine motor skills.

The present study attempts to evaluate the effects of age and hearing loss by separating the two factors, and comparing four groups of drivers. The groups are divided according to the following: young adults with normal hearing, young adults with hearing impairment, older adults with normal hearing, and older adults with hearing impairment.

Each participant is asked to drive an automotive simulator course. The simulator consists of a 6-degree-of-freedom motion platform upon which a 2010 Honda Accord with full interior and shell is mounted. Simultaneously, the participant participates in two tasks: listening and situational awareness distraction tasks. The situational awareness task includes identifying a checkered cube (4 meters^3) randomly appearing on the course. The listening task requires individuals to repeat the last word of 100 equally high and low predictability sentences in controlled background noise at a +4 dB signal-to-noise ratio taken from the Revised-Speech Perception in Noise test.

Testing is currently in progress. Preliminary results suggest that driving performance is affected negatively by both hearing loss and age, and even more so when in tandem. Preliminary evidence supports the importance in enhancing in-vehicle auditory aid systems to assist both hearing impaired and the elderly in driving, such that the roads can be a safer environment for all individuals. In fact, it is likely that auditory aid systems can prove to be beneficial to all populations of people beyond those affected by hearing impairment.
Research Project Title: Learning mechanism used when categorizing mathematical information surrounded by perceptual features

Student Presenter: Abigail Mills

Faculty Mentor: Vladimir Sloutsky

Faculty Mentor Department: Psychology

Research Abstract: Much research indicates fractions and proportions are difficult concepts to grasp. Is it possible to capitalize on a non-mathematical skill we already possess to help process these challenging concepts? We tested 97 undergraduate students at The Ohio State University in tasks that assessed their prior mathematical knowledge before having them complete a categorization task. Categorization was chosen as the method to teach proportion knowledge because much research shows adults can easily apply this skill to difficult, non-numerical concepts. The categorization task presented participants with two types of unknown creatures and asked them to differentiate between them on the basis of one of two deterministic ratios presented alongside non-numeric probabilistic features. Our results show that adults easily learned a novel fraction-rule across a variety of presentation conditions within our categorization task. However, accuracy was lower and reaction time was slower in conditions where the deterministic feature detailing the fraction-rule was presented with additional and extraneous perceptual features, which presumably distracted participants from the critical numerical information. This is interesting given similar data from children indicating that, in tasks with more challenging demands, adults and children are equally distracted by the irrelevant information, an unexpected parallel of poor performance. Scores on the prior math knowledge battery significantly predicted performance, meaning individuals with more previous math knowledge did better in the categorization task. This supports other research that individuals who start ahead, stay ahead, thus emphasizing the importance of solid mathematical foundations for later success. The results also inform our knowledge of how children think about difficult, novel math concepts, as well as how this may develop across the lifespan. By inducing adults to think like children with the introduction of challenging task demands, we can begin to understand the mechanism underlying children’s learning that will allow for better development of learning materials. Using a well-mastered skill (categorization) to learn a difficult math concept (fractions) without the presence of distracting perceptual information intruding on learning and transfer is a novel finding and may be a unique strategy for teaching other difficult concepts both inside and outside of formal education.
Research Project Title: A literature review of metabolomics and psychiatry: new insights for ADHD

Student Presenter: Catherine Panchyshyn

Faculty Mentor: Irene Hatsu

Faculty Mentor Department: Human Sciences

Research Abstract: Attention-Deficit Hyperactivity Disorder (ADHD) is a chronic neurodevelopmental disorder characterized by symptoms of inattention and/or hyperactivity-impulsivity. Prevalence is currently reported at 5.3% in children and 2.5-4.9% in adults.1 ADHD can have several negative consequences, such as hindering educational success and daily function, and increasing the likelihood of substance abuse or other comorbid psychiatric conditions.2 Early diagnosis is critical, since untreated ADHD can increase the possibility of more severe disorders in adulthood.2 The most common pharmaceutical treatments for ADHD involve amphetamines, which often have poor or unknown long-term side effects.2 Due to the limited treatment options and their side effects, new research is required to pursue identification of ADHD biomarkers. Monitoring levels of specific hormones, proteins, or other organic chemicals could assist in diagnosing a patient, improving treatment results, and providing a better understanding of ADHD pathology.3 Metabolomics, an innovative research tool, captures biological signatures of metabolites using blood, urine, or stool samples. Untargeted metabolomics studies identify the differing metabolic signatures from the study sample compared to controls. Identifying these signatures can lead to targeted metabolomics studies, which answer more specific questions about each metabolite’s function in the disorder.3 To date, there are no known studies using metabolomics in children with ADHD. Literature for this review was pulled from PubMed, and the Ohio State University library database, with a focus on metabolomics and biochemical studies within human ADHD populations or animal studies with an ADHD phenotype. The purpose of this literature review is to compare and combine information from existing metabolomics studies to gain insight into the biochemical pathways of ADHD pathology and treatment response. Our primary aim is to advocate for metabolomics research in an ADHD population, specifically within pediatrics, given that diagnosis often occurs in early childhood.

References


Research Project Title: The influence of anxiety and depression on cognitive and physical functioning and self-care among heart failure patients

Student Presenter: Nicole Santos

Faculty Mentor: Charles Emery

Faculty Mentor Department: Psychology

Research Abstract: Background

Heart Failure (HF) is a condition in which the ventricles of the heart are weakened or stiffened, reducing the capacity of the heart to pump blood throughout the body. In addition, elevated symptoms of depression and anxiety are common among patients with HF. Patients with HF often exhibit deficits in executive function and in self-care.

Few studies have examined the potential influence of depression and anxiety on executive functioning (e.g., working memory, processing speed) and physical functioning (exercise performance) in relation to self-care in HF patients.

Purpose

This study evaluated the impact of cognitive and physical functioning on three specific domains of self-care (i.e., maintenance, management, confidence) in patients with HF. These domains refer to a patient’s ability to adjust their lifestyle habits to accommodate their condition, identify symptoms, and assess the effectiveness of their actions to alleviate symptoms they may experience. Anxiety and depression were examined as moderators of the relationship of cognitive and physical function to self-care. It was hypothesized that anxiety and depression moderate the relationship of cognitive functioning and physical functioning with self-care.

Methods

The data were collected as a part of a larger study examining a behavioral intervention for insomnia among patients with HF. This project represents a planned secondary analysis of the data. Participants were 20 HF patients from both inpatient and outpatient clinics as well as cardiac rehabilitation facilities at OSU. In addition, participants were identified via Research Match, an online source of prospective research participants. This study analyzed only data from the baseline assessment. During the baseline assessment participants completed cognitive functioning tasks (i.e., Digit Symbol Substitution Test, Verbal Paired Associates I), self-reports of self-care, anxiety and depression (i.e., Self-Care of Heart Failure Index, Hospital Anxiety and Depression Scale) and a physical functioning task (i.e., Sixty-Foot Walk Test).

Results/Conclusion

Findings from this study increased our understanding of the relationship between cognitive, physical, and psychological factors on different domains of self-care among patients with HF. Better understanding of the relationship among these factors can help to elucidate important targets for improving self-care in this critically ill patient population.
Research Project Title: Can preparatory interval mitigate the negative effects of interruption?

Student Presenter: Zhaojie Zhang

Faculty Mentor: Andrew Leber

Faculty Mentor Department: Psychology

Research Abstract: Interruptions are one of the major problems faced by people in modern society and can result in negative effects such as errors, increased time to complete tasks. Previous research in the lab has shown a tendency towards worse memory due to interruptions. Adding an interval between the alerting of an interruption and the beginning of the interruption task, termed the interruption lag, can reduce errors and decrease the time to resume an interrupted task (Trafton et al. 2003). The interruption lag has been shown to improve immediate task performance after an interruption, but it is unclear what effects the lag has on long-term task processing and memory. This study aims to investigate the effects of an interruption lag on both short-term and long-term task processing. In this study, participants completed two phases. In Phase 1, participants were required to search for target objects embedded in a Rapid Serial Visual Presentation (RSVP) stream, while getting interrupted by a math problem approximately 50% of the time. A 2000 ms interruption lag was inserted on 50% of interrupted trials. In Phase 2, participants had their memory for the target from Phase 1 assessed and indicated their confidence in their memory. At the conclusion of the experiment, participants completed a survey stating how they felt about the lag. I hypothesized that an interruption would improve Phase 1 target searching accuracy and improve memory for interrupted targets. Analysis of Phase 1 data revealed the lag had no effect on stream accuracy, but did significantly decrease the time to complete the math problem, possibly indicating the lag helped participants prepare for interruption rather than returning to the target searching task. For Phase 2, the study did not replicate previous findings that interruptions negatively impacted memory; however, memory for targets shown in an interrupted trial was worse if a lag occurred and if subjects had some confidence in their answer. Filtering by survey responses, people who have a positive attitude for the lag remembered more targets than people who had a negative attitude. Future research could alter the position of the lag and investigate individual differences.
Research Project Title: The impact of physical activity on hair cortisol levels in adolescents

Student Presenter: Katelyn Smithberger

Faculty Mentor: Jodi Ford

Faculty Mentor Department: College of Nursing

Research Abstract: Although previous research documents the benefits of physical activity by reducing illness and stress, other studies found a correlation between strenuous physical activity and elevated salivary and hair cortisol levels. This study explored associations between levels of physical activity and cortisol levels in hair among adolescents. Elevated hair cortisol indicates elevated stress and potentially impaired immune function. This study employs analysis of two linked NIH studies on the health and well-being of urban adolescents. A representative sub-sample of 534 adolescents aged 11 to 17 years was used to demonstrate the relationship between physical activity and hair cortisol levels. Through an in-home survey, youth responded to three questions on the intensity and volume of physical activity from the previous week. The three variables “mild, moderate and strenuous activity” were analyzed via regression analyses as continuous measures to assess linear associations, and also categorized in which the top and bottom 10% of the distribution were compared to the middle to assess other associations. Hair samples from participants were tested for cortisol using Salimetrics assay in the College of Nursing Laboratory, controlling for hair weight and length. When the physical activity measures were analyzed as linear associations, there were no statistically significant associations between mild, moderate or strenuous physical activity and hair cortisol levels. In contrast, when non-linear associations were examined, hair cortisol levels were significantly higher in youth who participated in strenuous exercise 8 or more times a week (p<0.05) and marginally higher in those who engaged in no strenuous activity (p=0.10) compared to those who exercised at least once (or up to 7 times) a week. Hair cortisol levels were also marginally higher (p<0.09) in youth who participated in moderate exercise 8 or more times a week compared to those who participated at least once (and up to 7 times) a week. The findings suggest that high levels of strenuous or moderate physical activity (and possibly no strenuous activity) could contribute to higher hair cortisol levels and potentially negatively impact immune function.
Research Project Title: Associations between perceptions of relationship closeness and borderline personality disorder features

Student Presenter: Rachel Wininger

Faculty Mentor: Jennifer Cheavens

Faculty Mentor Department: Psychology

Research Abstract: Introduction

Borderline Personality Disorder (BPD) is a severe, debilitating mental disorder characterized by relationship instability, fear of abandonment, impulsivity, and emotion dysregulation (APA, 2013). Individuals with BPD often struggle to maintain long-lasting bonds such as friendships or marriages and report greater conflict and criticism in their relationships compared to healthy controls (Stepp, Pilkonis, Yaggi, Morse, & Feske, 2009). Furthermore, research suggests that individuals with BPD tend to make extreme evaluations of people, which contributes to relationship conflict (Veen, Arntz, 2000). Despite relationship conflict and instability, Lazarus and Cheavens (2017) found that individuals with BPD did not differ from healthy controls in their ratings of relationship closeness. One possible explanation for these findings is that individuals with more features of BPD may use different indicators (e.g., proximity, conflict, social support) or use these indicators differently to judge the closeness of their relationships compared to those with lower BPD features.

Methods

With the present research, we examined the associations between three dimensions of relationship closeness (i.e., proximity, social support, and conflict) and BPD symptom severity. We recruited 199 participants through the Research Experience Program (REP) and asked them to complete a survey that included the Inclusion of Other in the Self scale (IOS; Aron, Aron, & Smollan, 1992), the Unidimensional Relationship Closeness Scale (URCS; Dibble, Park, & Levine, 2011), and the Personality Assessment Inventory-Borderline subscale (PAI-BOR; Morey, 1991). Participants also completed a demographics questionnaire.

Results

Participants’ scores on the PAI-BOR ranged from 5 to 66, meaning participants exhibit a great deal of variation in borderline feature severity. Participants averaged 6.25 out of a possible 7 on the self-report questionnaire (URCS), indicating that they felt very close to the self-reported closest person in their lives. BPD feature severity was not significantly correlated with measures of relationship closeness (ps < .05).

Conclusions

There are no apparent associations between BPD feature severity and the selected dimensions of relationship closeness. Future research should examine other facets of relationship closeness to determine which aspects of social relationships BPD patients feel are most important, which may help therapists help BPD patients build long-lasting social networks.
Research Project Title: Improvement of fine motor skills found in chronic tetraplegia as detected using brain-computer interface-controlled functional stimulation during functional task practice

Student Presenter: Kaitie Eipel

Faculty Mentor: Marcia Bockbrader

Faculty Mentor Department: Physical Medicine and Rehabilitation

Research Abstract: Recovering upper extremity motor function is of high priority to chronic spinal cord injury (c-SCI) patients. Of the rehabilitative treatments available, there are no known therapies that allow c-SCI patients to improve motor function without changing their motor level or grip strength. The purpose of this study was to examine whether training functional tasks using a brain computer interface (BCI) functional electrical stimulation (FES) system in a patient with c-SCI could lead to increased independence. One male participant (age=26) with C5/C6 complete tetraplegia completed a standardized test battery to assess whether practicing motor tasks using the BCI-FES system on his dominant (right) forearm would carry over to improved function without the system. Tests of motor ability and functional participation were performed at baseline and after 3 years of BCI-FES practice. Our participant improved his hand motor function on the Action Research Arm Test (ARAT) by 17 points, scoring a total of 35 out of 57 possible points. Performance gains were noted in pincer, grasp, and grip subcategories and exceeded the minimum clinically important difference reported for the ARAT (MCID=6), indicating that the change was clinically significant. The Graded Redefined Assessment of Strength, Sensibility and Prehension (GRASSP) test revealed a significant improvement on performance prehension tasks, consistent with grasp function gains equivalent to moving from a C6 to C7/C8 neurologic level. Additionally, the participant showed a 6-point (MDD=3) difference on the right hand, whereas only a 2-point difference was observed on the left, supporting a practice effect that is specific to BCI system use. Functional participation was assessed by the Quadriplegic Index of Function (QIF). Initially, the participant was able to independently complete 9 out of 37 activities, but after BCI-FES practice could complete 17 activities allowing him to live more independently. In conclusion, the results suggest that using a BCI-FES can help improve fine motor skills and coordination for object manipulation without the system. These findings reveal a promising role of BCI-FES as an alternative therapy for c-SCI patients which may reduce their disability and decrease the amount of assistance needed by this population in daily life.
Research Project Title: Automatic identification of rod and cone photoreceptors in high resolution retinal images of the living human eye

Student Presenter: Divya Krishnagiri

Faculty Mentor: Nathan Doble

Faculty Mentor Department: Optometry

Research Abstract: Adaptive optics scanning laser ophthalmoscopy (AO-SLO) allows researchers to visualize individual cones and rods in the human retina. While it is relatively straightforward to automatically detect the centers of all the cells, determining which is a cone or rod is challenging and prone to human error. The purpose of this work is to create an algorithm that can automatically differentiate cones from rods based on a combination of retinal image-based metrics. The first step is to identify all the cells in the high resolution AO-SLO image using an established method based on detecting local intensity maxima. For each identified cell, the following measurements are then made: 1) Intensity at the center of the cell; 2) cell-to-cell nearest neighbor spacing; and 3) slope of the average radial intensity profile from the center of the cell. Using an AO-SLO training image from 10° in the temporal retina, 1) mean center intensity was found to be larger for cones compared to rods (170 ± 69 vs. 101 ± 42 arb. units); 2) mean cell-to-cell spacing was 8.1 ± 1.3 µm for cones while 2.5 ± 0.4 µm for rods; and 3) mean slope of the radial profile (measured at r = 1.6 µm) was steeper for cones, 0.28 Âµm-1 (cones) vs. 0.10 Âµm-1 (rods). Of the three variables, cell-to-cell spacing provided the best single metric discrimination, though a weighted combination of all three metrics is being investigated to provide a more accurate and robust identification.

There are millions of rods and cones in the human retina, so automated identification algorithm for cones and rods is essential in the characterization of photoreceptor packing geometry in both healthy normal and disease cases such as age related macular degeneration (AMD) and retinitis pigmentosa (RP). Longer term challenges involve discriminating between cells in diseased retina, as cells undergo structural changes with the progression of disease, e.g., swelling, shortening and changes in reflectance.
INTRODUCTION: Modeling is an incredibly diverse scientific activity. In biology, physics, and many other fields, models are crucial for scientific progress. Broadly, models can be understood as fulfilling some kind of representational role by serving as theoretical analogues for real-world phenomena. Using models, scientists justify inferences about a range of target systems. In the philosophy of science, multiple attempts have been made to provide a unified account of theoretical modeling but many of these have excluded model organisms used in biology and other experimental fields.

OBJECTIVES: The objective was to understand and identify features of modeling across a range of scientific fields. The primary research question for this project was: what features of theoretical modeling are present in modeling with organisms?

METHODS: The method involved tracking what makes modeling unique across a range of scientific models. The process started with a mathematical model known as the Lotka-Volterra model, moving to a physical scale model of the San Francisco Bay Delta, and finally addressing the most controversial case: model organisms used in plant biology.

RESULTS: In the three examples of modeling, there is a unique feature that play an explanatory and epistemic role: model validation. Through empirical and theoretical practices, scientists can verify the model-to-target relationship and justify theoretical claims from the model.

CONCLUSIONS: Focusing on the model-to-target relationship captures the increasingly sophisticated uses of model organisms. Model validation is a feature of modeling that accurately represents current scientific practices and is a necessary component of effective modeling.
Research Project Title: Intracranial-focused ultrasound surgery: treatment optimization and predicting treatment efficiency

Student Presenter: Dylan Beam

Faculty Mentor: Vibhor Krishna

Faculty Mentor Department: Neurosurgery

Research Abstract: Introduction/Background

Focused Ultrasound Surgery (FUS) is a noninvasive brain lesioning therapy used to treat Essential Tremor (ET) and Parkinsons Disease (PD). Patients are only allowed to be treated if their skull density ratio (SDR) is above a threshold value. This excludes a significant portion of patients from receiving FUS. This study aims to elucidate factors of treatment efficiency and optimization.

Methods

Anonymized head CT and MRI from 26 patients were analyzed using an open source treatment planning software, Kranion, and custom scripts in MATLAB. Two-sample t-tests were used to compare continuous variables and Pearson’s correlations were used to analyze correlation. Using the principles of ultrasound transmission and physics, the incident angle of simulated ultrasound beams and skull thickness values were combined to create a metric to estimate the proportion of power that penetrated through the skull (penetration metric). SDR, penetration metric and power were used as covariates in mixed-effects linear models to predict the average temperature rise at the focal point of each treatment.

Results

While the gender of the patient, hemisphere, and ablation target had no effect, the type of filter used to create the CT image had a significant effect on the SDR calculation. Elements on the contralateral side of the hemisphere being targeted were more likely to contribute ultrasound waves with incident angles < 20 degrees and therefore transmit more energy through the skull. The newly created penetration metric effectively predicted the temperature rise in 75% of 125 trials within 5 degrees Celsius.

Conclusions

It is crucial that the appropriate bone filter be used for CT reconstruction for calculating SDR. The distribution of effective elements in a transducer changes based on the targeted region in the brain. The newly constructed penetration metric can effectively predict the temperature rise at the ablation target.
Research Project Title: Mental illness in Tanzania: understanding the impact of history and culture on suicide

Student Presenter: Amber Moore

Faculty Mentor: Thomas McDow

Faculty Mentor Department: History

Research Abstract: INTRODUCTION: Tanzania is currently ranked #7 globally in number of deaths by suicide with a rate of approximately 24.9 out of 100,000 people. To date, however, only a few studies have been conducted in Tanzania regarding mental health generally, and virtually no studies that try to understand social stigma associated with mental illnesses. This study was conducted in Iringa, the district capital of a rural region in the southern highlands of Tanzania.

METHODS: This research analyzes the stigma associated with mental illnesses through the perspectives of Tanzanians in rural areas. The findings are based on in-country interviews with 15 individuals that represented a multitude of ages, education levels, and geographical locations. Each interview consisted of a series of questions including perceptions and symptoms of depression, treatment and care options, and the presence of stigma in media. Interviews revealed specific understandings of depression and regionally and culturally specific associations with suicide.

RESULTS: Analysis of interviews has shown that informants had consistent descriptions of depression symptoms, including: talking to oneself, acting violently, crying, and stealing. These descriptions are consistent with several forms of mental illness. Talking and singing to oneself relates to psychotic disorders, like schizophrenia. Stealing is a symptom of substance use, as people believe they must steal to pay for illicit drugs. In addition to perceptions, results have also indicated that men are more susceptible to suicide in Iringa, especially after traumatic or embarrassing events.

CONCLUSIONS: The relationship between shame and suicide amongst men in Iringa may be explained by historical events in the region, particularly the suicide of Chief Mkwawa to avoid capture during German conquests in 1898. As a highly respected and well-known military leader, his death normalized and encouraged committing suicide as opposed to living with embarrassment. Based on the findings of this study, there is a significant need for specialized mental health education that accounts for the cultural and historical values of the area to most effectively treat individuals.
Research Project Title: Clinical phenotypes in patients with concurrent multiple sclerosis and intracranial lipomas: case series

Student Presenter: Thomas Mengesha

Faculty Mentor: Jaime Imitola

Faculty Mentor Department: Neurology

Research Abstract: Introduction

The understanding of disease progression and neurodegeneration in Multiple Sclerosis is an area of active investigation; we posit that finding rare neurological and neurodegenerative phenotypes in MS patients may show unique features that can shed light on unique mechanisms of progression. We call these orphan phenotypes in MS. Intracranial lipomas are very rare congenital lesions of mesenchymal origin that represent 0.1-0.5% of all intracranial tumors. Most cases are asymptomatic pericallosal lesions arising from anomalous differentiation of the primitive meninges during development.

The goal of the study is to present the clinical, imaging, and neurovestibular characteristics of three unrelated cases of MS patients with intracranial lipomas. We discuss the challenges in management and the relevance of these rare MS phenotypes to understand disease progression in MS.

Methods of Materials

Clinical, MRI imaging, and neurotological data were collected from three patients that suggested involvement in pathways related with lipoma localization, under IRB approval.

Results

Lipomas are asymptomatic in many patients, however in our case series, all the patients presented severe burden of MS cognitive symptoms and neurovestibular dysfunction despite the low burden of disease activity. One patient presented a lipoma adjacent to the hypoplastic corpus callosum. Another patient presented a lipoma that was overlying the superior aspect of the cerebellar vermis. This was also presented with server ataxia, worsening tremors in bilateral upper extremities and nystagmus. A third patient presented a lipoma in the right cerebellopontine angle with progressive gait instability and ataxia. Furthermore, an exam of this patient revealed a worsening tremor thought to be of cerebellar origin. All patients displayed progressive symptoms consistent with progressive MS.

Conclusion

Lipomas are asymptomatic, however in our case study all three patients presented severe burden of MS symptoms despite the low burden of disease activity, some with atrophy and important burden of lesions. We postulate that the location of lipomas and contents may participate in the disease process in these patients.
Research Project Title: Recognition-induced forgetting of statements

Student Presenter: Samantha Stallkamp

Faculty Mentor: Maxcey No

Faculty Mentor Department: Ashleigh

Research Abstract: A negative consequence of accessing information in memory is the forgetting of other related information held in memory. This has been shown using single words (e.g., remembering that “France” was on a list leads to forgetting that “Germany” was on the list) and isolated pictures (e.g., recognizing that a blue spotted vase was shown earlier increases the forgetting of an orange striped vase). Here we asked whether this recognition-induced forgetting operates over more complex stimuli. We presented subjects with a list of fabricated student evaluations of instruction describing a fictitious professor, Dr. Jones. Half the statements were positive (e.g., “They gave good examples of real life applications of material”) and the remaining were negative (e.g., “Falls behind and then tries to cram information in a very short amount of time”). We asked whether practice recognizing positive statements from the list led to the forgetting of the non-practiced positive statements. We also asked if practice recognizing negative statements led to the forgetting of the non-practiced negative statements.

We found that when subjects practiced recognizing positive statements, this induced the forgetting of other positive statements. However, recognizing negative statements did not lead to the forgetting of negative statements. These results demonstrate that recognition-induced forgetting operates over more complex stimuli than previously employed in this paradigm. This data extends the boundaries of real-world circumstances that are vulnerable to this forgetting effect and also reveals a role of emotional arousal in the immunity to forgetting. Specifically, we were unable to induce the forgetting of negative comments, consistent with existing evidence that negative information is more memorable than positive information. We discuss the implications of induced forgetting of evaluative statements in fields like academia and the legal system.
Research Project Title: The teleology of trauma: how haruki murakami shapes narratives and their methods in creating and understanding trauma

Student Presenter: Noah Blacker

Faculty Mentor: Amy Shuman

Faculty Mentor Department: English

Research Abstract: Haruki Murakami (1949-) is a contemporary Japanese author whose works present our world on the cusp of embracing another where cats and sheep men can talk, where woman disappear, and where wells are as deep as unconsciousness. However, the majority of his works have a common theme throughout - trauma. The goal of this thesis is to accurately describe the trauma that can be found within many of Murakami's works, but also to understand Murakami's literary project and narrative theory via trauma. By conducting a close reading (formal identification of genre, consideration of narrative structure and methods) and analysis (psychoanalytic study of character, comparative theories of trauma) of Murakami's works, I show the trauma that is presented through the genre of magical realism in various ways including creating a different way to examine magical realism as a genre, and how the narrative structural elements of the texts such as narrators, tense, time, and the organization of the stories and framed narratives allude to trauma. In my analysis I move to combine genre and narrative structure in how the texts present expectations for us as readers that are never or are partially fulfilled with narrative closure creating trauma affect for readers. Finally, I take genre, structure, and closure into account resulting in an understanding of how we as readers interpret Murakami and trauma via a hermeneutic evaluation of his works in how we understand meaning and truth but also the meaning and truth of trauma. In my conclusion I propose that the common theme of trauma doesn't just permeate the worlds and characters Murakami creates, but it also encapsulates how the narratives are told, how they end, and how we interpret them.
Research Project Title: Refugee resettlement and NGO assistance: Refugees in Columbus

Student Presenter: Yuchen Huang

Faculty Mentor: Erin Lin

Faculty Mentor Department: Political Science

Research Abstract: Introduction: Refugee crisis is becoming an increasingly severe issue spreading in the international community. The paper here chose to research refugees in Columbus, Ohio, to examine the assistance the local NGOs provided to them. The refugees here are two groups, ones without assistance of NGO while the ones with assistance of NGO. I want to compare these two groups, to analyze the impacts of projects NGO provided. I hope the paper will can have more implications for the future development of NGO programs. The field work will take place in a local NGO, Community Resettlement Immigration Servicer Center (CRIS) and a local Somalian refugee community.

Methodology: Primary sources are Interviews and open-ended surveys. Secondary sources: Related articles found in libraries, UNHCR and other international organizations’ paper works. The self-sufficiency refugees are marked as B group and the refugees receiving assistance are marked as N group. Since I do the volunteering job at CRIS weekly, I can have access to interview refugees and officials there. I am going to ask a graduate student who is also doing the research on Somalian refugees in Columbus if I can go with her to do the field work.
Research Project Title: Post-migration challenges, family resources, and social support among Bhutanese-Nepali refugees: Results from a community needs assessment.

Student Presenter: Hannah Kayuha

Faculty Mentor: Jennifer Kue

Faculty Mentor Department: Public Health

Research Abstract: Over 15,000 Bhutanese-Nepali refugees have resettled in Columbus, Ohio since 2008. The majority of research on this community has focused on mental health and the rate of suicide among the Bhutanese. However, there is little known about post-migration living difficulties (PMLD) that Bhutanese-Nepali refugees face after resettlement.

Bilingual Nepali-speaking interviewers conducted a community needs assessment with Bhutanese-Nepali women and men, aged 18 years and older living in Columbus, OH. The questionnaire included topics of healthcare practices, cancer knowledge and screening behavior, mental health issues and preferences for mental health services, social support, family resources, and barriers to health/social services and resources. For the purpose of this study, secondary data analysis examined PMLD, social support, and family resources. Descriptive statistics (frequencies, t-test) were conducted using SPSS ver. 24.

A total of 201 participants were surveyed. More than half were men (51.7%) and 53.7% were between the ages of 25-44 years. More than 75% were on Medicare/Medicaid, 43.1% have a total family income of less than $15,000, and while over 50% are employed full-time, almost 35% are not working. The most commonly reported PMLD was communication/language difficulties with 54.2% of participants reporting a somewhat to a serious problem. Secondly, 40.3% reported a somewhat to a serious problem in difficulty adjusting to the weather/climate. Finally, 39% of participants reported being unable to find work and insufficient government help with welfare a somewhat to a serious problem. Regarding family resources, there is a significant difference between men and women in terms of monetary resources, t(197)= 1.12, p= 0.019. There is also a significant difference in perceived social support between men and women, t(197)= 1.30, p= 0.003.

Results from this study provide greater insight into the cultural and linguistic needs of Bhutanese-Nepali refugees who have recently resettled in Columbus. Language and communication is a major barrier to finding employment and resources. Despite these challenges, participants reported that they have strong social support, which may ease some of the burdens of resettlement. Future studies may want to examine ways to help maintain strong social networks in refugee communities to eliminate post-migration challenges.
Research Project Title: How has the United Kingdom responded to the HIV epidemic among women?

Student Presenter: Kenneth Kaple

Faculty Mentor: Tasleem Padamsee

Faculty Mentor Department: OSU College of Public Health - Division of Health Services Management and Policy

Research Abstract: Introduction/Background

Since the emergence of the HIV/AIDS in the United Kingdom, little attention has been provided to the socioeconomic and cultural dimensions of the disease, particularly among women. Women remain peripheral in the response to the HIV epidemic, with about 40 percent of the U.K.’s HIV cases among women, a large proportion (44 in every 1,000) of those cases occurring among black African women, and an estimated 22% of women with HIV remaining undiagnosed.

Methods

The goal of this project was to answer the question: “How has the United Kingdom responded to the HIV/AIDS epidemic among populations of diverse women?” To answer this question, I conducted an inductive qualitative analysis of informant data based on original interviews conducted with policymakers in the United Kingdom from 2005 to 2011.

Results

From these data, I found that in response to inequalities in HIV treatment and prevention in the U.K., organizations like the African Health Policy Network have attempted to address the socioeconomic and cultural barriers to treatment facing many African and migrant women living within the United Kingdom. Additionally, other initiatives to treat the HIV epidemic among women have focused on empowering women to take control of their sexuality by understanding the linkages between unsafe sex, injection drug use, teenage pregnancy, breastfeeding, and HIV transmission. Many policymakers and advocacy groups such as the National Support Team for Public Health Policy, the British HIV Association, and Positively U.K. have advocated for setting up sexual assault referral centers, supporting the implementation of sexual health strategies within HIV prevention, access to HIV testing, and other process-driven initiatives.

Conclusions

In conclusion, I found that despite increased initiatives to incorporate women into the HIV agenda, remaining issues - particularly the prevalence of HIV among African women and lack of clear recommendations for infant breastfeeding - reveal that the United Kingdom needs to further adjust its approach to the HIV epidemic among women.
Research Project Title: How did attitudes towards contraception from the Catholic Church impact the HIV epidemic in Iringa, Tanzania?

Student Presenter: Gabriella Leccese

Faculty Mentor: Thomas McDow

Faculty Mentor Department: History

Research Abstract: The Catholic Church has had a longstanding opposition towards the use of contraception because it prevents procreation. The church maintained this attitude world-wide throughout the 1980s and 1990s, even in the face of the burgeoning HIV epidemic and wide use of condoms as a preventative measure. Pope Benedict XVI, in 2005, stated that although HIV was a cruel epidemic, it could not be prevented by using contraception, further stigmatizing condom use for Catholics. Yet even as current Pope Francis acknowledged a place of condom use for disease prevention among Catholics, Tanzanian Catholics have insisted on more conservative practices (Zhou, 2009). This study focus on the Iringa region in Tanzania, with a high prevalence of HIV (9.1%, 2014) and practicing Catholicism (26.8%, 2016). This study is based on in-depth interviews with priests and Catholics university students in Iringa. Here we show that attitudes of parishioners and priests still reflected Pope Benedict’s original statements- in fact, contraception usage even as a method of prevention was considered morally abhorrent, demonstrating that conservative policy is still implemented by members of the Catholic Church. We found that even though HIV prevention campaigns have encouraged contraceptive use in the region since 1999, priests and parishioners report that contraceptive usage was not discussed by the church. While religious justifications were primary, both priests and students used popular misconceptions about condoms, such as the need for their refrigeration, to challenge their use. These findings demonstrate ongoing adherence in some religious communities to a set of beliefs that challenge HIV-prevention teachings and raise questions about what prevention techniques might be more acceptable to Catholics (Morgan, 2014).
Research Project Title: More than Babel: Iraqi women's narratives of migration and settlement

Student Presenter: Gretchen Klingler

Faculty Mentor: Jeffrey H. Cohen

Faculty Mentor Department: Anthropology

Research Abstract: Our paper explores how Iraqi women negotiate migration, settlement and their personal agency using an insecurity model; specifically, we define the insecurities that women face during each step of the migration process. Using ethnographic research methods to obtain qualitative data, Cohen and Klingler build upon Cohen and Sirkeciâ€™s model of migration and insecurity (2011). While migration and settlement vary in relation to an individualâ€™s status; status and agency are influenced by insecurities that are defined by real and imagined processes at points of origin and destination.

First, there is the complexity that movers confront as they decide to leave, including a model Klingler refers to as â€œdeath versus the potential of avoiding deathâ€; second, there are the challenges that face movers as they leave and as they are in transit to settlement; and third, the challenges that are associated with settlement. Once settled in the US these women face new multi-faceted hurdles they must navigate or overcome regarding the multiethnic settings that define their destinations in the US, as well as the difficulties associated with the unanticipated expectations that other immigrants, ethnic minorities and native born North American citizens carry as they meet. Using our work with Iraqi women who have settled in the US (around the bay area of California as well as central Ohio) we explore how they manage agency and negotiate status in the face of changing insecurities. We argue that decision making must always take account of the many challenges to be faced and negotiated.
Research Project Title: The rhetoric of world-building: challenges and offerings of the hybrid-world form

Student Presenter: Matthew Martello

Faculty Mentor: James Phelan

Faculty Mentor Department: English

Research Abstract: Fiction has the capacity to imitate reality, to drastically deviate from it, and to alter mere particulars, by turn offering the reader an interaction with a fictional world either similar to or different from the world in which she sits with the book. This research examines a variety of such interactions from a rhetorical perspective; that is, I’m interested in storyworlds (worlds evoked by narratives) as they’re constructed by authors for some purpose. I track the multilayered experience of storyworld immersion through seven literary narratives: Zadie Smith’s White Teeth, Salman Rushdie’s Haroun and the Sea of Stories, F. Scott Fitzgerald’s The Curious Case of Benjamin Button, Thomas Pynchon’s The Crying of Lot 49, Colson Whitehead’s Zone One, Ian McEwan’s Nutshell, and Bruce Sterling’s “Bicycle Repairman.” Each of these storyworlds exhibits a unique degree of difference from the actual world, and I use this variation in difference to construct a theoretical continuum on which every storyworld can be situated. The continuum runs from the primary world (the storyworld that is identical to the actual world in every important way) to the secondary world (the storyworld that is saliently and significantly different from the actual world) or, say, from historical fiction to hard fantasy. My general claim is that authors place storyworlds at certain points on the continuum in efforts to guide readers’ interpretive and experiential responses. From there I zoom in on what I call the hybrid world, the apparent primary world that cuts across its own realism with one or few impossible or extraordinary phenomena. This arrangement, I argue, provides a uniquely active and demanding reading experience. For if a story takes place in a fictive version of our world, yet it contains a phenomenon that our world deems impossible, we must work to understand how and why and to what end that phenomenon has happened in such world. By meeting the challenge to our understanding offered by these hybrid worlds, we sharpen our cognitive capacities; moreover, by attending to the ways hybrid worlds shed light on our actual world, we expand our knowledge of how to live in it. Â
Research Project Title: Incentive-based HIV prevention interventions - Iringa, Tanzania

Student Presenter: Shannon Phillips

Faculty Mentor: Jesse Kwiek

Faculty Mentor Department: Microbiology

Research Abstract: Introduction:

In Tanzania women are disproportionately affected by HIV. In 2011, HIV prevalence among women was 6.2% compared to 3.8% of men, according to the Tanzania HIV/AIDS and Malaria Indicator Survey; this is due, in part, to a lack of economic opportunity. Incentive-based interventions, which distribute monetary supplements contingent upon preventative health-related behavior, have the potential to reduce their risk for HIV. Incentive-based interventions are a relatively new HIV prevention strategy, and the best way to implement these interventions is currently unknown.

Methods:

The goal of this project was to use personal interviews and existing literature to explore multiple perspectives of incentive-based HIV programs implemented in Iringa. Two local programs were studied, Sauti (voice, in Swahili) and TAHEA (Tanzania Home Economics Association). Sauti, an NGO USDAID-funded organization that promotes HIV testing, counseling, and linkage to appropriate HIV services, has recently partnered with TAHEA, a local professional organization, to organize and promote community savings and loans groups. These groups comprise of 20-25 young women who each contribute to a group fund, which is then used to provide loans to group members.

Results:

Through a series of interviews, a few common themes/challenges emerged that better describe incentive-based HIV interventions in Iringa which can improve how they are implemented in the future. Among the eleven group members who were interviewed, most had success with starting a small business and have become financially independent. The women interviewed also benefited from the social support created from these groups. The major complaint among the interviewees was the need for the government or a financial institution to help contribute to their funds.

Conclusions:

This feedback from the beneficiaries will provide valuable information for how incentive-based HIV interventions can be implemented in the future, making sure that these programs are tailored specially for their target audience. These findings align with other studies to further provide evidence that incentive-based interventions are a promising strategy in a holistic approach to HIV prevention.
Research Project Title: Mobilizing linguistic resources for diabetes management in Latino families

Student Presenter: Jordan Royster

Faculty Mentor: Glenn Martinez

Faculty Mentor Department: Professor of Hispanic Linguistics, Director of CLLC Faculty

Research Abstract: Spanish-speakers are at a higher risk for being diagnosed with type 2 diabetes mellitus. Previous studies have been conducted on health outcomes in relationship to familismo on patients with diabetes. Familismo is a cultural value, which emphasizes the needs of one’s nuclear or extended family over one’s personal needs. However, this project aimed to focus on the process of familismo and the effect of trans-lingual interactions on the patient’s experience of diabetes disease management. Previous research has not been conducted to examine the interplay of disease management and cultural values. Data was collected through case studies with diabetic, Spanish-speakers in Ohio and members of their household. A content analysis was performed from data collected from the interviews based on deductive and inductive identified themes. This study elucidates the value of cultural influences on Spanish-speaking diabetic patients and thus enabling better care by leveraging resources in the community.
Research Project Title: Perceived quality of life with emphasis on social support in adaptive rowers

Student Presenter: Sarah Stark

Faculty Mentor: Jill Clutter

Faculty Mentor Department: Health Sciences

Research Abstract: Disabilities across the vast spectrum are recognized worldwide, and among those with physical and mental disabilities exists a high prevalence of sedentary lifestyles, predisposing them to an array of diseases and conditions. Participating in a competitive or noncompetitive sport can serve as a way to gain a sense of independence and purpose, as well as engage in regular exercise, assisting in the maintenance of overall health. Health is just one of the many domains that makes up an individual’s quality of life (QOL), or perceived general well-being. The specific domain being analyzed in this study is social support, referring to the physical, emotional or spiritual support given by peers or loved ones. Athletes were asked questions regarding external supports and motivational factors involved in the persistence of rowing participation, in hopes of identifying common themes across their responses.

This study used a sample of approximately 10 adaptive rowing athletes from the Greater Columbus Rowing Association club team. Members gave consent to participate before any data was collected. Once their consent forms were completed and retrieved, subjects were interviewed in a private space to ensure that their responses remained confidential; interviews were audio recorded, allowing for the data to be securely stored and qualitatively analyzed.

Initial analyses suggest that health maintenance and social opportunities are primary motivational factors, with social support from loved ones, peers and mentors proving beneficial and appreciated in the athletes’ participation in adaptive rowing. Further studies are necessary to determine the correlation between social support and success within an adaptive sport.
Research Project Title: The perspective of Tanzanian physicians on their positions in global health

Student Presenter: Nanditha Ravichandran

Faculty Mentor: Thomas McDow

Faculty Mentor Department: History

Research Abstract: How do Tanzanian physicians view their positions in the global fight against HIV? In the context of the HIV epidemic, Africa became the land of opportunity for Western scientists investigating manifestations and possible cures for the virus. Foreign researchers and physicians sought to take advantage of the abundant patient population in countries like Tanzania, and this led to what one author has called "a scramble for Africa" among global health professionals. As Tanzania's largest donor, the United States alone has spent $107.96 million towards global health efforts there. Although the work of these foreign scientists, workers, and donors have been well documented and disseminated, that of their African counterparts is less well known. This research seeks to understand the perspective of Tanzanian clinicians and to detail how they view themselves as contributors to global health interventions through in-depth interviews. Understanding these perspectives can help improve relationship within global health between practitioners in resource-poor settings and organizations that enlist their help to achieve healthcare objectives. Better communication with on-the-ground health practitioners can improve patient outcomes, thereby increasing efficacy of global health interventions in place.
Research Project Title: Youth story telling through journaling: the power of words & pictures in learning

Student Presenter: Ellen Williams

Faculty Mentor: Dawn Anderson-Butcher

Faculty Mentor Department: Social Work

Research Abstract: Sport-based youth development (PYD) programs contribute to improving protective factors, reducing risk factors, and promoting healthy development among youth participants (Gavin, et al., 2010). One sport-based PYD program, LiFEsports, serves over 600 youth annually through a 19-day Summer Camp. LiFEsports is designed to improve social and athletic competencies of youth by teaching Self-Control, Effort, Teamwork, and Social Responsibility (i.e. SETS). Past LiFEsports research has used various methodologies to demonstrate positive youth outcomes resulting from participation. This study aims to deepen our understanding of these positive outcomes and processes through qualitative research examining how youth understand, learn about, and apply SETS by exploring content presented in their youth journals. Specifically, 275 youth journals were randomly selected of which 235 were examined on the following elements: 1) self-reflective processing, 2) degree of reflection, and 3) youth understanding of SETS through word choice, pictures, and themes. A coding rubric utilizing both the Boud (1985) and Mezirow (1991) models of assessing self-reflections evaluated the overall youth reflective processing. Additionally, NVivo Software was used to examine youth understanding of SETS and to code for word choice and the associated themes. When organized into similar age groups (i.e. 9-10, 11-12, and 13-14), results display commonalities and differences in word usages, pictures, and themes across age groups. In addition, findings indicate that youth who score higher on the degree of self-reflection also display a greater understanding of SETS, as well as utilize an advanced level of words and themes when taking into account age. Notably, the study suggests that the presence of higher levels of self-reflective elements lead to a greater understanding of SETS and an increased transfer of social skills outside of LiFEsports Camp. Youth entries in their journals suggest LiFEsports is a groundbreaking model which uses sport to positively influence youth outcomes.
Research Project Title: Religiosity and restorative justice in Rwanda

Student Presenter: Jamie Wise

Faculty Mentor: Hollie Nyseth Brehm

Faculty Mentor Department: Sociology

Research Abstract: One of the most pressing challenges during the recovery from mass violence is designing a transitional justice process that effectively provides punishment to perpetrators, consolation to survivors, and healing to the nation. After the 1994 Genocide Against the Tutsi, the Rwandan government revived and modernized a community-based form of justice called the Gacaca courts, during which genocide perpetrators were incentivized to confess their crimes and survivors were encouraged to forgive. Although religion is an important aspect of Rwandan society, few scholars have investigated the impact of religiosity on the Gacaca courts as a means of restorative justice. This study consequently examines the contribution of spiritual attitudes, religious beliefs, and church institutions to the context of Gacaca. Particularly, it focuses on understanding the influence of religious teachings about forgiveness and confession on participation in Gacaca and in the broader national reconciliation process. This study draws from a collection of approximately 100 survivor interviews and testimonies, which reference religion during discussions of the genocide or its aftermath. Interviews were conducted with individuals who are actively involved in religious communities in Rwanda, as well as with defendants, witnesses, and judges who participated in Gacaca. Qualitative analysis of pertinent themes addressed during these interviews will contribute to knowledge about the relationship between religion and coping with mass violence, both on individual and community levels. Better understanding the influence of religion in the context of Gacaca can enable the development of suitable transitional justice mechanisms that successfully integrate culturally-specific factors following incidents of mass violence.
Research Project Title: The evolution of health promotion in the Iringa region and its effectiveness

Student Presenter: Reginald Woods

Faculty Mentor: Jesse Kwiek

Faculty Mentor Department: Microbiology

Research Abstract: Health promotion is the process of enabling people to have more control over their health including individual, social and environmental interventions. Previous studies have shown that community-based health education and access programs have become more prevalent throughout the last 2 decades. Although programming has increased, the base knowledge of behavior change methods and strategies that are essential for those community-based health education programs to be effective has not advanced. The gap between the output of programming and the stagnancy of individual knowledge can be reconciled by social marketing and health communication. In Tanzania, more specifically Iringa, we should know more about the evolution of social marketing and health communication, as well as how they may influence health promotion and health outcomes. The purpose of this study is to shows the evolution of HIV prevention based social marketing and the interpretations of this imagery from local Tanzanians. We collected 35 photos posted in Iringa, as well posters archived online. Our sample was then analyzed under a systematic inspection. To get the local perception of the social marketing and health communication, we conducted 15 minute interviews with 10 students at Ruaha Catholic University. This study found that the audiences targeted, individuals depicted, and the use of the acronym HIV in advertisements changed after the introduction of antiretroviral therapy to the general population in the region in around 2003. Our qualitative data from the interviews conducted suggests the social marketing and health communication efforts affected our sample of students differently. This study is a model for larger studies that combine the evolution of health communication and social marketing to understand how to better implement community-based HIV programming. Previous studies have shown on a smaller scale that the advancements of programming leads to greater participants reached. This study provides how the marketing of community-based HIV programming has evolved and affected students in Iringa. This is relevant for such developments in decreasing HIV transmission and acquisition in the region.
Research Project Title: Language and language impressions in Hong Kong: A geolinguistic exploration

Student Presenter: Hannah Shaheen Mosiniak

Faculty Mentor: Marjorie Chan

Faculty Mentor Department: Department of East Asian Languages and Literatures

Research Abstract: This study examines the geographic relationship between language, education, and income in Hong Kong. A 2005 study by Mee-Ling Lai found that high school students in Hong Kong perceive English speakers as wealthy and educated. This study seeks to determine if these perceptions of language speakers have a basis in real trends, and if those trends are geographic. Language (Cantonese, English, and Putonghua), income, and education data were analyzed for correlations by district and tested for spatial autocorrelation. A strong, positive correlation of 0.982 exists between the percentage of the population earning more than HK$30,000 per month and rates of English spoken by district (t0.05, 16= 20.894, p<0.001). Likewise, percentages of the population with a university degree and rates of English spoken by district have a strong positive correlation of 0.957 (s= 42, p<0.001). Bivariante choropleth maps of the data show direct correlations. These findings indicate that a spatial correlation between language, income, and education exists and may influence the perception of language speakers in Hong Kong.
Research Project Title: Creating a moving history in the light of difference

Student Presenter: Erin Yen

Faculty Mentor: Daniel Roberts

Faculty Mentor Department: Dance

Research Abstract: If I started two dances from the same movement phrase, would the resulting pieces created be shaped around the intricacies of the community doing the moving? Or would the voice of my own history’s movement lead both works down the same exploration? I was, and remain, interested in how dancers’ diverse movement histories show up in contemporary choreography. I wanted to investigate how different bodies full of eclectic movement trainings work together, and affect one another to actively shape a collective moving history (a dance).

I began in separate, weekly-scheduled rehearsals with each cast, where I taught both Group A and Group B a set 1.5-minute movement phrase generated from my body. Through the developing weeks I leaned into each new creative journey. I tracked how the groups differentiated themselves over time as dancers layered their own embodied histories in the movement given. To document this process, I used the Laban systems of movement analysis, a system of notating movement akin to musical notation, I recorded movement phrases as they developed alongside the dancers, and I drew my own scribbles and sensations on page. I also asked dancers to fill out self-evaluations proceeding each rehearsal. All forms of documentation have provided many lenses and languages through which I have viewed these separate group dances’ evolutions.

Through these processes we have recognized each other as individually diverse bodies of work; we have built our own cohesive works reflective of the eclecticism we found in our created communities. We shared the weight of our present physicality to the community, and we learned how to be responsible for the continued safety of others’ weight as they shared. We together learned how to better negotiate the space between our different movement trainings while moving forward to create a history of our own. In a space left open to acknowledging the intricacies of our diverse humanity, we found a way to agree as we allowed our differences to remain in conversation.
Research Project Title: Writing through adolescence: transition and transformation in diary-like writing within young adult literature

Student Presenter: Maggie Brim

Faculty Mentor: Rachel Rickard

Faculty Mentor Department: Teaching and Learning

Research Abstract: Background

Adolescence is often defined as a time of growth and change from childhood to adulthood. Psychologists and sociologists often characterize adolescence as a period of independence, turmoil, failures and victories. It is not a coincidence that diaries often start during times of transition in a person’s life and that many teens, both in the literary world and in reality, begin a diary to help them process the choppy waters of adolescence. Exploring, explaining, dissecting and persevering through these trials and moments help define the new world the young adult inhabits after periods of transitions.

Methods

YA diaries as a form have a substantial presence in young adult literature. Well-known examples include The Diary of Anne Frank or other historical diaries; however there are a plethora of other diaries and diary-like books., From Beatrice Sparks’s Go Ask Alice to Sherman Alexie’s The Absolutely True Diary of a Part Time Indian, diaries in young adult literature show levels of vulnerability in writing that provide permission to adolescents to do the same.

Through this research, I analyze two works of young adult literature that play with the diary form in some capacity. By looking at Laurie Halse Anderson’s classic, Speak, which can be read as a diary, and Regine Stokke’s, blog-turned-book, Regine’s Book, I explore the transformation a diary plays in the life of fictional and actual teens.

Results

Through examining nontraditional diaries, I hope to identify patterns in why the teen writers in these books begin to write diaries and, more importantly, to discover what they get out of their writing. Understanding the way characters within these books use diaries will allow for better understanding of the importance of the role writing outlets can play for adolescents.

Conclusions

Diary like writing has a much needed place within young adult literature because it allows for greater access to characters that relate to trials today's teens are facing. Representation is important, young adult literature in a diary format creates more representation in literature.
Research Project Title: Somali women's health project: understanding barriers to preventative health care among Somali immigrants in Columbus, Ohio

Student Presenter: Radhika Pandit

Faculty Mentor: Alison Norris

Faculty Mentor Department: College of Public Health Division of Epidemiology and College of Medicine Division of Infectious Diseases

Research Abstract: Civil war in Somalia has driven displaced Somalis to seek permanent asylum in the US since the early 1990s. In 2013, an estimated 45,000 Somali immigrants lived in Columbus, Ohio; the second largest settlement site in the US. Somali immigrants, particularly women, appear to have low levels of preventative health care utilization. Relatively little research has been carried out among African immigrants nationally or in Columbus, so specific barriers to healthcare utilization faced by Somali immigrants in Franklin County are not well-characterized.

Between July 2015 and November 2016, 10 in-depth qualitative interviews (IDIs) were conducted with healthcare providers who regularly care for Somali women in Columbus, with a goal of understanding providers’ perspectives into these barriers. These IDIs were transcribed, coded, and analyzed for key themes.

Two dominant themes emerged about barriers to healthcare. First, providers’ described significant language barriers. Although interpreters help, interpreters often have limited medical knowledge and cannot accurately communicate providers’ instructions to patients. In one instance, an interpreter failed to communicate a cancer diagnosis to a patient; the patient returned to the clinic expecting an X-ray, instead of the true treatment of chemotherapy. Language barriers between Somali patients and healthcare providers impair doctor-patient relationships and reduce the quality of care.

Secondly, cultural and religious differences create obstacles to high quality care. Many unmarried women are reluctant to discuss sexual health, due to the highly taboo nature of the subject. Many pregnant women strongly resist delivering via Caesarean section, regardless of their providers’ recommendations, due to fear of harming the baby. Providers who do not adapt their approaches to address these cultural norms may fail to connect with their Somali patients, leading to distrust of the healthcare system.

Low utilization of preventative reproductive healthcare services has enduring repercussions, particularly for women, and also impacts their families and community. Securing the health of the sizable Somali immigrant population is critical to providers and policy makers. Research about Somali women’s access to healthcare can guide culturally-engaged, evidence-based programs to increase access to care and improve reproductive health outcomes.
Research Project Title: The funeral industry with Jessica Mitford and the Caitlin Doughty

Student Presenter: Emily Boes

Faculty Mentor: Jolie Braun

Faculty Mentor Department: Special Collections

Research Abstract: “The Funeral Industry with Jessica Mitford and the Caitlin Doughty” revolves around author and freethinker Jessica Mitford and how her views on death and the American funeral industry have influenced modern cultural perceptions of death. Mitford was born to an aristocratic English family before eventually moving to the States and marrying lawyer Robert Treuhaft. She joined the Communist Party, fought for civil rights, and wrote the best-selling 1963 exposé on the funeral industry, The American Way of Death. Using this book, along with its sequel, The American Way of Death Revisited, I am comparing Mitford’s passionate views on the American funeral industry with how practices have changed in modern times.

I am using Caitlin Doughty’s 2014 piece, Smoke Gets in Your Eyes, as a supplement to Mitford’s books. Doughty’s autobiography features her time as a young woman newly employed as a crematory operator in Oakland, California. Both Mitford and Doughty believe that the American public in general is ignorant in the ways of death, but whereas Mitford focuses on the suspicious selling tactics of funeral directors, Doughty specializes in the public’s death-denying demeanor.

The two authors speak from experience in working with funeral homes, although they speak from different ends of the funeral process: the consumer and the worker providing the service. They agree that the American funeral industry needs to change, but they disagree on how. My goal is to reconcile the merits of their different opinions and explore how Mitford may have sparked changes in the funeral industry since the 1960s.
Research Project Title: Preaching vs. speaking: an analysis of the sermons and positionality of afro-sanctified women preachers

Student Presenter: Oyindamola Bola

Faculty Mentor: Korie Edwards

Faculty Mentor Department: Sociology

Research Abstract: Scholars have shown that there exists a relationship between the content and structure of sermons and the identity of the preacher. Unlike previous studies, my research explores this relationship solely among Afro-Sanctified women preachers. I use open-ended interviews and content analyses to examine common life experiences and beliefs among black women preachers, as well as dominant themes and structures within their sermons. Thus, I ask within Sanctified women-preaching-spaces (a) how do preachers assemble sermons? And (b) what experiences arise from being an Afro-Sanctified woman preacher? Preliminary analyses (four interviews and twelve sermons) reveal similar experiences among the women, such as teaching biblical classes and a struggle to accept the “call” to preach. While patterns in sermon topics and structures also emerged, such as encouraging educational attainment, emulating Christ, popular culture references, and biblical passages. I ask these questions as it is valuable for sociology to investigate the actions of marginalized people who are given the platform to speak. Ultimately, I will collect twenty sermons (two from each preacher) and interview ten Sanctified formal (head pastors) and informal (non-head pastors) ministers in Columbus, Ohio. My research expands sociological research by showing yet another way marginalization affects African American women via an investigation of race, gender, class, and religiosity.
Research Project Title: Nuggets of truth and the creative writing process

Student Presenter: Alejandra Timmins

Faculty Mentor: William White

Faculty Mentor Department: English

Research Abstract: In narrative writing, we split genres based on truth: fiction or non-fiction. In the world of fiction, we think that the author has free reign to decide how the world of the story works and whether laws of physics even apply there. However, in fictitious stories, the author must always keep truth in mind. This truth is not factual, but rather it is the emotional honesty of the piece. For my honors thesis, I worked on a collection of short stories that explored the theme of motherhood in different contexts. The stories are different in many aspects: one short story looks at the tension between a wealthy matriarch and her middle-aged son while another is about a young girl who struggles to comply to her mother’s standard of beauty. Despite their differences, throughout them all is an attempt to scratch the surface of the emotional truths below the surface of relationships between mothers and their children. In the creative writing process, one of the biggest struggles is to know when or how to communicate these truths. The timing and demonstration of these moments drastically changes the way a reader interacts with the work, and whether or not they choose to believe these truths.
Research Project Title: The Alsatian connection: Preserving the cultural heritage of "The Little Alsace of Texas"

Student Presenter: Troy Weider

Faculty Mentor: Jennifer Willging

Faculty Mentor Department: French

Research Abstract: The rural Texan community of Castroville was founded in September 1844 by Henri Castro and a few dozen European colonists. The majority of these immigrants were from the French border region of Alsace, which had long been fought over by the French and the Germans. These Alsatians possessed their own unique regional culture that was the product of this complicated history, and while they were French citizens, their language, cuisine, architecture, and customs were Germanic in origin. This community, while less than 30 miles west from San Antonio, remained very isolated for one hundred years and they preserved the language and culture of their homeland. During this period, you were more likely to hear Alsatian than English in Castroville, but two World Wars and a number of sociocultural factors led to the rapid decline of Texas Alsatian. After years of irreversible linguistic decline, local activists attempted to revive the Alsatian culture of the town. In the 1970's, a series of exchanges and partnerships between the "Little Alsace of Texas" and Alsace, France were initiated, and a cultural renaissance ensued. Numerous heritage associations were founded, many old Texas Alsatian buildings were restored, and old recipes and traditions were reintroduced. While these efforts have managed to keep the culture alive, language use in the region is continuing its rapid decline. Today few people can speak Alsatian and this once dominant group feels that its influence in the town is declining, as 'outsiders' are moving in and San Antonio continues its rapid expansion westward. Current identity politics play a major role in a town trying to preserve its foreign heritage while receiving an influx of new Mexican and American residents. Castroville has been changing for decades, but globalization and an aging population of Alsatian speakers are threatening the future of this isolated community. Within the next generation, the Alsatian language will die out in Castroville, but the Texas Alsatian culture of the community will persist. This study examines how culture can survive after language death, and how this is not the last generation of Alsatian cowboys in Texas.
Research Project Title: Tune in and let go: tracking movement, sensitivity, and catharsis in the body

Student Presenter: Calder White

Faculty Mentor: Norah Zuniga-Shaw

Faculty Mentor Department: ACCAD/Dance

Research Abstract: For my Senior Distinction Project in Dance, I am researching catharsis in the body and artistic means of expressing sensitivity and care toward self and others. Emerging from my interest in recent political events, social justice, and group dance improvisation, I am interested in representing how sensitivity can be nurtured on an individual level, between individuals, within communities, and across real and perceived borders. Using these themes, I choreographed a durational group dance that was performed in the rotunda of Sullivant Hall in December of 2017 and a solo that will be performed at the American College Dance Association conference at Ohio University as well as in the Motion Lab at OSU this March. I am interested in how we sense what we are doing and feeling on the surface and internally, and how these subtle shifts of state can signal progression towards larger personal and shared goals. In these efforts, the theme of catharsis arises in my work from my awareness of the effect of sociopolitical tension on bodies and our emotions. I am curious about how the stages of catharsis— an implied past or present tension preceding a current or eventual release— can occur in the musculature of the body, in the atmosphere of a dance work, in the relationships created between performers and for the audience in the act of viewing.
Research Project Title: How South Korean pop music (Kpop) has redefined Korean masculinity

Student Presenter: Kyle Williams

Faculty Mentor: Phil Ho Kim

Faculty Mentor Department: Department of East Asian Languages and Literature

Research Abstract: South Korean pop music (Kpop) has been the quintessential driving force for gender liberalization in South Korea since 1996. The performers over the past two decades have redefined the idea of what "masculinity" is by wearing makeup, wearing bright and colorful clothes, and having traditionally "feminine" body language. Throughout my research, I examine how South Korean music and society prior to the countries economic liberalization in the late 1980s was traditional and conservative. The exposure to western media created the very first Kpop bands and throughout the decades the music genre has developed into a cultural staple of South Korea. Throughout the next twenty years, these boy bands have given Korean millennials an opportunity to see a new perspective on male gender. The acceptance of gender bending amongst Korean youth also coincides with the growing acceptance of homosexuality. According to the Pew Research center, 71% of Korean millennials support LGBT rights. My research attributes this small victory for the Korean LGBT community to the success of Kpop and the performers abilities to redefine to a generation what being a man means.
Research Project Title: EMEPO- A novel therapeutic approach for heart disease

Student Presenter: Eaman Abay

Faculty Mentor: Mark Ziolo

Faculty Mentor Department: Physiology and Cell Biology

Research Abstract: Heart disease is the leading cause of death in the US and around the world. Consequently, there is a high demand for novel therapeutics to treat the myriad of cardiomyopathies. These diseased hearts generally have high oxidative stress, which is an increase in reactive oxygen species (ROS) levels. Unfortunately, clinical trials using only antioxidants failed. In addition to the oxidative stress, there are also reduced nitric oxide (NO) levels. This suggests that one mechanism of heart disease is through the nitroso-redox imbalance (increased ROS, decreased NO) in the heart. We synthesized a novel drug 2-(2-ethoxy-2-oxoethyl)-2-(ethoxycarbonyl)-3,4-dihydro-2H-pyrrole 1-oxide (EMEPO), which restores the nitroso-redox balance by decreasing ROS while releasing NO. In this study, we tested EMEPO’s potential therapeutic effect on heart function in a murine model of heart disease. To test this, wild type mice were given myocardial infarction (MI) at 3 months which is a common ischemic model for heart disease. Three days post MI they were injected with either EMEPO, Allopurinol (an anti-oxidant), or left untreated. Pressure-volume (PV) loop analysis was used to measure heart function under electrical stimulation (rates of pressure development) and under induced stress with adrenergic stimulation (Dobutamine). Compared to the other groups, mice injected with EMEPO had significantly better functional response during stimulation as measured by maximum (dP/dtmax) and minimum (dP/dtmin) pressure at various heart rates, and ventricular relaxation (Tau). Similarly, the mice also had a higher beta-adrenergic response when stimulated (as shown by the significantly higher dP/dtmax and Tau values), meaning the mice had an improved response to stress through contractile force. The infarcted mice showed notably increased heart function in vivo when treated with EMEPO. Restoring nitroso-redox balance via this treatment is significantly better than just the use of anti-oxidants. Thus, EMEPO may provide a comprehensive strategy for treating patients with heart disease.
Research Project Title: Associations among post-operative pain, narcotic administration, and maternal anxiety in infants with congenital heart disease

Student Presenter: Jacob Bailey

Faculty Mentor: Tondi Harrison

Faculty Mentor Department: College of Nursing

Research Abstract: Introduction/Background

Infants with complex congenital heart disease (CCHD) undergo surgical interventions in the first weeks of life and may experience significant post-operative pain. Parental anxiety may affect infant pain, and mothers of infants with CCHD have increased anxiety. Our purpose was to examine relationships among infant postoperative pain, narcotic administration, and maternal anxiety.

Methods

This study examined a secondary aim of a two-group randomized controlled trial testing a 30-minute massage intervention in 60 infants undergoing their first cardiac surgery before age 12 months. Measures included pain (Face, Legs, Activity, Cry, Consolability), maternal anxiety (State-Trait Anxiety Inventory), average daily narcotic administration, disease severity (Risk Adjustment for Cardiac Surgery), and infant sex. Data were analyzed with group-based trajectory modeling for pain scores and narcotics administration. Resultant classifications were outcome variables in logistic regression models with predictor variables maternal anxiety, group, disease severity, and infant sex.

Results

The 2-class pain trajectory model revealed 83.21% of infants had stable low pain scores (Class 1), and 16.79% had initial high scores that gradually dropped (Class 2). Infants likely to be in Class 2 had mothers with higher anxiety (OR=5.34, CI=0.96,29.72), received massages (3.25, CI=0.53,20.08), and were male (OR=0.70, CI=0.14,3.55). The 2-class narcotic model revealed 85.00% sample had a low, stable trajectory (Class 1) and 15.00% had an inverted-U trajectory (Class 2). Infants likely to be in Class 2 had mothers with higher maternal anxiety (OR=1.59, CI=0.48,5.32), received massages (OR=3.82, CI=0.67,21.57), and had more severe disease (OR=3.80, CI=1.09,13.31).

Conclusions

Although firm conclusions cannot be drawn due to large confidence intervals, findings suggest that maternal anxiety may be associated with both pain and narcotic administration. Interventions to reduce parental anxiety are a potential approach to reducing infant post-operative pain. Additional research is needed to examine associations of infant pain with maternal anxiety as well as massage, disease severity, and infant characteristics.
Research Project Title: GlcNAc conjugated atorvastatin with enhanced water solubility and cellular internalization

Student Presenter: Justin Jiang

Faculty Mentor: Yizhou Dong

Faculty Mentor Department: College of Pharmacy

Research Abstract: Atorvastatin, also known by its trade name Lipitor, is a drug used to treat high lipid levels and prevent certain cardiovascular diseases. Although atorvastatin is still widely prescribed today, its bioavailability is rather low, which can be contributed to its poor water solubility, dissolution rate, and membrane permeability. Therefore, to improve the effectiveness of atorvastatin, we conjugated it with a targeting ligand, N-acetylglucosamine, that previous studies identified as having strong affinity for hepatic receptors. We synthesized two ligand-drug conjugates with differing pH sensitivities and quantified both their solubility and membrane permeability via UV-Vis spectra. Furthermore, we performed a previously published method to measure the low-density lipoprotein receptor expression as an indication of atorvastatin’s mechanism of action. Through these studies, we concluded that both conjugates significantly improved cellular uptake and solubility of atorvastatin while maintaining comparable levels of biological activity. Therefore, our ligand-conjugates offer a promising model for improving the cell specificity of atorvastatin.
Research Project Title: A continued analysis of the cost-effectiveness regarding inhaled pulmonary vasodilator therapy in adults

Student Presenter: Andrea Gerstner

Faculty Mentor: Georgianna Sergakis

Faculty Mentor Department: Respiratory therapy

Research Abstract: ABSTRACT: In the adult population, the inhaled pulmonary vasodilator, epoprostenol (iEPO), is readily used in conjunction with other therapies to help treat several different clinical scenarios. The inhaled pulmonary vasodilator, epoprostenol, is FDA approved to treat pulmonary hypertension but is also used in other off label indications such as hypoxemia and ARDS. This agent improves oxygenation, inhibits platelet aggregation, reduces inflammation, and decreases pulmonary vascular resistance. Currently at our institution there is no criterion in place for the initiation, weaning and discontinuation of iEPO on patients for which this drug is used in patients, other than those with pulmonary hypertension. Currently, there are gaps in the literature that provide initiation, weaning and discontinuation criteria for hospitals that use iEPO for diagnoses such as hypoxemia. The purpose of this study is to examine retrospective charting on patients for which iEPO was initiated, to determine effectiveness of oxygenation and to determine the utility of a protocol for initiation, weaning and discontinuation of iEPO. Our aims were to answer:

1. What are the current practices for using IEPO for hypoxemia at our institution?
2. What is the average time it currently takes to wean iEPO at The Ohio State Wexner Medical Center?
3. What are the cost-savings when applying an evidence-based protocol to use of inhaled epoprostenol for hypoxemia?

METHODS: Following IRB approval, a retrospective chart review will be conducted for all patients who were started on inhaled epoprostenol at the Ohio State University Wexner Medical Center (OSUWMC) in the year 2015-2017. The review will be completed in order to create an evidence-based protocol for initiation, weaning and discontinuation of inhaled epoprostenol. The studied population will be restricted to adult patients, specifically patients who are receiving iEPO for hypoxemia. The primary data points that will be recorded are the PaO2/FiO2 ratio, the oxygen index, the MAP and the patient’s SpO2. These four primary data points will be measured to conclude improvement in the patient’s oxygenation. The data points will be observed before the administration of inhaled epoprostenol and will be compared to the most recent values recorded after the medication was administered. Ventilator settings will also be recorded, along with the patient’s PEEP, FiO2, the mode of ventilation, duration of time on the ventilator, significant changes in the patient’s care, if the patient was on nitric oxide simultaneously, if the patient was placed in the prone position, and the patient’s outcome (mortality). Weaning strategies will also be described (whether or not the patient was suddenly or slowly weaned from the medication). The evidence-based protocol will be produced by observing trends in the data for which iEPO was initiated on patient’s with hypoxemia, which can be defined as a PaO2 of 50-60mmHg on an FiO2 of greater than 60%. Along with initiation of an evidence-based protocol, potential cost savings will also be examined.
RESULTS: By developing an evidence-based protocol, it is found that money can be saved at the hospital for the initiation, weaning and discontinuation of iEPO. Currently at our institution there is no protocol in place for the initiation, weaning and discontinuation or iEPO.

CONCLUSION: An evidence-based protocol should be used in place of the current practices at The Ohio State Wexner Medical Center for the initiation, weaning and discontinuation of iEPO.
Research Project Title: PRMT5 inhibitors in the re-expression of fetal hemoglobin

Student Presenter: Kaylin Kavanaugh

Faculty Mentor: Rosa Lapalombella

Faculty Mentor Department: Internal Medicine

Research Abstract: Sickle Cell Disease is a chronic blood disorder caused by a missense mutation where the 6th amino acid, glutamic acid, is replaced by valine. Symptoms of the disorder include anemia due to shorter cell life, pain episodes (known as crises) that last anywhere from a couple of hours to a few weeks, frequent infection, and permanent organ damage. Protein arginine methyltransferase 5, also known as PRMT5, is an enzyme that methylates histone arginine residues such as H3R8 or H4R3. Studies have shown patients with Hereditary Persistence of Fetal Hemoglobin (HPFH) experience continuous production of fetal hemoglobin (HbF) into adulthood. Sickle cell patients with HPFH (although a less common phenotype of Sickle Cell) see large reductions in symptoms. The overall aim of our specific research is to pharmacologically re-express HbF in order to replicate the re-expression of HbF found in S/HPFH patients, and therapeutically alleviate symptoms of the disorder. Previous work from our lab showed small molecule inhibitors of PRMT5 to be effective in re-expressing HbF in human cells. We hypothesized the experimental compounds PRT220 and EPZ015666, known PRMT5 inhibitors, will re-express HbF in a similar fashion. We tested compounds PRT220 and EPZ015666 by dosing them on HEL92.1.7 cell lines within a 72 hour period. Viability of cells was checked daily via trypan blue. After the 72 hour period, whole cell lysates were collected and run on an immunoblot. Of the two PRMT5 inhibitors, PRT220 showed a reduction in PRMT5 activity at histone H3R8 without affecting cell viability. Ultimately, further development of these compounds will lead to the expansion of clinical treatments of therapeutic alleviation of patients with Sickle Cell Disease.
Research Project Title: Non-invasive preclinical porcine maxillofacial model to study excessive scarring of the face following burn injury

Student Presenter: Douglas Guzior

Faculty Mentor: Sashwati Roy

Faculty Mentor Department: Surgery

Research Abstract: Background: Following burn injury, facial scarring is excessive wherein it is not comparable to scarring on other parts of the body. Facial burn leads to marked functional deficits including oral incompetence and facial abnormalities, along with impacts such as increase social, emotional, and psychological stress of the subject. This study was aimed at developing a robust preclinical model for maxillofacial burn injury with emphasis on non-invasive techniques, such as laser speckle imaging (LSI) to monitor blood flow as well as utilizing harmonic ultrasound doppler imaging (HUSD) to monitor wound depth, elasticity, and scar formation. Methods: Burn wounds were made using a gauged, electrically-powered burner that continuously measured instrument temperature, which then automatically increased power to the instrument to maintain a constant desired temperature. Up to 50% of the face and four distinct regions of the back were affected by severe 200°C burn wounds. Wound healing progression was monitored via non-invasive imaging such as laser speckle microperfusion imaging and harmonic ultrasound with Doppler (n=7 pigs). Results: Application of burns resulted in fourth degree burns (verified by CT imaging) with bone involvement leading to deficits such as contracture and excessive scarring. Contracture and scarring were evident as early as 56 days post-burn. Ectropion, eversion of the lower lip, and oral incompetence were also observed. Conclusion: This DOD funded study constitutes the first preclinical model to study burn injury in the face and underlying mechanisms.
Research Project Title: Exploring the antimicrobial activity of novel bacterial topoisomerase inhibitors

Student Presenter: Jacob Harris

Faculty Mentor: Dan Wozniak

Faculty Mentor Department: Microbiology

Research Abstract: Fluoroquinolones are a class of broad-spectrum antibiotics commonly used to treat a variety of bacterial infections. Their antimicrobial activity is due to their ability to inhibit the function of bacterial DNA gyrase proteins. DNA gyrases, also known as DNA topoisomerases, are enzymes that regulate the over-winding of the DNA which occurs during DNA replication. These enzymes are essential for the integrity of the genetic material during replication. However, despite the potency of this class of antibiotics, fluoroquinolone resistant isolates have emerged at an alarming rate. These resistant mutants typically have acquired mutations in multiple genes which contribute to the organism’s ability to resist antibiotic treatment. Most commonly, resistant strains have modified the target protein or upregulated their multidrug efflux pump proteins. Moreover, this increasing amount of resistant strains has been met with limited development of new antimicrobials that can treat bacterial infections. Thus, it is imperative to continue to explore novel bacterial topoisomerase inhibitors (NBTI’s) for use against resistant strains.

In collaboration with a lab in the College of Pharmacy, we have acquired ~70 NBTI’s that are derivatives of fluoroquinolones. We have performed minimum inhibitory concentration (MIC) assays using these compounds against a lab standard strain of Staphylococcus aureus (ATCC 29213), as well as a methicillin resistant Staphylococcus aureus (MRSA) strain. We have preliminary evidence that suggest some of these compounds demonstrate similar antimicrobial activity as the currently available fluoroquinolones. Additionally, these NBTI’s will be assessed against other bacterial species, both Gram positive and Gram negative. Including, the Gram-negatives Pseudomonas aeruginosa and Acinetobacter baumannii, to determine if there is any antimicrobial activity.
Research Project Title: Long-acting formulations conjugated with known HIV drugs shows higher potency in vitro

Student Presenter: Austin Keller

Faculty Mentor: Jesse Kwiek

Faculty Mentor Department: Microbiology

Research Abstract: Introduction and Background:

Daily antiretroviral therapy (ART) is commonly prescribed to suppress Human Immunodeficiency Virus (HIV-1) replication among people living with HIV-1. In recent years many researchers have shown an interest in exploring ways to replace daily ART therapies with longer lasting regimens. One of the innovative approaches is the conjugation of antiretroviral drugs with the long-acting formulations (LAF). Based on the evidences of success with some of the HIV-1 drugs conjugated with LAF in treating HIV-1 infected patients, here we test the potency of two novel antiretroviral drug conjugates.

Methods:

Hela derived genetically engineered TZM-bl cells were infected with HIV-1 NL4-3 in the presence and absence of ten-fold dilutions of both LAF conjugates and unconjugated drugs for 48h at 37°C. Post infection, the tat-induced reporter gene expression was measured in infected and non-infected TZM-bl cells by luminescence produced using Bright-GloTM reagent (Promega, USA) quantified on Spectramax i3X (Molecular Devices, USA). Dose-response curves and the half maximal effective concentration value (EC50) for each drug was calculated using GraphPad Prism.

Results:

The LAF-conjugates maintained their antiviral activity, and when compared to the unconjugated drugs, the LAF-conjugates were almost 10-fold more potent.

Conclusion:

Upon conjugation, the antiretroviral efficacy of the novel drugs remains intact, however, the LAF-conjugates are more potent than their unconjugated counterparts. This shift in potency may be due to the fact that the LAF allows for better absorption of the drug, which in turn means a lower concentration is needed to act at the same level of inhibition as the unconjugated form. Better absorption and higher potency would allow HIV-1 infected patients to take ART medications less frequently. It is believed that with longer lasting regimens, prescription and adherence to ART would significantly increase leading to reduced transmission of HIV-1 as well as reduced numbers of patient deaths.
Research Project Title:

Student Presenter: Natalia Oliverira

Faculty Mentor:

Faculty Mentor Department:

Research Abstract: The effect of L-carnitine in contrast-induced nephropathy in diabetic rats
Research Project Title: Small molecule M4 disperses Salmonella biofilms

Student Presenter: Laura Kuo

Faculty Mentor: John Gunn

Faculty Mentor Department: Microbiology

Research Abstract: Typhoid fever continues to be a pressing global health concern affecting millions of people per year. Individuals contract the disease by consuming food and water contaminated with the etiologic agent, Salmonella Typhi (S. Typhi). Of those that resolve the systemic infection, 3-5% will go on to become chronic carriers with the primary reservoir of the bacteria being the gallbladder. The development of chronic carriage has been strongly correlated with the presence of gallstones. Furthermore, we have demonstrated that the ability of S. Typhi to form biofilms on gallstones provides tolerance to bile and antibiotics and facilitates typhoid carriage. Chronic carriers are crucial in the spread of the disease as there are no other biotic vectors for this human-specific pathogen. Due to the importance of biofilms in the development of chronic carriage, the identification of biofilm dispersal agents will provide new therapeutic strategies. We have evaluated the anti-biofilm properties of several small molecules against Salmonella and identified a promising 3,5-dichloro compound, M4. This compound inhibits and disperses Salmonella biofilms with an IC50 of 8.1 uM and 21.0 uM, respectively, but does not kill Salmonella and showed no significant toxicity to eukaryotic cells or Galleria mellonella larvae. Our findings demonstrate that M4 could provide a pharmaceutical alternative to eliminate the asymptomatic carriage state and thus limit the global spread of typhoid fever.
Research Project Title: MIR-21 in resolution of wound inflammation

Student Presenter: Carly Polcyn

Faculty Mentor: Amitava Das

Faculty Mentor Department: Surgery

Research Abstract: Wound inflammation is a part of the wound healing cascade that aims to restore normal physiological function of injured tissue. Persistent inflammatory response might be detrimental and cause loss of organ function. Diabetic wounds are characterized by increased burden of dead cells. Cleaning of dead cells by macrophages (efferocytosis) is important to resolve inflammation. miRNAs are small non-coding RNA molecules which regulate gene expression by binding to the 3' UTR of targeted mRNA and have a critical role in inflammation. Our lab has previously reported an increased expression of inducible miR-21 in post-effercytotic peripheral blood monocyte-derived macrophages resulting in a net anti-inflammatory phenotype. However, wound macrophages are considerably different from cultured macrophages and there is no evidence on the role of miR-21 in wound macrophages in vivo. To elucidate the significance of wound macrophage miR-21 in wound inflammation, an animal model with myeloid specific knock down of miR-21 was developed by crossbreeding mice carrying floxed miR-21 allele (miR-21fl/fl) with LysM-Cre mice. The animals were characterized by genotyping with DNA from tail biopsies by PCR. Bone marrow-derived monocytes (BMDM) were isolated from the femurs of mice and followed by positive selection using magnetic beads conjugated with CD11b antibody. For wound macrophages, PVA sponges were isolated on day 7 by repeated compression followed by CD11b positive selection. RTPCR analysis revealed a significant knockdown of miR-21 in BMDM and wound macrophages. Current studies are ongoing to test the significance of the miR-21 in wound inflammation that would enable an understanding of the miR-21-dependent mechanisms which are impaired in chronic wounds.
Research Project Title: Integrating molecular and epidemiological data in models of HIV-1 transmitted integrase strand transfer inhibitor resistance

Student Presenter: Alexander Northrop

Faculty Mentor: Laura Pomeroy

Faculty Mentor Department: College of Public Health, Division of Environmental Health Sciences

Research Abstract: Introduction:

The human immunodeficiency virus (HIV-1) affects nearly 37 million individuals globally and causes acquired immunodeficiency syndrome (AIDS). No vaccine for HIV-1 nor cure for AIDS currently exists; however, with access and adherence to medicine known as antiretroviral therapy, those infected with HIV-1 can survive for many years. Guidelines for HIV-1 treatment consist of a regimen of different classes of drugs, which target various parts of the viral replication cycle. A recently developed class of antiretroviral drugs, Integrase Strand Transfer Inhibitors (INSTIs), is remarkably effective in treating HIV-1. Yet, there is a growing concern that the current widespread use of INSTI-class drugs will lead to an accumulation of INSTI-resistant HIV-1 mutants because drug resistance has occurred in all other antiretroviral drug classes developed to date. Due to the relatively low prevalence of INSTI-resistant mutants in drug-naïve populations and the recent introduction of INSTI drugs to the market, it is difficult to measure rates of HIV-1 drug resistance molecularly or epidemiologically. Nevertheless, it is important to determine these rates of both acquired and transmitted drug resistance in order to maintain effectiveness of the drugs.

Methods:

Toward this goal, we designed a mathematical model that estimates the rate of transmission of HIV-1 strains with primary INSTI-resistant mutants or transmitted drug resistance (TDR). We parameterized the model with estimates from molecular and epidemiological literature to represent HIV-1 transmission in Washington D.C.

Results:

We compared rates of TDR to rates of overall drug resistance and assumed that the difference quantifies acquired drug resistance conferred by selective pressure from the use of antiretrovirals. In this way, we quantified and predicted cumulative INSTI drug resistance.

Conclusions:

This work informs HIV-1 treatment. First, we estimated the rate of TDR versus acquired drug resistance, which has yet to be accomplished in epidemiological or biological studies. Secondly, we predict when it would be advisable for clinicians to screen patients of drug resistant strains of HIV-1 before prescribing INSTI-class drugs. Finally, by developing the model, we have established a method to evaluate the drug resistance for other cases of drug resistance.
Research Project Title: Evaluation of fetuin-A as a mediator of scar formation

Student Presenter: Nicholas Pappa

Faculty Mentor: Traci Wilgus

Faculty Mentor Department: Pathology

Research Abstract: There are major differences in wound healing between adult and fetal skin. It has been discovered that early gestation fetal skin heals by regeneration with no scarring, yet late gestation fetal skin and adult skin heal with the formation of scar tissue. The formation of scar tissue can have negative effects as scar tissue can hinder normal tissue growth and even affect patients psychologically. Fibroblasts are essential to wound healing and scar formation. These cells produce the excess collagen that forms a scar. Therefore, fibroblasts are a crucial factor in determining whether the wound healing process will result in scar formation or the damaged skin will regenerate. Research was performed comparing protein expression in fibroblasts from different stages of development. Proteomic analysis showed that expression of the protein fetuin-A (FetA) was significantly higher in fibroblasts of embryonic day 18 skin, which heals with a scar, compared to fibroblasts of embryonic day 15 skin, which heals by regeneration. Higher levels of FetA were also observed in whole E18 skin compared to E15 skin. Injection of recombinant FetA into E15 fetal wounds increased the amount of scarring compared to control wounds. Cultured fibroblasts treated with FetA showed an increase in collagen expression compared to control samples. The data suggest that FetA may promote scar formation. Very little research has been done on the effect of FetA on fibroblast function and scar formation, but the results suggest that inhibition of FetA may be a mechanism to reduce scar formation in wounds. Current studies are being performed to examine scar formation in FetA knockout mice to confirm the significance of FetA in scar formation.
Research Project Title: Identification of small molecules with curative and transmission blocking activities to the human malarial parasite, Plasmodium falciparum

Student Presenter: Abu Rogers

Faculty Mentor: Mark Drew

Faculty Mentor Department: Microbial Infection and Immunity, Ohio State University College of Medicine

Research Abstract: Plasmodium falciparum, the most pathogenic human malarial parasite, has multiple life stages within the human host: primarily the asexual blood stages that cause disease and the sexual blood stages, called gametocytes, which are infective to female Anopheles mosquitos. In order to both treat and to eradicate the disease, novel anti-malarial therapeutics with curative and transmission-blocking properties are required. Transmission of the parasite to the mosquito can be blocked by killing the gametocytes present in the bloodstream (gametocidal) or by inhibiting the process of the sexual development (anti-gametogenic). For the first part of this study, several in vitro assays were utilized to investigate the activity of six compounds purified from Cinnamosma fragrans, a Madagascan plant used as an antimalarial in traditional medicine. All six compounds were found to be potent against the asexual stages, with the most potent displaying an IC50 in the sub-micromolar range. Current studies indicate two of these compounds inhibit the process of gametocyte exflagellation, suggesting dual curative-transmission blocking activity. For the second part of this study, we focus on central carbon metabolism of gametocytes. Our lab has identified several inhibitors of the Plasmodium falciparum enzyme hexokinase (PfHK) which block formation of glucose to glucose-6-phosphate. These compounds kill asexual parasites at sub-micromolar concentrations, and are not toxic to human cell-lines. Assays are currently underway to assess their transmission blocking activity on sexual gametocytes.
Research Project Title: Hypoxamirs in ischemic wound healing: Role of miR-210 and miR-101

Student Presenter: Erin Sheehan

Faculty Mentor: Subhadip Ghatak

Faculty Mentor Department: Department of Surgery

Research Abstract: Background: Hypoxia is the deprivation of oxygen in the wound and causes severe peripheral vasculopathies inducing the hypoxamiR miR-210. Elevated miR-210, persisting in wound edge tissue as ischemic memory suppresses oxidative metabolism and inhibits cell proliferation necessary for healing. Moderate hypoxia is important for angiogenesis that facilitates wound healing. miR-101 regulates angiogenesis. However, the significance of miR-101 expression in hypoxia is still elusive.

Methods: 8-10 weeks old male C57bl/6 mice were used for this study. A monopedicle flap measuring 3 cm long and 1 cm wide was developed on the dorsal skin of the mouse. A silicon sheet was planted underneath the flap to negate the possibility of probable perfusion under the flap. The flap edges were cauterized and sutured to adjacent skin. Laser speckle imaging was performed to evaluate the extent of perfusion in the flap. At day 3 after the surgery, the flap was collected and divided in three different region (1 cm apart) named as proximal, intermediate and distal according to the extent of hypoxia. One part of each fraction was collected in OCT and the other portion was snap frozen for RNA isolation. Epithelial keratinocytes were collected using Laser Capture Microdissection (LCM). RNA isolation, cDNA synthesis and qRT-PCR were performed to measure the expression of miR-101 and miR-210 in each section. U6 was used as housekeeping control.

Results: Using mono-pedicle flap model, the extent of ischemia was categorically characterized by dividing the flap into three parts (proximal, intermediate and distal). Laser speckle imaging showed that the distal portion of the flap is more ischemic than the proximal part. Expression of miR-210 was found to be proportional to the extent of hypoxia. Unlike miR-201, the expression of miR-101 was found to be proportionally downregulated with the extent of ischemia. Laser Capture Microdissection of the keratinocytes showed that downregulation of miR-101 is more in the region of moderate hypoxia (proximal region) whereas in the distal region the expression of miR-101 is unaffected.

Conclusion: This data suggests that expression of miR-101 is downregulated in response to moderate hypoxia that may be attributed to induce the expression of angiogenic genes.
Research Project Title: Fish oil supplementation reduces high levels of circulating pro-inflammatory cytokines in older adults with chronic wounds

Student Presenter: Sarah Wood

Faculty Mentor: Jodi McDaniel

Faculty Mentor Department: The Ohio State University College of Nursing

Research Abstract: High levels of circulating pro-inflammatory cytokines are characteristic of chronic systemic inflammation, a condition that promotes many age-related disorders including chronic wounds, cardiovascular disease (CVD), and arthritis. Low-risk therapies to reduce chronically high levels of pro-inflammatory cytokines in aging are needed because by 2060 the U.S. population aged ≥ 65 years is projected to reach 23.5% (98 million). Some studies have shown that the bioactive components of fish oil, eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), moderate pro-inflammatory cytokine synthesis, but their effects specifically in older adults remain unclear. This study’s purpose was to compare plasma levels of three major pro-inflammatory cytokines in older adults with chronic wounds receiving oral EPA+DHA therapy versus placebo therapy. This randomized, double-blind study evaluated 35 older adults with chronically inflamed leg wounds at a university research center. For 8 weeks, EPA+DHA Group participants (n=16) consumed EPA+DHA supplements (2.5 g/d) and Placebo Group participants (n=19) consumed a placebo. Fasting blood plasma samples were collected at Weeks 0, 4 and 8 to quantify levels of pro-inflammatory cytokines IL-6, IL-1β, and TNF-α. Sociodemographic, comorbidity, and body mass index (BMI) data were also collected. On average, participants were 60.6 years (SD=11.96) with a BMI of 41.7 (SD=11.51). The majority were male (60%), Caucasian (74%) and had diagnoses of CVD (77%) and/or arthritis (51%) in addition to a chronic wound. There were no significant differences in age, BMI, or comorbidities between groups. After adjusting for baseline differences, the EPA+DHA Group demonstrated significantly lower levels of IL-6 (p = .008), IL-1β (p < .001), and TNF-α (p < .001) at Week 4 and at Week 8 [IL-6 (p = .007), IL-1β (p < .001), and TNF-α (p < .001)] than the Placebo Group. Additionally, there were no reported side effects. The findings suggest that low-risk EPA+DHA therapy may help prevent or reduce severity of common inflammation-driven disorders in aging. It is recommended that future studies test EPA+DHA therapy in larger, more diverse samples of older adults.
Research Project Title: The effect of protocol adherence and equipment type for blood pressure measurement

Student Presenter: John Mickley

Faculty Mentor: Kevin Evans

Faculty Mentor Department: Radiologic Sciences / Respiratory Therapy Division

Research Abstract: High blood pressure is found in 1 out of 3 U.S. adults and is increasing in prevalence. The screening of patients is accomplished by obtaining a patient's blood pressure (BP) either manually or with an automated system. The manual technique for obtaining a BP was the original gold standard, but with technologic improvements, automated machines in clinics and at home has created an alternative. This study was devised to address providers concerns over the validity of automated BP measurements. This study was designed to compare how the readings of manual and automated BP were related and the changes induced with varied protocols for measuring BP. The goal was to determine whether the equipment or method could cause discrepancies in BP readings when transitioning from manual to automated apparatuses. All subjects (39) had their BP measured following protocol, utilizing three different measurement devices: manual (MA), automated Midmark IQ vitals (PR), and an automated Omron home unit (OM) as well as measured in a typical doctor's office visits (TY). The results showed that the mean systolic BP (SYS) for TY (123.7mmHg) > OM (118.3mmHg) > PR (114.8mmHg) > MA (111.0mmHg), all statistically significant (p<0.01). The mean diastolic BP (DIA) for TY (79.6mmHg) > PR (71.15mmHg), OM (71.05mmHg) and MA (70.0mmHg), with TY significantly higher than the other 3 (p<0.01). Despite the significant difference, all the measurements had a high intraclass coefficient between them, SYS (0.87mmHg), DIA (0.81mmHg). When comparing the number of participants categorized in each hypertension stage, TY categorized 7 participants as stage 1 hypertensive while OM categorized 3, and both MA and PR only categorized 1. The results demonstrate that, in this cohort of participants, there was a significant difference between protocol adherence and the lack of protocol, which was more than the difference between manual and automated apparatuses. These study results would suggest that there is a potential for possible misclassification of patients based on BP protocol. This could have implications for treating patients based on improper BP protocol. It is imperative medical professionals revisit the process for measuring BP and properly treat hypertensive patients.
Research Project Title: Topically administered imiquimod induces systemic autoimmunity in humanized NSG mice

Student Presenter: Perry Blough

Faculty Mentor: Jarjour No

Faculty Mentor Department: Wael

Research Abstract: Introduction/Background

Imiquimod (IMQ), a TLR7 agonist, has been shown to induce a phenotype in mice that resembles Systemic Lupus Erythematosus (SLE) in humans. When applied topically, IMQ prompts systemic autoreactivity that mimics lupus-like manifestations such as autoantibodies, cutaneous lesions, and glomerulonephritis. However, the role of lymphocytes in this lupus model is not well understood. Moreover, the function of cutaneous lymphocytes in humans and lupus mouse models is relatively unknown. The aim of our project is to establish a humanized lupus mouse model that exhibits skin and kidney disease in order to explore the role of cutaneous lymphocytes in the development of lupus skin lesions in these mice.

Methods

Two cohorts of immunodeficient mice were injected with either human peripheral blood mononuclear cells or phosphate-buffered saline as a control. Additionally, each cohort was topically treated with IMQ on their shaved left dorsum and a control cream on their shaved right dorsum twice per week over the course of four weeks. Weights were recorded each week, and blood and urine samples collected throughout the duration of the experiment were analyzed using autoantibody ELISAs, Urine Albumin ELISAs, and BUN assays. At the conclusion of the study, all mice were sacrificed and various tissues were harvested for histopathologic assessment.

Results

At the conclusion of the project, the experimental cohort developed significantly worse cutaneous lesions than the control cohort on the side treated with IMQ. Additionally, the experimental cohort exhibited elevated levels of serum autoantibodies, and histopathologic analysis of kidney tissue indicated the development of glomerular IgG deposition in the experimental cohort. Immunohistochemistry also revealed elevated levels of IgG in the lesional skin of the experimental cohort.

Conclusion

Preliminary data suggests that lymphocytes play a key role in the development of lupus-like manifestations. Further experiments are necessary to resolve the specific cell-type mediating this disease, which may help determine therapeutic pathways regulating such manifestations that could be translated into impactful treatments for individuals suffering from SLE and other autoimmune diseases.
Research Project Title:

Student Presenter: ahmad shkoukani

Faculty Mentor: sergakis No

Faculty Mentor Department: georgianna

Research Abstract: Inhaled Epoprostenol for hypoxemia: Review of Current Utilization and development of an Evidence-Based Protocol
Research Project Title: Intersectionality of race and gender in higher education: the plight of the African-American woman at a predominantly white institution (PWI).

Student Presenter: Candace Cooper

Faculty Mentor: Carla Curtis

Faculty Mentor Department: Social Work

Research Abstract: According to the National Center for Education Statistics, African-American women are the most educated group in the United States of America. During the academic year of 2013-2014, African-American women earned 66 percent of associate degrees, 64 percent of bachelor’s degrees, 70 percent of master’s degrees and 64 percent of doctoral degrees. In today’s society, African-American students have a different collegiate experience than their counterparts due to the basis of race and gender. Moses (1989) eloquently states, “African-American women have a unique experience of being two minorities: both black and female and because of this have been treated in a peripheral manner by higher education.” The purpose of this study was to conduct a qualitative study focusing on the intersectionality of race and gender in higher education and how these domains may impact the academic successes of African-American women at Predominantly White Institutions or PWIs like The Ohio State University. Measurement was through a primary data collection with usage of audio recorders during in-person interviews. A Qualtrics survey was administered during the in-person interviews that lasted an hour long. The survey examined social supports, campus climate and sense of belonging. Data was transcribed verbatim upon the collection of auditory data recording and themes were developed. Questions constructed for the interview included assessment of barriers that these supports may present and the advantage of these supports will be included. Additional questions were focused on lived experience of each participant that impact their collegiate career, their perspective of support of African-American women at the university level and their experience academically at a PWI. Results show that African-American women are constantly reminded that they are a part of two minority groups Black and female. This alone can create an environment where women feel the need to work twice as hard to receive the resources, benefits and support like their counterparts receive at the university level.
Research Project Title: The role of 6-8th grade English and Language Arts curriculum in transmitting messages about mental health

Student Presenter: Sarah Leonard

Faculty Mentor: Joseph Guada

Faculty Mentor Department: Social Work

Research Abstract: Mental illness is a serious issue facing numerous children in the U.S. If not treated early, childhood mental illness can lead to negative outcomes which are painful for the child, family, and community. Research shows that both exposure to stigmatizing messages and a lack of information about mental health prevent individuals from seeking needed treatment and that such messages might be present in the school setting where children spend the majority of their time. The following study explores the presence of mental health-related messages in 6-8th grade English and Language Arts (ELA) curriculum materials that can have an impact on help-seeking behaviors among students. This mixed-methods exploratory study aims to determine whether middle school ELA classes could be utilized to improve mental health literacy and outcomes in young people. The first part of the study includes a content analysis of ELA curriculum materials, with a focus on mental health-related themes and messages. The second part of the study involves collecting quantitative data via a survey of 6-8th grade ELA teachers to assess their knowledge about and attitudes toward mental illness as well as their experiences with mental health issues among students. ELA curriculum materials were expected to include stigmatizing messages about mental health, but a preliminary content analysis of two books and one short story suggests that they can also provide students with information that actually might prompt help-seeking behaviors. Preliminary analyses of survey results from 59 6-8th grade ELA teachers support this finding. Several survey participants report that students have been prompted to seek help for mental health concerns based on topics presented in curriculum materials. Although data collection and analysis are ongoing, these preliminary results offer the hope that children are receiving positive messages regarding mental health issues from their ELA classes that can prompt help-seeking behaviors in the event that there is a need for treatment.
Research Project Title: Assessment of test anxiety on the OSU Lima Campus: prevalence, intensity, and coping methods

Student Presenter: Andrea Morales

Faculty Mentor: Joseph Green

Faculty Mentor Department: Psychology

Research Abstract: Previous research has suggested that a large percentage of students are affected by test anxiety yet don’t know how to successfully cope with it (Sung, Chao, & Tseng, 2016). In an attempt to better understand test anxiety within a college sample, we surveyed over 200 undergraduate students at The Ohio State University at Lima. Students completed a variety of questionnaires including the GAD-7, the Cognitive Test Anxiety Scale, and the Westside Test Anxiety Scale, and they granted us permission to obtain their GPA, SAT/ACT, and declared major from university records. Students also reported, in narrative form, what methods they typically use to cope with test anxiety. Our goal is to better understand the frequency and severity of test anxiety symptoms among students on our campus and whether the intensity of test anxiety differs by major, subject matter, gender, or academic ability. We will tally and rank order students’ preferred method of coping with test anxiety. We will also conduct correlations between our scales. Our results are forthcoming. We believe that our results will be helpful not only to students, but also campus counselors, administrations, faculty and staff that work with students struggling with test anxiety.


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Research Abstract: Category: Social and Behavioral Sciences

Title: American Attitudes Towards the Funding of Higher Education

Student Presenter: Keyla Navarrete

Faculty Advisor: Natasha Quadlin

When people think about education as a factor of society they most often think of the learning that occurs in its simplest forms. A great deal of people fail to notice the role that education plays in developing and preserving inequality. In modern day society, higher education is a vital factor in social mobility and its effects are everlasting for generations to come. In an attempt to provide the equal opportunity of a higher education to all, institutions such as The Ohio State University have granted Pell-Grant recipients tuition subsidies. These efforts are not only restricted to micro-levels, but are equivocal at the macro-level as well. An active implementation was noted in the 2017 academic year, adhering to federal regulations, student attendance must be confirmed before issuing refunds for Title IV recipients. Different subsets of society have differing perceptions of who should be paying the costs of college. There are various factors (gender, age, SES) that explain the varying responses of which education does not seem to play a pivotal role, but why? To bring light to American attitudes regarding the funding of higher education I will be reviewing telephone responses from a survey called the Constructing the Family Survey, a national survey of approximately 800 U.S adults that was fielded in 2015. The data were collected through the Indiana Center for Survey Research. Among these surveys not only am I going to discover who the American public believe should be paying for the cost of higher education, but also the underlying reasoning for their opinions on this issue. Early results indicate that many individuals believe students should pay the cost of college because graduating high school serves as a rite of passage into adulthood. Alternative responses relating to parents, local/state/federal government are analyzed as well and will be presented at the 2018 Denman Research Forum. These responses will provide the public with a chance for their voice to be heard, which is especially important as it has been missing for quite some time on this important social issue.
Research Project Title: The impact of publishing Ohio teachers’ value-added scores

Student Presenter: Eleni Packis

Faculty Mentor: Stéphane Lavertu

Faculty Mentor Department: Public Affairs

Research Abstract: “Value added” is a teacher evaluation technique that has garnered quite a bit of publicity and controversy. It refers to the amount of “value” that a teacher provides as measured by gains in their students’ test scores. Research indicates that students whose teachers have high value-added scores enjoy a number of benefits later in life, including higher earnings. However, research also indicates that effective teachers (as measured by value-added) are more likely to leave low-performing schools in favor of higher-performing schools, while less effective teachers are more likely to stay in low-performing schools or leave the school system or profession altogether.

This project examines such dynamics among teachers in Ohio. Specifically, it investigates the lasting effects from the Cleveland Plain Dealer’s unexpected publication of 4,200 Ohio teachers’ value-added scores in June of 2013. It uses data from 2008-2016 from the Ohio Department of Education on all Ohio teachers’ education levels, salaries, specific job position and location within their school district, and school- and district-level effectiveness measures. Thus, these data enable me to follow these teachers, schools, and buildings that had individual teachers’ value-added scores published by The Plain Dealer (designated as “treatment” groups in my study) over time, to analyze differences in outcomes for teachers, schools, and districts based upon their value-added scores, and to estimate how publishing teachers’ scores affected those groups involved.

Using a difference-in-differences statistical model, my results suggest that treatment schools had a statistically significant higher amount of turnover since 2010 i.e., a higher number of teachers leaving or being fired from that school since 2010 than schools that did not have individual teachers’ value-added scores published. Additionally, I found higher average school-level achievement gains in test scores among schools that participated in the value-added teacher evaluation program. These findings suggest that buildings that participated in this study may have taken action to remove teachers receiving low value-added scores, and through doing so, may have improved their average student performance. This carries interesting implications for the usage of value-added or other teacher evaluation measures in the future.
Research Project Title: The Impact of school district fiscal stress labels on district and charter school enrollments

Student Presenter: Sarah Souders

Faculty Mentor: Stéphane Lavertu

Faculty Mentor Department: Glenn College of Public Affairs

Research Abstract: School choice policies require that parents make informed decisions about where to enroll their children. If parents select schools that are inferior to those their children otherwise would have attended, then these policies could actually weaken U.S. public education. Whether information about school district finances affects the school’s parents choose is unknown, however. This study examines one publicly disseminated piece of financial information—whether school districts are in financial distress—and estimates its impact on student enrollment in charter schools located within their district’s bounds between 2001-2012.

The shock that comes from fiscal stress label receipt makes it likely that it will impact decision-making. Unlike academic quality indicators, financial information is rarely picked up by the news. It is often only after receipt of a fiscal stress label that budget deficits are made known, as state law requires the Auditor of State to announce label receipt.

This research extends upon Thompson’s 2016 paper, which is the first to examine the impact of fiscal labels on school districts. Thompson finds that unlabeled districts have better test scores, finances, and fewer economically disadvantaged students than labeled districts. Once districts receive a label they reduce capital expenditures by $850 per pupil and increase local tax revenues by nearly $500 per pupil, on average. Thompson also finds that, following label receipt, district enrollments decrease by 5% and the number of schools and teachers also decrease. I extend this work by identifying where students go.

I examine whether fiscal stress labels lead to a decline in district enrollments because students are entering charter schools by comparing changes in charter enrollments between districts that did and did not receive a label. This difference-in-differences analysis determines changes in charter and district enrollments and controls for district’s student-teacher ratios and performance index scores, which research shows affect parental decision-making. The results indicate that labeled districts experience enrollment declines of 6% in the next year, which is slightly higher than Thompson’s estimate, while charter schools in labeled districts experience enrollment increases of 53.8%, on average, holding all else equal. Both results are statistically significant at the 5% level.
Research Project Title: The future of programming jobs: Changing realities and stagnant perspectives

Student Presenter: Andrea Stanic

Faculty Mentor: Nancy Ettlinger

Faculty Mentor Department: Geography

Research Abstract: Across the United States, there has been a massive expansion of coding boot camps. This development is tied to the emphasis in K-12 schools and universities on teaching students coding skills to prepare students for jobs. Academicians debate the sustainability of programming and related jobs. Some argue that the demand for programmers will meet the growing number of coders, while others argue that coding jobs in the United States will be threatened by outsourcing, automation, and the precarious, less-than-full-time nature of these jobs. I will evaluate this debate and also examine programmers-in-training’s in/familiarity with potential problems of the jobs for which they are preparing, how they view their future job prospects, and the reasoning behind their beliefs in their job prospects. I will compile data from reports on programming jobs and their employment projections. Additionally, I will interview computer science students at The Ohio State University, Youngstown State University, and Illinois Institute of Technology. I plan to submit a proposal to the IRB by end of the first week in February. Jobs in information technology are predicted to decline considerably in the United States. Automation in the form of artificial intelligence is already cutting programming jobs abroad in India, where US firms have been outsourcing and offshoring programming jobs since 1990. However, most Americans, including programmers, do not see their jobs at risk of automation. Although jobs in information technology are predicted to decline, student programmers and computer science students more generally are confident about their future employment, and moreover are unaware of ongoing debates. Their confidence stems from conventional notions that only blue-collar jobs are at risk due to automation, outsourcing, and flexibilization of jobs. The disconnect between changing realities and perceptions of the future of programming-related jobs can be explained by neoliberal norms that guide students to pursue skills deemed valuable in society while universities lack education about industrial change in the context of processes occurring in the global economy. Students are focused on increasing their human capital without attention to the changing context of the jobs for which they train.
Research Project Title: Affects of manipulation of perceptual features on children's ability to understand fraction concepts

Student Presenter: Madison Ramirez

Faculty Mentor: Vladimir Sloutsky

Faculty Mentor Department: Psychology

Research Abstract: The formation of a strong foundation in early math education can enable a child to develop a deeper understanding of math in their future academic endeavors. Complex math concepts (e.g., fractions) are particularly challenging for elementary-age children to grasp (Bailey et al., 2012; Department of Education, 1997). In the current study, we explored children’s ability to learn and generalize difficult fraction concepts through an abstraction task in the face of varying perceptual information (as encountered in the real world). We presented four-to six-year-old children with a computer task that displayed exemplars of novel fractions that progressed from perceptually impoverished to perceptually rich (concreteness fading; per Fyfe et al., 2014). Through the use of a pre-and post-test design, the present study examined whether children could learn and generalize a novel fraction concepts following training (pre-to post-test gains). Data show that children could learn a novel fraction concept through this concreteness training in an abstraction task. However, with such a short training, the results did not indicate that children were able to do this for novel (non-taught) fractions, nor were pre-to post-test gains on a more traditional measure of fraction knowledge observed. A follow-up experiment explored the mechanism behind children’s success in the original abstraction task. Pilot data suggest their use of a ‘whole number strategy’, such that they succeeded at identifying a new fraction if they could successfully identify its numerator. These findings have implications for curriculum development and teacher training.
Research Project Title: Evaluation of the Vice President's conversation on the future of Extension

Student Presenter: Mariah Stollar

Faculty Mentor: Greg Davis

Faculty Mentor Department: OSU Extension

Research Abstract: The purpose of this research project was to better understand perceptions surrounding the outcomes of the VP Conversation. Results of this project could inform future steps of the VP Conversation or similar efforts.

Four OSU Extension Administrative Cabinet members and four VP Conversation Steering Committee members were identified and interviewed by the lead investigator in person or via phone. Administrative Cabinet members were selected for this project because of their state level orientation. The Steering Committee members were selected because of their involvement in the project planning and implementation; and their perceived ability to see the project’s impact on county work.

Overall, participants saw value in the VP Conversation and the study outputs generated. A shift in the organization’s thinking toward the future, rather than reacting to crises, was observed. However, several issues were identified. Discussion and utilization of knowledge gained from the VP Conversation was observed to be minimal. Confusion surrounding the concepts of futuring and visioning were still believed to exist within the organization. Lack of application of key project concepts in daily work and fear of change to organizational structure were also observed.

OSU Extension should place a greater emphasis on educational efforts regarding the VP Conversation and use of the resources that it produced. It may also be beneficial to readdress the VP Conversation. Cabinet members and administrators of OSU Extension may need to brainstorm ways to revitalize the concepts and ideas surrounding the VP Conversation, possibly by developing new curriculum and programs. It may also be beneficial to continue to educate how this program could directly benefit participants, and how to effectively integrate its key concepts into day-to-day work.
Research Project Title: Past, present, future: developing kinesthetic teaching methodology and choreographing experience

Student Presenter: Anthony Milian

Faculty Mentor: Ann Sofie Clemmensen

Faculty Mentor Department: Dance

Research Abstract: A dancer’s body is the instrument through which a dance is created. I am researching the process of developing a teaching methodology centered around finding the necessary physical skills needed to successfully embody the core aesthetic qualities found in my choreographic work. It is widely understood in the field of dance that the stronger and more flexible a dancer’s body is, the more capable it is of a wide range of movement. The central question in my research is: what specific skill-sets and/or physical qualities does a dancer need to successfully engage in my choreographic process and perform my work with confidence? I am working to cultivate a specific teaching methodology intended to enhance my choreographic aesthetic, resulting in a choreographic work presented in Spring 2018. I have been able to develop my teaching methodology through studio practice, and practical, in-person dialog with professional movement educators during last summer’s study abroad opportunities in Europe, including Dance Denmark and The Dance Italia Program, in Lucca, Italy. My methodology looks specifically at the integration of a multi-unit torso by examining the use of pelvis and scapula; pursuing specificity in spinal articulation through the usage of isolated shoulder and pelvic movements. The spine is integral in movement because it holds the main infrastructure of the body. All movement in the body is controlled by the brain, then sent through the spinal cord via neurotransmitters into the muscles. In my choreographic aesthetic and teaching methodology, my goal is to focus on the movement pathways traveling throughout the spine. I am looking to accentuate this movement pathway from the brain, to the limbs, and provide a visual tracking of this physicality. By giving my dancers the liberty to embellish movements and use an explorative process, they are able to find what suits their own bodies most effectively. I am looking to find how my dancers can personally embody, physicalize, and develop the choreography to further demonstrate the idea of a highly kinetic mobile spine.
Research Project Title: Factors influencing preservice teachers' decision to major in agriscience education

Student Presenter: Sarah Landis

Faculty Mentor: Susie Whittington

Faculty Mentor Department: Agricultural Communication, Education and Leadership

Research Abstract: The purpose of the study was to acquire information that could assist the Department of Agricultural Communication, Education, and Leadership in developing materials and targeting audiences to assist in addressing the shortage of agricultural science teachers across Ohio. The objective was to describe factors influencing students to choose Agriscience Education as a major in college. In this study, a census (N = 19) of the students participating in the 2017 Preservice Teacher Professional Block Program at The Ohio State University completed a questionnaire describing factors influencing their decision to choose Agriscience Education as a college major. The research questionnaire was distributed to all students with 100% participation. The questionnaire was comprised of a 5-point Likert scale, from strongly disagree to strongly agree, measuring factors such as desire to work with students, influence from parents, past agricultural teachers, friends, and their own experiences in agricultural organizations such as FFA and 4-H. From the data, the top factors influencing students to enter the major included: their experience with traditional agricultural student organizations (i.e. 4-H, FFA), the opportunity to teach students, the opportunity to educate the public about agriculture, and the chance to teach a community about many aspects of agriculture. Conclusions from the data included putting emphasis on FFA events and other agricultural related organizations’ events that encourage members to use their strengths in scenarios dealing with educating the public. Specifically, educating the public about agriculturally-related concepts was important. Implications include encouraging students to be involved with events, so that more students may be interested in entering the agricultural education program and therefore, becoming agricultural science educators.
Research Project Title: Session notes: Understanding tutor practice in the Writing Center

Student Presenter: Samantha Turner

Faculty Mentor: Genie Giaimo

Faculty Mentor Department: Center for the Study and Teaching of Writing

Research Abstract: Session notes, also called Client Report Forms (CRFs), are utilized in writing center reflective practice and administrative record-keeping. CRFs are completed by writing tutors after each session they conduct, and typically include information about the content of the session. Although session notes are common, research and training suggestions are extremely limited; the most prominent scholarship focuses on external and institutional uses of the forms (Pemberton, 1995; Cogie, 1998). This study aims to reimagine session notes as primary documents for internal use—"in other words, as a reflection of the inter-workings of a writing center that can serve as an assessment tool. I first identified discrepancies between the conceptual and practical uses of session notes and addressed this gap through the design and implementation of a center-wide training module. CRF data (n=3,000) was collected from an analytics and scheduling software (WCOnline) and stripped of identifying markers before being coded according to the normed rubric. I analyzed our center’s completed CRFs using a hand-coding method of discourse analysis in which a rubric for linguistic assessment and coding was created. Variables of interest included keywords and phrases that indicate descriptive and prescriptive language, as well as key terms related to training, such as specific tutoring methods. It was found that the usage and completion of session notes within the OSU Writing Center varies by consultant, despite standardized trainings. Much of the data presents statistical significance of usage discrepancies between consultant identity categories. For instance, when looking at education rank and usage of prescriptive language among consultants of the same experience and training level, CRFs from undergraduate consultants include higher levels of prescription than those forms completed by their graduate student counterparts. In short, this study focuses on session notes as a site of occupational data uniquely capable of fulfilling many functional and administrative goals within writing centers. The study offers deeper insight into the practical usage of a largely theoretical part of the field; by tracing local impact of this assessment onto our writing center’s tutoring practices, we can facilitate reflection around the tutoring process and understand how tutors understand their work.
Research Project Title:  
Student Presenter: Breno Avancini

Faculty Mentor:  
Faculty Mentor Department:  

Research Abstract: Computational simulation of the flow in the interior of a supersonic separator of gases
Worm-like surfactant micelles are already being used to efficiently and inexpensively transport fluids by reducing the effect of pressure loss in turbulent flow. However, these solutions are not easily used in systems that require changes in temperature since these micelles also reduce the effect of heat transfer. It has been found that for a certain drag-reducing solution that combines zwitterionic and cationic surfactants, adding solvent to the solution can cause these micelles to precipitate. When these micelles have precipitated out of solution, they are no longer able to reduce drag and heat transfer.

Therefore, for this research project, the concentration of drag-reducing solutions in a lab-scale piping system was changed before and after the use of a heat exchanger to minimize the reduction of heat transfer that these micelles can cause. To do this, an existing system for testing drag and heat transfer reduction was used with a small water stream added before a heat exchanger, and a reverse osmosis membrane was added after the same heat exchanger, changing the concentration of the solution before and after heat transfer.

Graphs showing the drag reduction and heat transfer reduction in comparison to water at varying Reynolds numbers and temperatures were produced for the zwittercationic solution used in this experiment. These graphs were then analyzed to determine if concentration change was a feasible method for reducing drag with little to no heat transfer reduction. It is anticipated that the graphs will show that concentration change is a legitimate method for improving heat transfer in this drag-reducing solution. However, any success with this concentration change method was largely dependent on the use of heat, static mixers, and careful planning of the amount of solvent added before and after the heat exchanger, making this an unlikely method for improving heat transfer in re-circulating flow systems on a large scale anytime in the near future.
Research Project Title: Using cross-sectioning and embedding techniques to quantify proteins and polysaccharides in a biologically fouled crossflow membrane

Student Presenter: Samuel Corbin

Faculty Mentor: Linda Weavers

Faculty Mentor Department: Civil, Environmental, and Geodetic Engineering

Research Abstract: Some water filtration systems may use membranes to remove particulates, colloids, and ions. However, biofouling, deposition and growth of biomass on membrane surfaces, severely lowers the efficiency of membrane systems. Techniques such as ultrasonic cleaning have been tested to reverse biofouling. In order to understand the mechanisms underpinning membrane cleaning, fouled membrane structural components such as proteins and polysaccharides have been visualized using fluorescent light microscopy. Critically, the effectiveness of this imaging is reduced for thick biofilms due to attenuation of the light signal caused by biomass. This project will apply up-to-date histological methods to image thick biofilms on fouled membranes. This proposed method will use light microscopy to image cross-sectioned and resin-embedded stabilized biofilms. Cross-sectioning will be performed using a cyromicrotome that will take micrometer-thin slices of the fouled membrane. Embedding the membrane in a resin will stabilize it during sectioning to reduce changes to the biofilm and to facilitate sectioning. The proposed combination of these techniques will overcome limitations in current biofouling research such as light attenuation in thick samples and sample degradation. Expected results for this project include increased depth visualization of proteins and polysaccharides with less attenuation for cross-sectioned and embedded biofouled membranes than current methods. Development of this technique will facilitate future research into antifouling technology by allowing researchers to collect higher-quality data on the effects of cleaning.
Research Project Title: Hydrogen production using a syngas generation system

Student Presenter: Emma Garber

Faculty Mentor: L.-S. Fan

Faculty Mentor Department: Chemical and Biomolecular Engineering

Research Abstract: Hydrogen gas can be used as an alternative fuel in many applications, such as transportation energy or as a power supply. It is desirable because it is an energy source that is free of carbon emissions. Although hydrogen gas has benefits, it is a secondary fuel, and must be produced from another source. Currently, over 95% of H2 produced comes from natural gas. The standard way to produce hydrogen gas is through a process called steam methane reforming (SMR), which is relatively expensive due to the energy required to fuel the endothermic nature of the process. This study considers a chemical looping based alternative to SMR in order to reduce natural gas consumption and the associated costs. The net SMR reaction requires external methane combustion to provide for this endothermic process. The chemical looping configuration developed in this study produces syngas from methane in a reducer reactor using an iron-based metal-oxide in an endothermic process. The reduced iron-oxide from the reducer reactor is then re-oxidized in a separate reactor called the combustor, which is exothermic. The synchronization of these endothermic and exothermic reactions using the iron-based metal-oxide offers this chemical looping configuration a chance to produce a greater amount of syngas than the conventional SMR technology. This results in a higher amount of H2 production from methane and the specific tradeoffs associated with the design of this chemical looping system are presented. The simulations are performed in ASPEN PLUS software using the Gibbs Free energy minimization module. Initially, isothermal operating conditions are investigated for quantifying the limits of syngas production. The study then investigates multiple variables like solid flow rates and preheat temperatures to synchronize the endothermic and exothermic heats of reactions in the two chemical looping reactors. Preliminary results show a 10% improvement in H2 yield over the conventional SMR systems.
Research Project Title: Using digital PCR in the detection of microorganisms in house dust

Student Presenter: David Kormos

Faculty Mentor: Karen Dannemiller

Faculty Mentor Department: Civil, Environmental, and Geodetic Engineering

Research Abstract: We spend 90% of our time indoors where we are exposed to a diverse microbial community that can negatively impact health, especially for people with asthma. Indoor dust is an important source of this exposure in humans. Microbes in the indoor environment can be detected by using polymerase chain reaction (qPCR), but qPCR has some limitations. Digital PCR (dPCR) may provide greater precision at low concentrations and is less prone to inhibition. The goal of the study is to determine the accuracy, precision, and reproducibility of these methods. Bacillus atrophaeus, Aspergillus fumigatus, and Escherichia coli cells were grown, counted, and then spiked into house dust. This dust and cell combination was embedded into low pile and medium pile carpets dust samples and vacuumed from the carpets, the DNA was extracted, and qPCR was performed to gain a comparison for dPCR. Previous results revealed that carpet pile had a larger influence on DNA recovery than microbe type. The extraction efficiencies from the carpet ranged from 92 to 95 percent from the low pile carpet for the microbes, and 69 to 76 percent from the medium pile carpet. These carpet trials will be redone as conditions are changing to maximize the efficiencies of the extractions. The efficiencies for the qPCR must be reproduced and calculated before reporting. The digital PCR experiments will soon be conducted to calculate the efficiencies and compare the precision of the different methods. Understanding these collection and extraction efficiencies is important for accurate determination of microbial concentrations. The results from this study will inform future studies of indoor exposures applicable to public health and policy.
Research Project Title: Atomistic understandings of the effects of force field on their predictions of carbon dioxide adsorption properties in all-silica zeolites

Student Presenter: Jian Ren Lim

Faculty Mentor: Li-Chiang Lin

Faculty Mentor Department: Chemical and Biomolecular Engineering

Research Abstract: The escalated carbon dioxide concentration has become one of the great challenges humanity is currently facing. One of the promising approaches to reduce carbon emissions is through Carbon Capture and Sequestration (CCS). The idea is to ad/absorb CO2 selectively from flue gases (e.g., emissions from coal-fired power plants) and store it in the underground. Compare to amine scrubbing methods, nanoporous materials such as zeolites as adsorbents are predicted to be able to use 30-40% less energy. In search for optimal nanoporous materials, computational approaches using state-of-the-art molecular simulations play a critical role, allowing one to effectively study a vast number of materials. For this, to ensure accurate predictions, adopting a force field to accurately describe intermolecular interactions is of utmost importance. To date, six available force fields have been reported to describe CO2 in zeolites. In this project, we strive to study the difference between force fields with the aim of identifying which force fields that may provide the most consistent predictions. To this end, we investigated more than one hundred and fifty geometrically diverse zeolite structures. We used grand canonical Monte Carlo simulations with available force fields to calculate the adsorption property of CO2 in each zeolite. Our results evidently show that the predictions made by different force fields can be differed by order of magnitudes. The observed discrepancy was also correlated to the structural properties of zeolites, informing what type of zeolites may require extra care as a large uncertainty in computational predictions may exist. Furthermore, van der Waals corrected density functional theory calculations were carried out to compute the interactions between CO2 and zeolites, serving as a preference to evaluate these available force fields. The outcomes of this study have led to important insights toward the future development of force fields. Specifically, several key reference data such as saturation loading and diffusion coefficients were identified to help facilitate the parameterization of transferable force fields.
Research Project Title: Synthesis and characterization of metal nitrides for atmospheric pressure ammonia synthesis

Student Presenter: John McGrogan

Faculty Mentor: Umit Ozkan

Faculty Mentor Department: Chemical Engineering

Research Abstract: Ammonia is a key molecule in the production of many essential products such as fertilizers, household cleaning products, and pharmaceuticals. Currently, this molecule is produced through the Haber process which requires a large amount of energy to apply extreme pressures to force the formation of ammonia from hydrogen gas and nitrogen gas. In addition, the source of this hydrogen gas comes from steam reformation which creates a lot of carbon dioxide as a byproduct. In order to reduce the cost of these processes while reducing the carbon dioxide emissions, our proposed method will use metal nitrides in solid oxide fuel cells to form ammonia from water and nitrogen at ambient pressure. My portion of the research will focus on determining the best methods of synthesizing catalysts for this process and how they perform in the production of ammonia.

Through preliminary research, metal nitrides were determined to be a promising catalyst to use in solid oxide fuel cells for ammonia production since they have highly active nitrogen ions in lattice. The nitrogen flowing into the reactor is there to replenish these ions in the metal nitrides. Four metal nitrides were found to be the most promising in this application: zirconia nitride, chromium nitride, vanadium nitride, and niobium nitride. From here, further research was performed to determine synthesis methods that would be able to produce these catalysts. Using X-Ray Diffraction crystallography, the structures of these catalysts will be tested to determine which synthesis methods worked best.

Once the optimal synthesis methods have been determined for each of the four metal nitrides, their activity in ammonia production will be tested using temperature programmed reaction. The metal nitride will be packed into a reactor bed and reactant gases will be flown in. The temperature of the reaction will be ramped up to determine at what temperatures the production of ammonia will occur and what mechanism is being followed. Reactants of water and hydrogen will both be tested to see how they impact the temperature of ammonia formation. The results of this experiment will determine the operating temperature in solid oxide fuel cells.
Research Project Title: Understanding the effect of ion content on adhesion of ionomer films using coarse grained molecular dynamics simulations

Student Presenter: Patrick Murtha

Faculty Mentor: Lisa Hall

Faculty Mentor Department: Chemical and Biomolecular Engineering

Research Abstract: Category: Engineering

Title: Understanding the effect of ion content on adhesion of ionomer films using coarse grained molecular dynamics simulations

Student Presenter: Patrick Murtha

Faculty Advisor: Hall, Lisa

Abstract: Ionomers are polymers that contain a small fraction of ionic groups, attached to a neutral backbone. These ions come together to form nanoscale aggregates, which improve the material's mechanical properties relative to its neutral counterpart. Due to this, ionomers are used in a wide variety of applications, from dental fixtures to packaging. A more recent area of ionomer application has been in the field of 3D printing, as they can be easily processed at high temperatures and are able to maintain their strength at these elevated temperatures. During 3D printing, individual layers adhere to one another to form the composite object. Hence, surface adhesion is an important property to characterize in order to improve strength and overall product quality. We aim to understand this by employing molecular dynamics simulations, as we can access the length scale of a few nanometers, the scale over which adhesion occurs in ionomer films. In order to access longer time and length scales and effectively bridge the gap between simulation and experiments, we employ a coarse grained model that reduces the number of particles and makes the simulation more tractable. Using this method, we model the commercial ionomer Surlyn®, which is manufactured by DuPont for and can be used 3D printing purposes. We consider a dense melt of ionomers and counterions with no solvent. Using the LAMMPS simulation package, we simulate a freestanding film which is sufficiently thick so that the interfaces do not interact with each other and bulk properties are maintained at the center. Qualitatively, we find that ionic aggregates are much less common at the interface, in agreement with prior experimental findings. Quantitative density profiles show that there is a pronounced layering of neutral and charged groups at the interface. We bring two surfaces in contact to study adhesion. These analyses were done systematically for systems with varying ion content similar to commercial grades of Surlyn."
Research Project Title: Quantification of active apohemoglobin heme-binding sites via dicyanohemin incorporation

Student Presenter: Ivan Pires

Faculty Mentor: Andre Palmer

Faculty Mentor Department: Chemical and Biomolecular Engineering

Research Abstract: Apohemoglobin (apoHb) is produced by removing heme from hemoglobin (Hb). However, preparations of apoHb may contain damaged globins, which render total protein assays inaccurate for active apoHb quantification. Fortunately, apoHb heme-binding sites react with heme via the proximal histidine-F8 (His-F8) residue, which can be monitored spectrophotometrically. The bond between the His-F8 residue of apoHb and heme is vital for maintenance of fully functional and cooperative Hb. Additionally, most apoHb drug delivery applications facilitate hydrophobic drug incorporation inside the apoHb hydrophobic heme-binding pocket in which the His-F8 residue resides. This makes the His-F8 residue a proper target for apoHb activity quantification. In this work, dicyanohemin (DCNh), a stable monomeric porphyrin species, was used as a probe molecule to quantify active apoHb through monocyanohemin-His-F8 bond formation. ApoHb activity was quantified via the analysis of the 420 nm equilibrium absorbance of DCNh and apoHb mixtures. His-F8 saturation was determined by the presence of an inflection point from a plot of the 420 nm absorbance of a fixed concentration of apoHb against an increasing DCNh concentration. Various concentrations of a stock apoHb solution were tested to demonstrate the precision of the assay. The accuracy of the assay was assessed via spectral deconvolution, confirming His-F8 saturation at the inflection point. The effect of the heme-binding protein bovine serum albumin and precipitated apoHb on assay sensitivity was not significant. An analysis of the biophysical properties of reconstituted Hb confirmed heme-binding pocket activity. Taken together, this assay provides a simple and reliable method for determination of apoHb activity.
Research Project Title: Photoswitchable quantum dot fluorescent probes for high resolution 3-dimensional stochastic optical reconstruction microscopy

Student Presenter: Thomas Porter

Faculty Mentor: Jessica Winter

Faculty Mentor Department: Chemical and Biomolecular Engineering, Biomedical Engineering

Research Abstract: High resolution imaging in thick tissue has the potential to elucidate important biological processes in vivo. However, due to scattering and optical irregularities present in thick tissue, resolution less than 50 nanometers has been difficult to achieve in 3D imaging. Stochastic optical reconstruction microscopy (STORM) can overcome the diffraction limit of optical imaging by reconstructing an image from thousands of optically resolvable images where localization is attained by stochastic photoswitching of fluorescent probes. By developing photoswitchable fluorescent probes with higher optical cross section, turnover rate, and stability than currently used fluorescent dyes, resolution can be greatly increased. Quantum dots (QDs) are strong candidates as fluorescent probes for imaging because of their higher photon emission rates and increased stability against photobleaching compared to fluorescent dyes. Since QDs are not inherently photoswitchable, current research is focused on developing them as STORM probes for 3D super-resolution imaging. Photoswitchability can be achieved in QDs through the proximity dependent Förster resonance energy transfer (FRET) mechanism with gold nanoparticles (AuNPs) as the quenchers. This study proposes the development of reversibly photoswitchable QD-AuNP probes conjugated by complementary azobenzene modified single-stranded DNA oligonucleotides. Reversible photoswitchability is accomplished by manipulating DNA stability via light-induced azobenzene isomerization. However, preliminary probes developed in our lab did not achieve maximum FRET efficiency because of steric hindrance from the thick polymeric surfaces of commercial aqueous QDs. Therefore, the loops-trains-tails method is being used for aqueous transfer of QDs with a compact multifunctional peptide coating to improve FRET efficiency above 95%. These probes are being studied using fluorescence measurement with simultaneous azobenzene induced on/off switching controlled by an external laser. The optimized probes will then be analyzed by comparison with current STORM probes. The final QD-AuNP probes should provide high photon counts and localization precision for high resolution 3D STORM imaging.
Research Project Title: Investigating catalyst deactivation in a packed bed reactor for glucose to fructose isomerization

Student Presenter: Nora Shaheen

Faculty Mentor: Nicholas Brunelli

Faculty Mentor Department: Chemical Engineering

Research Abstract: Glucose isomerization to fructose is a key reaction in the conversion of biomass to higher valued products such as biofuels and specialty chemicals. Recent studies in using organic base catalysts have shown promise as homogeneous catalysts. These materials have provided a pathway for the development of heterogeneous analogues that are more easily separated from the bulk solution. In this study, heterogeneous catalysts have been synthesized by immobilizing a basic tertiary amine organosilane to the surface of a mesoporous silica support, SBA-15. While the catalyst provides a viable route to effectively catalyze the reaction, performance limitations remain due to catalyst deactivation. Current work focuses on investigating the deactivation pathway of the catalyst by pairing pre- and post-reaction characterization data with kinetic testing data. Preliminary results indicate the collapse of the silica micropores under hydrothermal conditions may be a significant contributor to deactivation. By tuning the catalyst structure, the catalyst will provide a sustainable, and inexpensive method for the isomerization of glucose to fructose.
Research Abstract: Low-cost and environmentally friendly district heating has become a popular trend in northern Europe. These systems use excess heat from plants or factories to heat water, which is then pumped to homes and buildings in the area to heat them up. To decrease costs in these systems, studies have shown that a drag reducing surfactant additive can be added to the hot water in order to increase the flow rate without requiring additional pump energy. However, due to their tendency to reduce turbulent mixing, drag reducing solutions are not typically effective heat transfer fluids. For this reason, it is desirable to develop drag reducing solutions with switchable properties such that they will be drag reducing in part of the district heating system and non-drag reducing in other sections. In this study, one such solution was developed showing 1 degree temperature switchability.

An aqueous drag reducing solution made of 3-chlorobenzoate and Arquad S50 was developed and pumped through a recirculating flow system. At a constant Reynolds Number of 30,000, temperature sweeps were performed in order to determine the heat transfer and drag reducing properties of the system and demonstrate its switchability. Temperature and pressure drop readings were recorded.

As the solution’s temperature was increased, it experienced a sharp increase from 5% to 71% drag reduction at 24.6 degrees Celsius. At two tenths of a degree lower, the solution was non-drag reducing at 5%. In addition, the solution increased from 19% to 85% in heat transfer reduction. Similarly, two tenths of a degree lower, heat transfer reduction was measured at 8%.

The solution’s temperature was then decreased. As a result, the solution experienced a sudden drop from 86% to 22% heat transfer reduction. Following this, the solution went from drag reducing to non-drag reducing almost instantly at 23.3 degrees Celsius, dropping from 66% to 4% drag reducing.

This solution can be applied to district heating systems, along with other recirculating systems. This scheme will allow the drag reducing and heat transfer reduction properties of the solution to be activated and deactivated on demand almost instantly.
Research Project Title: Development of a switchable and tunable surfactant drag reducing solution for application in district heating and cooling systems

Student Presenter: Lucas Watson

Faculty Mentor: Jacques Zakin

Faculty Mentor Department: Chemical Engineering

Research Abstract: Drag reduction is a flow phenomenon by which very low concentrations of high aspect ratio particles entrained in a liquid can reduce the turbulent pressure drop by up to 90%. The most common examples of these are high molecular weight polymers used to reduce pumping costs in oil transport pipelines; however, various other types of drag reducing additives (DRAs) exist. Polymer DRAs are limited to once-through applications without heat transfer. This is due to their degradation by shear stresses in pumps, as well as the reduced heat transfer ability that comes with drag reduction.

Surfactant DRAs are of particular interest due to their self assembled nature. Because surfactant DRAs reassemble after periods of high shear (ie in pumps), they can be used in recirculating systems such as district heating and cooling systems. Furthermore, the complex chemistry of surfactant self assembly allows for the development of solutions with switchable drag reducing and heat transfer properties.

The drag reducing solution for this study was developed based upon applying the thermodynamics of micelle formation to published drag reduction data. Drag reduction measurements were done by measuring the pressure drop in a straight length of tube and comparing friction factors for the DRA solution and pure water. Heat transfer reduction measurements were done by measuring the temperature difference across a shell and tube heat exchanger and comparing convective heat transfer coefficients for the DRA solution and pure water. Rheology data was taken using an ARES rheometer with a cone and plate geometry. Experiments were done at various shear rates and temperatures.

In this study, a surfactant drag reducing solution was developed that shows remarkable responsiveness to changes in shear rate and temperature. Furthermore, the effects of temperature and shear on drag reduction have been shown to be tunable.
Research Project Title: Utilizing microscopy techniques to study the growth phase and spatial distribution of fungi and bacteria in carpet and carpet dust

Student Presenter: Lingyi Xu

Faculty Mentor: Karen Dannemiller

Faculty Mentor Department: College of Engineering, Civil, Environmental & Geodetic Engineering
College of Public Health, Environmental Health Sciences

Research Abstract: Elevated relative humidity can cause microbial growth in carpet dust. However, this growth is not well-characterized. We utilized microscopy to identify the growth phase and spatial distribution of fungal growth in carpet and carpet dust, including identifying an appropriate stain. We used a LABOMED Lx500 microscope to examine carpet fibers with and without embedded dust that were incubated at 100% equilibrium relative humidity for 3 weeks. Fungal growth was observed on both the carpet fiber and dust. We evaluated three stains to visualize this growth, including Calcoflour white stain 5mM, a LIVE/DEAD BacLight Bacterial Viability Kit L13152 and acridine orange stain. Calcoflour white stain is a fluorescent blue dye that is used to observe fungi, algae and plants. The excitation time of this stain is 360nm, but the shortest wavelength of the LABOMED Lx500 microscope is 480nm. the LIVE/DEAD BacLight Bacterial Viability Kit L1315 contains a mixture of two components, Component A and Component B. Component A, SYTO9, is a green fluorescent nuclei acid stain which can show an intact membrane under 480/500nm. Component B is a propidium iodide, a red-fluorescent nuclei acid stain which shows bacteria with damaged membranes under 490/635nm. After observing images taken from the microscope, the optimal ratio of SYTO9-PI for observing the samples was determined to be 40:10 â€“ 30:20. However, this stain only works for bacteria and not fungi. Using the acridine orange stain, fungi and bacteria are observed with an orange tint under 480um with 1000X magnification, though this stain must be adjusted with a buffer solution. Overall, growth was observed in the carpet dust, and more work will be conducted to optimize the use of a stain to observe both fungi and bacteria in carpet and carpet dust.
Research Project Title: Analysis of traffic related pollution through low cost mobile air quality sensors

Student Presenter: Emma van Dommelen

Faculty Mentor: Andrew May

Faculty Mentor Department: Civil and Environmental Engineering

Research Abstract: Air pollution monitoring is often stationary and expensive, failing to provide easily accessible real-time data in most nearby locations to where people live and work. In an age of technology, it should be possible to obtain this type of information to create a better understanding of health impacts associated with air pollution. The purpose of this investigation and analysis is to create a method of regular low-cost mobile air quality sampling for Ohio State University’s (OSU) campus using OSU’s bus system, Campus Area Bus Service (CABS), as a mobile platform and locate highly concentrated areas of traffic emissions. These highly concentrated areas could be hazardous for students who are walking to class on a daily basis. Regular weekly data collection from the sensors will populate a program for overlaying the concentration of each pollutant on a map of the campus. Further analysis will reveal correlations between air quality and traffic activity, where conclusions can be drawn about the health impacts on students.
Research Project Title: Noble gas approach to the source of hydrocarbons in Gulf of Mexico gas hydrates

Student Presenter: Brent Lary

Faculty Mentor: Thomas Darrah

Faculty Mentor Department: School of Earth Sciences

Research Abstract: Global gas hydrate deposits along continental slopes and below permafrost are estimated to contain ~1000 gigatons of carbon. However, their role in the energy sector and the global carbon cycle remains uncertain. Integrating noble gas geochemistry with conventional hydrocarbon molecular and isotopic approaches offers insight into how natural gas contained in hydrates was generated (e.g., biogenic, thermogenic, mixed) and the manner in which hydrocarbons contained in clathrates migrated. An improved understanding of how natural gasses contained in clathrates formed will improve exploration techniques, the fundamental understanding of their formation mechanisms and help better estimate their economic potential. Furthermore, if natural gas is produced in situ by methanogenic archaea, noble gas data can help determine the age of the natural gas formation and fluid residence time in hydrate reservoirs.

Because the original noble gas composition of a fluid is preserved independent of microbial activity, chemical reactions, or changes in oxygen fugacity, the integration of noble gas data can provide both a geochemical fingerprint for sources of fluids and an additional insight as to the uncertainty between effects of mixing versus post-genetic modification. Pressurized cores acquired from the UT-GOM2-01 drilling project in the GC955 block of the Green Canyon within the Gulf of Mexico were analyzed for hydrocarbon (e.g., C1-C6) composition, major gas abundances (e.g., H2, N2, CO2), and noble gases and their isotopes (e.g., He, Ne, Ar). Clathrates acquired during this cruise were dominantly biogenic and contained evidence of 2-phase migration with a residence time of 6.2 to 49.8 kyr. Supplemental geochemical data from three additional locations within the Gulf of Mexico from previous studies was also analyzed. The additional data demonstrated contributions from biogenic and thermogenic sources.
Research Project Title: Converting natural gas to H2 using high pressure chemical looping

Student Presenter: Tyler Christeson

Faculty Mentor: Fan Yes

Faculty Mentor Department: Liang-Shih

Research Abstract: Hydrogen (H2) is a clean, secondary fuel derived from natural gas and is expected to increase in proportion to the increase in natural gas consumption, driven by factors like the shale gas boom. Currently, ~90% of all H2 is produced via Steam Methane Reforming (SMR). SMR is an endothermic reaction, which requires external natural gas combustion to provide for the heat to sustain. Further, SMR produces syngas which requires several processing steps before pure H2 can be obtained. The iron-based moving bed chemical looping technology developed at the Ohio State University (OSU) is a promising candidate to reduce costs associated with SMR for H2 production. The OSU system performs the natural gas utilization and H2 production in two separate reactors, eliminating the need for multiple processing units for H2 purification. Initial estimates have shown an improvement in production (2.4 moles of H2 per mole of carbon in natural gas for chemical looping as opposed to 2.2 moles of H2 in the same basis for SMR system). Earlier results quantifying the thermodynamics of the chemical looping system atmospheric pressure are promising, however applications utilizing H2 require it to be supplied at pressures of ~30-50 bar. This study seeks to quantify the thermodynamic feasibility of high-pressure chemical looping applications. Identified optimal isothermal operating conditions are used for simulating commercially relevant adiabatic reactor operation. Investigation of variation in the pre-heats of natural gas, the amount of supports to synchronize the endothermic reducer reactor and the exothermic combustor reaction show maxima in trends associated with each reducer inlet temperature and operating pressure. The study will investigate the individual and synergistic effects of variables like the number of compressor and expander stages, variation in reactant space hourly velocities and the trade-offs associated with using pinch and transshipment type technology for heat exchanger network synthesis. Preliminary results show that operating chemical looping systems at higher pressures is feasible with an autothermal production achieved at pressures of 32 and 64 bar, while maintaining better performance than conventional SMR systems and atmospheric chemical looping systems.
Research Project Title: Protein engineering for improved split intein purification

Student Presenter: Maria Znidarsic

Faculty Mentor: Wood No

Faculty Mentor Department: David

Research Abstract: The purification of proteins is often associated with significant downstream processing in order to achieve an acceptable purity for both research and industrial purposes. Several methods and technological developments have been employed to address the challenge of increasing the yield of protein product while maintaining high purity and justifiable costs. Affinity ligand technology offers a powerful purification platform with high specificity that relies on an attached protein tag. Limitations associated with later tag removal can be avoided through use of a self cleaving split intein.

An ongoing challenge regarding self-cleaving inteins lies in performance variability dependent on the protein to be purified. Differences in cleavage rate and yield based on the protein of interest significantly limits the potential reach of the split intein purification platform. Previous research accredited the inconsistent behavior to differences in the inherent characteristics of the intein. However, an initial analysis on the first two amino acids following the intein suggests that the identity of these amino acids is a more significant factor as to how the intein behaves.

The group looks to further analyze the effect of the amino acids directly surrounding the intein. Specifically, the group will expand on the previous work by studying the amino acids following and preceding the intein. The experiment will involve measuring pH sensitivity, cleavage rates and protein yields.

The results from this experiment intend to provide insight into the effect of the sequence of amino acids directly surrounding the intein on cleaving amount or rate. This sort of discovery could allow proteins that were once were not thought to work with this technology to be salvaged by simply adding a certain amino acid. If the identity of the certain amino acids surrounding the intein are discovered to have a significant effect, it could greatly increase the reliability and economic efficiency of the purification platform using split intein technology.
Research Project Title:

Student Presenter: Kian Boon Low

Faculty Mentor: Fan Yes

Faculty Mentor Department: Liang-Shih

Research Abstract: Hydrogen Production from Ammonia Decomposition via Chemical Looping System
Research Project Title: Influence of substrate mechanical properties on lens epithelial cell behavior

Student Presenter: Mallory Allen

Faculty Mentor: Katelyn Swindle-Reilly

Faculty Mentor Department: Biomedical Engineering

Research Abstract: Worldwide, it is estimated that more than 23 million cataract surgeries are performed each year. Posterior capsular opacification (PCO), or secondary cataract, is the most common complication after cataract surgery, but current clinical solutions are expensive, incomplete, and are not available in developing countries. This complication has been reported in as many as 50% of all patients 2-5 years after surgery, with a higher incidence for pediatric patients. PCO occurs when lens epithelial cells (LEC) adhere to the surface of the intraocular lens (IOL) implanted after cataract extraction and then undergo a transition into mesenchymal cells, making the surface of the implant blurry. While PCO has been widely studied, little to no research exists to examine the link between mechanical properties of implanted IOLs and occurrence of secondary cataract after surgery. The goal of this project is to close this scientific gap by measuring mechanical properties of a series of amphiphilic polymers and investigating their impact on lens epithelial cell (LEC) response. The monomers used for preparing these polymers are similar to those found in commercially available IOLs. Polymers with different levels of crosslinking were synthesized to modulate mechanical stiffness. The elastic moduli of these polymers were measured through atomic force microscopy (AFM), and morphology was determined using scanning electron microscopy (SEM). An MTT assay was used to assess LEC viability on the polymers. Microscopy and assays were used to measure the epithelial-to-mesenchymal transition (EMT) markers that are characteristic of PCO. These results can potentially provide information on whether mechanical properties can be optimized for IOLs to prevent secondary cataract.
Research Project Title: The long-term residual effects of low intensity vibration on remodeling of trabecular bone in murine femurs

Student Presenter: Megan Balgemann

Faculty Mentor: Richard Hart

Faculty Mentor Department: Biomedical Engineering

Research Abstract: Introduction/Background: Over 50% of women over the age of 65 in the United States are affected by osteoporosis, a degenerative bone disease (Rubin et al., 2006, Low-Level Mechanical Signals). Low-intensity vibration (LIV) treatment is proven to counteract the effects of osteoporosis by restoring bone density. However, little is known about the time-dependent nature of LIV. There is no guarantee that vibration therapy will inhibit further development of osteoporosis later in life. This study aimed to investigate the long-lasting effects of vibration therapy. By performing an experiment with an initial LIV regimen, then designating an extended time-period of rest before analysis, the lasting effects of LIV can be observed and quantified.

Methods: For this investigation, vibrations of 0.3g accelerations at 90 Hz were applied to 119 10-week-old female BALB/cByJ mice for 15 minutes per day, 5 days per week over 8 weeks, and rest period durations were 0, 8, and 16 weeks after completion of the vibration (N=17). Calcein and alizarin fluorochrome labels were administered a week apart. These labels attach to new bone and indicate areas of bone remodeling. Femurs were embedded in opaque PMMA resin, then sectioned using a Leica Jung 2035 Rotary Microtome (Wetzlar, DE). Cross sections were imaged under 90x magnification with UV light.

Results: Preliminary results show calcein and alizarin labels on trabeculae. Fluorochrome analysis of trabecular bone will be performed by importing deconvoluted images to CalceinHisto software which analyzes parameters including bone formation rate, mineral apposition rate, and mineralizing surface to bone surface ratio (Liverpool, UK). Expected results include observing increased trabecular density and thickness after 8 weeks of vibration. In groups that experienced rest periods, trabecular density will either remain elevated or decline over time.

Conclusions: If bone density is shown to decline, LIV treatment may be required for a prolonged time period in order for the effects to endure throughout a patientâ€™s lifetime. However, if the findings show that bone density remains elevated over time, it will support the lasting positive effects of vibration therapy, and eliminate the need for long-term treatment.
Research Project Title: Interstitial flow combined with CXCL12 promotes breast cancer cell invasion

Student Presenter: Talia Arcieri

Faculty Mentor: Jonathan Song

Faculty Mentor Department: Mechanical & Aerospace Engineering

Research Abstract: Introduction/Background: Metastasis is responsible for 90% of deaths attributed to breast cancer. CXCL12, an inflammatory stromal cytokine, has been shown to be overexpressed in 25-30% of metastatic breast cancer patients. In addition, slowly moving fluid flow through the extracellular matrix (ECM), known as interstitial flow, is believed to promote cancer cell invasion leading to metastasis. Therefore, the goal of this study was to identify the tumor metastasis promoting effects of combined CXCL12 stimulation with interstitial flow.

Methods: We compared the responses of two breast cancer cell lines: MCF10A, a non-transformed mammary epithelial breast cancer cell, and MCF10CA1a, a malignantly transformed variant of MCF10A. Invasion was studied using a novel 3-D microfluidic invasion assay comprised of type I collagen ECM. CXCL12 was administered at a concentration of 100 ng/mL and refreshed daily. ImageJ software was used to measure cell invasion. In addition, three interstitial flow conditions were administered: i) static control condition, ii) low flow driven by passive pumping (~5 Âμm/s), and iii) high flow (~10 Âμm/s) driven by a hydrostatic pressure gradient.

Results: When MCF10CA1a cells were treated with CXCL12, we observed that interstitial flow (both low and high) significantly promotes invasion of these cells compared to cells with no CXCL12 and interstitial flow stimulation. Under the static/no flow condition, there was no difference in the level of invasion for the MCF10CA1a cells in the presence and absence of CXCL12. For the MCF10A cells, CXCL12 stimulation did not induce any invasion into the ECM except when combined with low interstitial flow. This result suggests that combined stimulation of interstitial flow with CXCL12 can selectively impart a pro-metastatic effect on non-malignant MCF10A cells.

Conclusions: We show that the addition of interstitial flow through the ECM significantly promotes CXCL12-mediated breast cancer cell invasion. Future directions of this study include applying our microfluidic system as a sensitive screening platform for candidate compounds that stop cancer invasion.
Research Project Title: Modulation of hydraulic permeability in a microfluidic model of the tumor stroma

Student Presenter: Jonathan Chang

Faculty Mentor: Jonathan Song

Faculty Mentor Department: Mechanical Engineering

Research Abstract: The tumor microenvironment (TME) plays a critical role in regulating cancer progression and the development of therapeutic resistance. Cancer-associated fibroblasts (CAFs), a specialized stromal cell type, can remodel the architecture and physical properties of the TME. Moreover, loss of the tumor suppressing gene phosphatase and tensin homolog (PTEN) has been shown to augment cancer growth. In preliminary experimentation, we have created a microfluidic model of the tumor stroma and refined techniques for assessing the TME’s physical properties. Specifically, PTEN deleted pancreatic CAFs significantly decreased the hydraulic permeability of the TME in comparison to controls. We hypothesized that the PTEN deleted CAFs remodeled their surrounding microenvironment to lead to this decreased permeability. Therefore, the specific goals of this project were (1) to investigate the use of therapeutic treatments for alleviating the negative effects of PTEN deletion and (2) to elucidate how changes in matrix structure affect hydraulic permeability. For experiments, a straight channel microfluidic device was fabricated out of polydimethylsiloxane and injected with CAF suspended collagen gel. Then, a pressure difference was applied to the channel to flow a fluorescent tracer dye into the microdevice. Time-lapse videos of the moving dye were taken to obtain flow speed which is used to calculate hydraulic permeability. To test methods for recovering reduced hydraulic permeability, two drugs were used: hyaluronidase and an AKT-inhibitor (MK2206). These therapeutics were chosen respectively for their ability to degrade or inhibit the secretion of hyaluronan an ECM molecule hypothesized to decrease permeability. In agreement with our hypothesis, both treatments significantly increased hydraulic permeability of the PTEN deleted CAFs to levels comparable to the control. To examine how changes in microenvironmental composition affect permeability, acellular collagen gels were created and supplemented with transglutaminase II a collagen crosslinker and hyaluronan. After performing hydraulic permeability measurements, our initial results indicate that the addition of hyaluronan may lower hydraulic permeability, but collagen crosslinking has minimal effect. These findings corroborate our hypothesis that PTEN deleted CAFs decrease the hydraulic permeability of the TME via hyaluronan secretion. The results of this project could eventually be developed into stroma-targeted treatments for combating tumor aggression.
Research Project Title: In-situ characterization of collagen mineralization using atomic force microscopy

Student Presenter: Zhengyang Du

Faculty Mentor: Hanna Cho

Faculty Mentor Department: Mechanical and Aerospace Engineering

Research Abstract: Category: Engineering

Title: In-situ Characterization of Collagen Mineralization Using Atomic Force Microscopy

Student Presenter: Zhengyang Du

Faculty Advisor: Cho, Hanna

Collagen is an abundant protein that exists in our human body and other animals. It has a wide range of formations in different tissues with specific functions such as toughening bone, tendon, dentin, softening cartilage etc. It is also well known for being one of the main components in bone. Its piezoelectricity and other electromechanical properties play important roles in the mineralization and remodeling process of bone. My research will focus on characterizing the collagen mineralization process and mimicking the bioprocess of collagen mineralization to study the behavior and mechanism of bone mineralization by applying the state-of-the-art Atomic Force Microscopy (AFM) techniques. The mechanism of collagen mineralization can also be further utilized to design smart materials with the ability to control its own mechanical properties in different environments.
Research Project Title: Influence of amphiphilic polymers on corneal wound healing

Student Presenter: Sophie Carus

Faculty Mentor: Katelyn Swindle-Reilly

Faculty Mentor Department: Biomedical Engineering

Research Abstract: The cornea is the outermost layer of the eye, making it more susceptible to injury. In 2015 approximately 604,000 individuals in the US underwent some form of refractive laser surgery. Many individuals who undergo refractive laser surgery develop corneal flaps created by the surgery that do not fully heal and do not completely reattach to the cornea even years after surgery. Additionally, 27% of all patient visits for ocular injuries are the result of corneal abrasions and lacerations. Instances of improper corneal wound healing indicate a clinical need for a therapeutic method to improve corneal wound healing without scarring. Throughout the phases of corneal wound healing, fibroblasts and myofibroblasts proliferate and begin to form an extracellular matrix, which frequently causes abnormal healing that results in opacity, leading to the requirement of a corneal transplant. Many researchers have studied the mechanical and biological properties of healthy corneas while others have seen epithelial cell migration on therapeutic contact lenses after surgery. However, despite this extensive research there is a scientific gap in the understanding of how the chemical and mechanical properties of materials influence corneal wound healing. The purpose of this study aims to identify the optimal surface free energy that promotes preferential attachment of corneal epithelial cells to ultimately design better materials, such as therapeutic bandage lenses, for use in corneal repair. Amphiphilic polymers with different ratios of 2-hydroxyethyl methacrylate (HEMA) and 3-methacryloxypropyltris(trimethylsiloxy)silane (TRIS) were synthesized via free radical copolymerization to produce amphiphilic copolymers. Surface free energies will be determined utilizing a goniometer to take contact angle measurements. Seeding of corneal epithelial cells onto the polymer films will be done to determine cell attachment and viability differences between the polymers. MTS assays will be performed to determine how the polymers influence epithelial cell growth. Following initial results further research will be done into mechanical properties to develop a therapeutic bandage lens to enhance corneal epithelial wound healing without scarring.
Research Project Title: Role of miR-210 on macrophage polarization in wound microenvironment

Student Presenter: Summer Gallentine

Faculty Mentor: Sashwati Roy

Faculty Mentor Department: Surgery

Research Abstract: Macrophages are major contributors to cutaneous wound healing. Macrophages are highly plastic cells which differentiate to proinflammatory type I macrophage (M1) or anti-inflammatory or proreparative type II macrophage (M2) phenotypes based on environmental cues. Immune response to wounds relies heavily on oxygenation of tissue in the wound microenvironment. Ischemia of wound leads to hypoxia, significantly decreasing the ability of a wound to heal. In response to hypoxia, macrophage polarization shifts towards the pro-inflammatory state. miRNAs (micro-RNAs) are segments of RNA that code for gene regulation and expression through binding of coding mRNA and play a crucial role during inflammation. miR-210 is a hypoxia-inducible miR (hypoxamiR), which is ubiquitously expressed in a wide range of cells, serving versatile functions. Current literature on miR-210 suggests that microRNA-210 negatively regulates LPS-induced production of pro-inflammatory cytokines by targeting NF-κB1 in murine macrophages. However there is no evidence on the role of miR-210 in wound macrophages in vivo. To elucidate the significance of wound macrophage miR-210 in wound inflammation, an animal model with myeloid specific knock down of miR-210 was developed by crossbreeding mice carrying floxed miR-210 allele (miR-210 fl/fl) with LysM-Cre mice. The animals’ genotypes were confirmed through DNA tail digestion and PCR. Wound macrophages were isolated from subcutaneously implanted PVA sponges through repetitive squeezing and CD11b positive selection. Bone marrow-derived monocytes (BMDM) were isolated from the femurs of these mice using magnetic beads conjugated with CD11b antibody. A significant knockdown of miR-210 was observed both in the wound macrophages as well as the BMDMs. Current studies are ongoing to test the significance of the miR-210 in macrophage polarization which would enable an understanding of the miR-210-dependent mechanisms that are impaired in chronic wounds.
Research Project Title: Augmented reality training to reduce battlefield deaths

Student Presenter: Simon Fernandez

Faculty Mentor: Emily Patterson

Faculty Mentor Department: Human Factors Engineering

Research Abstract: Tension pneumothorax is one of the primary conditions that lead to preventable deaths in military combat casualties. Pneumothorax is a collected pocket of fluid in the thoracic cavity. When the pressure exerted by the pneumothorax on the lungs and heart is great enough, it rapidly deteriorates into tension pneumothorax, defined by severe cardiovascular distress, and is immediately life threatening. Rate of preventable death from all causes had not changed in the armed forces from the Vietnam War to Operation Enduring Freedom. New training doctrine by the Committee on Tactical Combat Casualty Care has significantly reduced this rate by focusing on increased speed of treatment. Doctrine has established a focus on rapid diagnosis and aggressive treatment by use of needle decompression. Current training standards use manikin simulations, which while effective in training reduced time to treatment, does not adequately support reducing time to diagnosis. Manikin simulations lack subtle cues, the recognition of which is important for developing expertise as a clinician. Diagnosis expertise through recognizing subtle symptoms in the patient can lead to a condition being identified earlier, and in a less severe state, increasing patient survival. Augmented Reality (AR) simulations, which would display a computer-generated model of a patient over a manikin, can display subtle and dynamic cues. In a clinical setting, tension pneumothorax is diagnosed with chest imaging. Medics can only use a small range of symptoms to diagnose, each symptom individually not indicative of tension pneumothorax. Thus, the medic must rely on a combination of subtle symptoms to diagnose tension pneumothorax in the field, and training simulations that better display subtle cues should reduce time to diagnosis. The hypothesis is that novice medics (>2 years of experience) trained using the augmented reality training course will have a significantly lower time to diagnose tension pneumothorax than those medics trained using the standard course. Using the Garden Path method of scenario design, medics from the training groups will be evaluated. Anticipated results are that AR trained medics will have a faster time to diagnose. Ultimately, faster diagnosis on the battlefield means more casualties that survive.
Research Project Title: Biomimetic and biophysical approach to profile metastatic cancer cell migration

Student Presenter: Jacob Enders

Faculty Mentor: Jonathan Song

Faculty Mentor Department: Mechanical Engineering

Research Abstract: Introduction: Metastasis, the spread of a primary tumor to secondary sites, is responsible for up to 90% of cancer-related deaths. Intrinsic to the process of metastasis are the modes of cell migration that allow primary tumor cells to invade nearby tissues and blood vessels. Amoeboid migration is one such method, where cells navigate via subcellular blebbing. However, the forces involved in amoeboid migration are not yet fully understood, and current methods for measuring cell-generated forces such as cellular traction force microscopy (CTFM) are largely limited to 2-D assays. We aim to overcome these challenges by functionalizing polydimethylsiloxane (PDMS) microdevices with nanoscale DNA origami force sensors (DOFS) to create a 3-dimensional system for nanoscale force measurement.

Materials and Methods: The PDMS microfluidic devices are fabricated by soft lithography replica molding in our laboratory, and are then bonded to glass slides using plasma oxidation to create an array of confined 3-D microtracks. The devices are flushed with streptavidin, a protein with a high affinity for biotin on the ends of the DOFS. The DOFS are then injected at a 1 nM concentration and bind with the streptavidin to create a uniform distribution of sensors in the microfluidic device. Tracking the fluorescent states of the DOFS using total internal reflection microscopy (TIRF) and fluorescent resonance energy transfer (FRET) allows for nanoscale force measurement.

Results and Discussion: Results show a statistically significant, two-fold increase in average DOFS attachment when streptavidin present versus DOFS alone. Furthermore, a concentration of 1000 pM is optimal to ensure sufficient coverage while limiting sensor aggregation. DOFS at 1000 pM bind with a mean of 32 sensors per 100 um2. We have also successfully seeded and tracked individual cells in microchannels and can image the cells and DOFS simultaneously using our TIRF microscope.

Conclusions: Our microfluidic devices are able to be functionalized with DNA origami force sensors with high efficiency. Nearly all DOFS remain in the open state upon attachment. Future work will include measuring cell generated forces in both the mesenchymal and amoeboid phenotypes to gain insight into their contrasting mechanisms.
Research Project Title: Non-toxic approach for treatment of breast cancer and its cutaneous metastasis: Capecitabine (XelodaTM)-enhanced PhotoDynamic Therapy in a murine tumor model

Student Presenter: Mukul Govande

Faculty Mentor: Sanjay Anand

Faculty Mentor Department: Biomedical Engineering

Research Abstract: Breast Cancer (BCA) is the most frequently diagnosed cancer in women, with 1.7 million new cases diagnosed worldwide each year. In BCA patients, distant metastases to lung, liver, bone and skin (cutaneous metastasis) are seen in approximately 40% cases. As an additional complication, local chest wall relapse and metastases occur at a rate of 5%. Ionizing radiation therapy (RT) has been successfully employed for the treatment of cutaneous metastases; however, multiple rounds of RT are required and are associated with undesirable side effects such as radiation dermatitis, blistering and chronic ulcers. This study explores PDT as an alternative to RT, that could be used either alone or in combination with RT and chemotherapy. We have developed differentiation-enhanced combination PDT (cPDT), a concept in which a differentiation-promoting agent (methotrexate; vitamin D; or 5-fluorouracil, SFU) is used as a neoadjuvant prior to PDT. When given prior to ALA, the neoadjuvants increase the levels of protoporphyrin IX (PpIX) in animal tumor models of skin, prostate, and BCA, and lead to better PDT efficacy following ALA-PDT. However, the neoadjuvants have toxicity issues when administered systemically. Here, we use a nontoxic SFU precursor called Capecitabine (CPBN) for cPDT. CPBN is a standard chemotherapeutic for metastatic BCA that is metabolized to 5FU specifically within tumor tissue. Murine (4T1) BCA cell line was injected into breast fat pads of nude mice. After tumor nodules appeared, CPBN (600 mg/kg/day) was administered by oral gavage for 5 days followed by i.p. ALA administration on day 6. Mice were either sacrificed and tumors harvested, or were treated with 100 J/cm2 of red light (633 nm). CPBN pretreatment of 4T1 tumors led to increased tumor cell differentiation, homogenous elevation of PpIX levels, and enhanced tumor cell death post-PDT, relative to vehicle control. As anticipated, CPBN treatment decreased proliferation in 4T1 tumors. Using an in vivo imaging system (IVIS), a decline in tumor growth following PDT was observed in the CPBN-PDT group. In summary, the data from this study using non-toxic CPBN as a neoadjuvant for PDT suggests a combination approach that has significant potential for translation into the clinic.
Research Project Title: Long-term residual benefits of LIV therapy on murine cortical bone

Student Presenter: Kyle Kuchynsky

Faculty Mentor: Richard Hart

Faculty Mentor Department: Biomedical Engineering

Research Abstract: Introduction/Background: Low-intensity vibration therapy (LIV) exploits the body’s bone remodeling response to loading by administering low-magnitude, high-frequency loads to induce bone growth and inhibit bone resorption. Therefore, LIV can serve as an anabolic treatment for low bone mineral density due to osteoporosis, prolonged disuse, and other factors (Qin et al., 1998, Nonlinear dependence of loading; Ward et al., 2004, Low level mechanical loading). Though compliance is essential for improvement during treatment, it isn’t known whether there are residual benefits following a LIV regimen. This study focused on the long-term post-treatment benefits of LIV on cortical bone. If there are long-term benefits, patients who complete treatment can stop without regressing shortly after. It was predicted that up to 16 weeks after the completion of an 8-week vibration regimen, the cortical bone in mice exposed to LIV would see greater mineralization than that in controls.

Methods: 119 female BALB/cByJ mice were divided into one baseline control group, three experimental groups, and three control groups (N=17). For 8 weeks, 5 days per week, 15 minutes per day, experimental mice were exposed to 0.3g (g = 9.8 m/s²), 90 Hz accelerations via a LIV platform and control mice were placed on a resting platform. At 0, 8, and 16 week intervals after treatment, one experimental and control group were twice injected with saline-buffered alizarin or calcein fluorochrome solutions one week apart, then sacrificed. The femurs were excised, dehydrated in a graded ethanol series, and infiltrated and embedded in opaque PMMA. The embedded specimens were sliced using a Leica Jung 2035 Rotary Microtome (Wetzlar, DE) and longitudinal cross-sections were imaged under ultraviolet light to reveal fluorochrome labels, which are bone remodeling sites. The images were processed using a deconvolution script in MATLAB (Natick, MA), then analyzed in CalceinHisto (Liverpool, UK).

Results: Preliminary imaging results have revealed an abundance of distinct alizarin and calcein labels, including double labels in 8-week LIV cortical bone.

Conclusions: Preliminary imaging suggests that cortical remodeling has occurred in mice immediately after LIV. Quantitative results that show greater cortical remodeling activity in animals exposed to LIV compared to controls are expected.
Research Project Title: The effect of low intensity vibration on mouse femur modulus

Student Presenter: Michael Heyden

Faculty Mentor: Kyle Bodnyk

Faculty Mentor Department: Biomedical Engineering

Research Abstract: Introduction/Background: Osteoporosis is a common degenerative disease that results in a more porous bone structure (Kanis et. al, 1994). Decreased bone-mineral density makes bones more prone to fractures; therefore, it is critical to maintain good bone health to prevent injuries like these. As the general population continues to age, there is a demand for new methods to sustain bone vitality. One potential method to improve bone health is the application of low intensity vibration (LIV) (Oxlund et. al, 2003). Oscillatory forces from LIV can induce the formation of osteoblasts, bone-building cells, and reduce the formation of osteoclasts, bone-resorption cells. Increased osteoblast activity and decreased osteoclast activity should result in a higher bone density and modulus. This study sought to understand how applying LIV (15 min/day, 0.3 g, 91 Hz, experimental) or SHAM (no vibration, control) to 119 (N=17) 10-week-old female BALB/cByJ mice over 8 weeks, plus additional 8 and 16 weeks post treatment, affected femur modulus. Methods: After the other undergraduate assistants and graduate student completed the vibrational, euthanizing, and bone-preservation phase of the experiment, femurs of the LIV and SHAM groups were loaded in 3-point bending for quasi-static and Dynamic Mechanical Analysis (DMA) in a Bose Electroforce mechanical testing device (Framingham, MA). The results of mechanical testing, along with moment of inertia taken from Micro CT reconstructions of the femurs, allowed us to determine bone modulus. It was hypothesized that the groups that underwent LIV would demonstrate higher moduli than SHAM groups at all time points. T-tests were performed to compare data from LIV and SHAM to draw conclusions. Results: The preliminary quasi-static bending data suggests that 8-week LIV group was 5.08% stiffer compared to SHAM (p=0.0449). Conclusion: This is consistent with our hypothesis, indicating that LIV could potentially enhance bone strength and prevent the problems associated with osteoporosis. Further data analysis from 8 and 16-week post-treatment groups needs to be completed to draw more conclusions.

Sources:

Research Project Title: Role of βIV-spectrin in control of STAT3 signaling in cardiac fibroblasts

Student Presenter: Deborah Hong

Faculty Mentor: Thomas Hund

Faculty Mentor Department: Biomedical Engineering

Research Abstract: The fibroblast, a connective tissue cell, maintains the extracellular matrix (ECM) via chemical signaling that alters gene expression. Cardiac fibroblasts maintain structure and function of the heart, but through injury, these changes may become maladaptive, leading to fibrosis and reduced function. Signal transducer and activator of transcription 3 (STAT3) is a transcription factor that regulates genes involved in cell proliferation, survival, and synthesis of ECM components in fibroblasts. A complex involving cytoskeletal protein βIV-spectrin and STAT3 has been identified. Loss of βIV-spectrin function promotes STAT3 mislocalization, changes in gene expression, and maladaptive cardiac remodeling. While previous work has utilized a cardiomyocyte specific βIV-spectrin knockout mouse to examine the role of spectrin/STAT3 complex in cardiomyocytes, the role of this complex in non-myocytes (e.g. fibroblasts) and the mechanism by which STAT3 mislocalization results in altered gene transcription in any cell are not fully understood. This study will test the hypothesis that βIV-spectrin associates with STAT3 in cardiac fibroblasts to directly regulate gene expression of proteins related to stress signaling and cardiac remodeling. The following mouse models will be used: wild type, cardiomyocyte-, and cardiac fibroblast-specific βIV-spectrin knockouts. First, confocal microscopy will be used to study the distribution of STAT3 in fibroblasts in the presence and absence of βIV-spectrin. Next, quantitative PCR (qPCR) will be used to quantify the expression of genes that code for key proteins, and immunoblotting will be used to verify the presence of collagen, an indicator of fibroblast activation. Finally, viral infection will be used to knock out the βIV-spectrin gene in the fibroblasts and a cell proliferation assay will be used to quantify proliferation. Confocal microscopy shows STAT3 distributed throughout the fibroblast in the wild type and localization to the nucleus in the cardiomyocyte-specific βIV-spectrin knockout mouse model. Ongoing experiments will explore the spectrin/STAT3 association and how STAT3 alters gene expression and how this compares to cardiomyocytes in relation to cardiac remodeling. Completed experiments have shown that the loss of βIV-spectrin function promotes STAT3 mislocalization in fibroblasts, similar to that of cardiomyocytes. The mechanisms seen in cardiomyocytes and fibroblasts are potential targets for reducing or inhibiting remodeling effects.
Research Project Title: Characterizing the mechanical properties of the tumor extracellular matrix with a DNA origami sensor

Student Presenter: Kelly Kolotka

Faculty Mentor: Jonathan Song

Faculty Mentor Department: Mechanical Engineering

Research Abstract: Tumor growth and metastasis are believed to be promoted by alterations to the mechanical properties of the extracellular matrix (ECM). These mechanical alterations in tumors are also highly dynamic, but our understanding of the exact causes and consequences of tumor ECM remodeling is constrained by the current methodologies used to measure them. Therefore, the goal of this study was to better understand stability and matrix properties by developing a new sensor capable of detecting for alterations in the mechanical properties of the ECM with improved temporal and spatial resolution compared to current methodologies. To achieve this goal, we used the NanoDyn, a DNA origami nanostructure, which has been previously used to measure the mechanical properties of polyethylene glycol solutions. Our study aimed to adapt the NanoDyn for measuring stability and behavior within biological material. The NanoDyn detection scheme consists of a double barrel structure which can be either in an open or closed state depending on its surroundings. The state of the device is found by fluorescence resonance energy transfer (FRET) due to the changing proximity of two fluorophores. By measuring stability and overlap concentration of well-characterized polymer solutions, the NanoDyn was initially characterized. Then, stability testing for the NanoDyn in collagen and hyaluronan, which are two of the main constituents of tumor ECM, were conducted using transmission electron microscopy (TEM) and gel electrophoresis. Results from the overlap concentration measurements showed that the NanoDyn measurements coincide with accepted literature. Additionally, the NanoDyn has been found to be stable in collagen for two weeks by changing the solution composition from magnesium chloride to sodium chloride. Therefore, the NanoDyn structure has the capability of measuring biological components of the microenvironment due to early successes in stability and measurement. In future investigation, the NanoDyn in collagen and hyaluronan solutions will be analyzed using FRET to determine how these biological components impact the state of the NanoDyn. These findings would provide a better understanding of the tumor promoting properties of two of the main components of the ECM.
Research Project Title: The role of CaMKII-dependent augmented INa,L in arrhythmias during acute β-adrenergic stimulation

Student Presenter: Cemantha Lane

Faculty Mentor: Thomas Hund

Faculty Mentor Department: Biomedical Engineering

Research Abstract: The heart has evolved elaborate pathways for adapting its function to acute stress stimuli. Notably, sympathetic ß-adrenergic stimulation (ß-AS) contributes to the â€œfight-or-flightâ€ response elicited during stress. However, ß-AS has been shown to enhance arrhythmogenesis by causing Ca2+ overload in cardiac tissue,1,2,3 though the mechanism by which it leads to arrhythmogenesis remains incompletely understood. Previous research has implicated Ca2+/calmodulin-dependent protein kinase II (CaMKII) as a key enzyme that phosphorylates the cardiac sodium channel (Nav1.5) at Ser571 to regulate late sodium current (INa,L), and is activated following ß-AS. CaMKII-dependent increase in INa,L has been linked to cardiac dysfunction in the form of Ca2+ mishandling and arrhythmogenesis.4,5 Furthermore, INa,L blockers such as ranolazine have been shown to improve outcomes in patients with heart failure and arrhythmias.6,7 We hypothesized that CaMKII-dependent phosphorylation of the Nav1.5 Ser571 site and subsequent increases in INa,L are essential for Ca2+ handling defects and acute arrhythmic response during ß-adrenergic stimulation. To test our hypothesis, we examined Ca2+-transient duration, decay constant, and occurrence of premature ventricular contractions (PVCs) in wild type (WT) and Scn5a knock-in mice that either had a phosphomimetic mutation at the Ser571 site (S571E) or had the phosphorylation site ablated (S571A). The hearts of these mice were excised, and their calcium transients were optically imaged under control conditions and with isoprenaline (200 nM) to simulate ß-AS. Ca2+-transient duration at 80% maximal width (CaD80) was prolonged in S571E mice at baseline, while isoprenaline eliminated differences in CaD80 between S571E and WT. As expected, isoprenaline shortened CaD80 for all mouse models. While the Ca2+ decay constant was not different between S571E and S571A at baseline, S571E had a faster decay relative to S571A hearts with isoprenaline. Faster decay was observed for all mouse models with isoprenaline relative to baseline. Importantly, S571E hearts had more PVCs relative to WT or S571A. These data demonstrate that the CaMKII-dependent phosphorylation of the Nav1.5 Ser571 site is integral in Ca2+ handling and arrhythmogenesis with and without ß-adrenergic stimulation. Targeting the CaMKII/Nav1.5 axis is a potential therapeutic target for patient populations that are vulnerable sympathetic-induced Ca2+ mishandling and arrhythmogenesis.
Research Project Title: Extracellular matrix composition and microstructure influence hydraulic conductivity

Student Presenter: Aaron Seibel

Faculty Mentor: Jonathan Song

Faculty Mentor Department: Mechanical & Aerospace Engr

Research Abstract: Collagen, the main structural component of the extracellular matrix (ECM), has an important role in controlling the mechano-material properties of tissue. Studies have shown that compared to normal tissue, the ECM surrounding tumors has an altered composition, consisting of a denser, more-aligned collagen matrix and an increased concentration of non-collagenous ECM components such as hyaluronic acid (HA). These alterations to the tumor ECM result in tumor promoting mechanical properties. For example, the excess HA leads to increased interstitial pressure, impeding drug delivery to the tumor, and the dense, aligned collagen matrix may contribute to cancer invasiveness. However, the mechanisms by which ECM structure and composition alter mechanical properties in the tumor microenvironment are not well understood. This study investigated the relationship between the composition and microstructure of the ECM, and how they affect the hydraulic conductivity, or the permissiveness to drug and fluid transport. The ECM was modeled using a PDMS microfluidic device with a straight channel. The channel was filled with collagen at concentrations of 3mg/ml and 6mg/ml. Some collagen solutions were supplemented with either HA or transglutaminase, a collagen cross-linking agent. Hydraulic conductivity was measured using Darcy’s law by measuring the average velocity of dye moving through the channel with a known hydrostatic pressure. The collagen microstructure was imaged using confocal reflectance microscopy to produce a 3D image stack. Images were processed using MATLAB to determine average pore size, fiber alignment, and average fiber length. Initial results show that average pore size, fiber length, and hydraulic conductivity decrease with increasing collagen concentration. The results also showed that devices supplemented with HA had larger average pore sizes, and it is expected that HA will result in a lower hydraulic conductivity. There was no significant difference in fiber alignment between any conditions. Future directions for this study include supplementing the collagen matrix with other ECM factors, such as fibronectin, and testing other mechanical properties of the matrix, such as stiffness.
Research Project Title: Serum-free human platelet lysate (hPL) versus fetal bovine serum (FBS) albumen sources for human bone marrow-derived mesenchymal stem cell culture on poly(propylene fumarate) tissue engineered bone scaffolds

Student Presenter: Patrick Smith

Faculty Mentor: David Dean

Faculty Mentor Department: Plastic Surgery

Research Abstract: A risk to clinical translation of cell-based therapies using bone marrow-derived human Mesenchymal Stem Cells (hMSCs) is the use of xenogeneic factors in the cell culture protocol. Standard cell culture media utilizes animal sera, specifically fetal bovine serum (FBS), which presents several risks including variant CreutzfeldtJakob Disease (vCJD), undefined formulations, batch-to-batch inconsistencies, and the potential to induce an immunological response to antigens in the serum. To circumvent use of animal sera, RoosterBio (Frederick, MD) and other companies have developed serum-free media formulations for expansion of hMSCs which substitute human platelet lysate (hPL) for FBS. We hypothesize that culturing hMSCs in serum-free media will result in equal expansion and osteoblast differentiation of hMSCs. Differentiation of hMSCs to osteoblasts is associated with deposition of bone Extracellular Matrix (ECM) on poly(propylene fumarate) (PPF) scaffolds. We tested both hPL- and FBS-containing media with the same growth factors at the same doses previously determined optimal by our lab.

This study used four groups (n=7 scaffolds per group) of media to culture hMSCs on PPF thin films for 21 days. The first group was cultured in only as-purchased FBS-free RoosterBio hMSC High Performance Media Kit XF (KT-016) as a control. The second group was cultured in media from the control kit with optimized growth factors. A third media group contained 5% hPL (Cook Regentec, Indianapolis, IN) rather than booster along with optimized additives. The fourth group, another control, contained RoosterBio’s media kit with their GTX booster (contains FBS). A PrestoBlue® metabolic assay was performed at days 1 and 3 to evaluate cell proliferation. Alizarin Red S (ARS) and Alkaline Phosphatase (ALP) assays were performed at days 3, 6, 9, 12, 15, 21 to measure formation of bone ECM as the hMSCs differentiate to the osteogenic lineage. Preliminary results illustrate the hPL-containing group’s earlier peak ALP expression, i.e., differentiation to osteoblast. Increased ARS expression at Day 21 in hPL suggests improved ECM deposition. The results of the study show that hPL-containing, serum-free media formulations perform as well if not better than the FBS-containing media for proliferation and differentiation of hMSCs on bone tissue engineering PPF scaffolds.
Research Project Title: Effect of sphingosine-1-phosphate on endothelial hydraulic conductivity is fluid force dependent

Student Presenter: Griffin Spychalski

Faculty Mentor: Jonathan Song

Faculty Mentor Department: Mechanical and Aerospace Engineering

Research Abstract: Introduction: Anti-angiogenic therapy is a standard therapeutic approach for various cancers through suppressing tumor growth, but treatment often confers resistance over continued application. Sphingosine-1-phosphate (S1P) is a bioactive lipid with a physiological gradient from lumen to tissue that is disrupted within tumors. Recent research has highlighted S1P signaling as a potential target for anti-angiogenic therapies to improve clinical outcome. However, the physiochemical context of S1P signaling and its effects on vascular barrier function “concomitant with angiogenesis” remains poorly understood. Here, we introduce a microfluidic model of a branching vessel to monitor changes in endothelial hydraulic conductivity co-regulated by S1P and local fluid stresses at precise locations along a bifurcating vessel structure.

Methods: The polydimethylsiloxane device consists of an inlet channel that divides at a bifurcation point (BP) into two branching vessels (BV) around an extracellular matrix (ECM) compartment composed of type I collagen. The channels were lined with human umbilical vein endothelial cells. Experimental perfusion conditions consisted of static and perfusion at 10 µL/min, creating 3 dyn/cm² laminar shear stress (LSS) along BV apertures and bifurcating fluid flow (BFF) at the BP aperture. Hydraulic conductivity was measured by perfusing devices with FITC-dextran and monitoring its extravasation rate across the endothelium. Applying Starling’s principle, we calculated the hydraulic conductivity (Lp).

Results: Lp was significantly increased when exposed to 500 nM S1P under static conditions compared to static control baseline. Conversely, there was no significant change in Lp when exposed to 500 nM S1P and LSS/BFF compared to perfused baseline. Treatment with 200 µM L-N-monomethyl arginine, a pan nitric oxide synthase inhibitor, retained Lp near static baseline despite application of 500 nM S1P under static and perfused conditions.

Conclusions: These findings demonstrate the role of fluid forces in regulating the effect of S1P on Lp at vessel bifurcations, and indicate nitric oxide as a secondary messenger that mediates the fluid force-dependence. Taken together, we have established a novel system for assaying the effects of integrated fluid mechanical stimuli and chemical signals on vascular morphogenesis. Future studies will apply our microsystem to investigate longer-term co-regulation of angiogenesis by S1P and fluid mechanical forces.
Research Project Title: Production and quantitative characterization of tissue engineered bone extracellular matrix deposited on 3D printed, resorbable poly(propylene fumarate) scaffolds

Student Presenter: Katelyn Richardson

Faculty Mentor: David Dean

Faculty Mentor Department: Department of Plastic Surgery

Research Abstract: Current approaches to bone defect repair surgery are dependent on bone graft transplantation, which is associated with the possibility of graft site morbidity and pain, graft infection, insufficient donor tissue, and high cost. Incorporation of bone tissue engineering therapies (i.e., bone tissue engineered grafts) promises to alleviate these limitations. Previous culturing of human bone marrow-derived mesenchymal stem cells (BM-hMSC) has produced a bone-like extracellular matrix (ECM) coating on poly(propylene fumarate) (PPF) thin films. A recent experiment aimed to develop and characterize 3D bone ECM by culturing and differentiating BM-hMSCs on a 90% porous PPF cylindrical scaffold (10 mm length, 6 mm diameter) with a gyroid pore geometry. The scaffolds were pre-soaked in basal media + RoosterBio (Frederick, MD) GTX and seeded at a density of 360,000 cells/scaffold. Biochemical assays (PrestoBlue®, ALP, and A-red) were performed at each time point (days 1, 3, 7, 14, and 21) to confirm that the resulting mineralized coating was consistent with bone ECM. Due to inconsistent initial BM-hMSC attachment efficiency, experimental results were variable. Therefore, a seeding efficiency study was done before repeating the experiment. The efficiency study began with a pre-soak attachment study, comparing pre-soaks of basal media + GTX, 10% fetal bovine serum (FBS), and 100% FBS. PPF is mildly hydrophobic, and the serum albumen present in FBS compensates for that, leading to better cell attachment. Pre-soaking scaffolds in 100% FBS, compared to the pre-soak of basal media + GTX, resulted in a 30% increase in seeding efficiency. A second study was done to determine if seeding 1-3 times the original seeding density would affect the seeding efficiency. All of the scaffolds were pre-soaked in 100% FBS and seeded with either 450,000, 900,000, or 1,350,000 cells/scaffold with a sample size of n = 6. After 24 hours a PrestoBlue® assay was done and the seeding efficiency for each group was calculated. The scaffolds seeded at 1,350,000 cells had the highest seeding efficiency at 69.7%. Based on these results, the histological characterization of in vitro generated bone ECM, will be repeated with a pre-soak of 100% FBS and a seeding density of 1,350,000 cells/scaffold.
Research Project Title: Deconvolution of in-plane fluorochrome labels to analyze bone histomorphology

Student Presenter: Brooke Stephens

Faculty Mentor: Kyle Bodnyk

Faculty Mentor Department: Biomedical Engineering

Research Abstract: Introduction/Background: Blur, resulting from imaging a volume under a microscope, is caused by the interference of out of focus regions around the plane of focus. The final image from a microscope is produced by each point of light being convolved with a point spread function. The point spread function is based on the point source of light and represents the impulse response of an optical system. An alternative to confocal microscopy is the use of deconvolution. Deconvolution removes blur and noise from images using a mathematical model. Blind deconvolution is a relatively new approach to deconvolution. It requires less input information because the object and the point spread functions are estimated. The aim of this study was to investigate the deconvolution techniques provided on MATLAB (Natick, MA) to determine the impact of low intensity vibration (LIV) therapy on bone histomorphology.

Methods: Cross sections of mice femur bones embedded in opaque PMMA resin were imaged under 90x magnification with UV light to detect fluorochrome labels following LIV therapy. Various deconvolution techniques were applied in MATLAB to yield the clearest image of the fluorochrome single and double labels on each femur cross section image. The blind deconvolution function was used, which only required the blurred image and the initial guess of the point spread function as inputs. In order to find the best point spread function for noise reduction, the size and standard deviation of the Gaussian lowpass filter were manipulated. Then final deconvoluted images were used to determine the amount of bone remodeling that occurred following LIV treatment.

Results: The `deconvblind(I, INITPSF)` function was the most successful deconvolution function used to deblur the microscopic images. The clearest images were produced with a point spread function of size `fspecial(‘gaussian’,13,17)`.

Conclusions: This method of using blind deconvolution with a Gaussian sized function for deconvolution worked well for reducing noise in the image, given the noise and the blur were not known prior to deconvolution. The deconvolution software in MATLAB was effective in deblurring microscopic images to show bone remodeling in femur cross sections.
Research Project Title: Development and use of clinically-oriented methods to quantify ankle proprioception and postural control

Student Presenter: Rachel Teater

Faculty Mentor: Ajit Chaudhari

Faculty Mentor Department: Biomedical Engineering

Research Abstract: Proprioception is an essential component to balance and postural control and is defined as the ability to sense the position and movements of limb segments relative to one another. Proprioception and postural control deficits are associated with many health conditions and evaluation of these measures is an essential first step in identifying at-risk patients and beginning therapeutic intervention. There is also a gap in knowledge in how ankle joint position sense (a component of proprioception) and postural control are related. The objectives of this project are to adapt a Nintendo Wii Balance Board into a clinical tool to evaluate postural control, evaluate the ability of a free iOS application, CoreX Therapy, to identify differences in ankle joint position sense between populations of high and low ankle instability, and to assess the relationship between ankle joint position sense and postural control using a clinically-oriented procedure. Data for this study was collected at the 2017 American Society of Biomechanics' Annual Conference. Participants self-reported their ankle instability through a questionnaire and their ankle joint position sense was assessed using CoreX Therapy. Participants also performed three trials of quiet standing on a Wii Balance Board for assessment of postural control. Before data collection, a custom LabVIEW program was created to allow the Wii Balance Board to collect center of pressure (CoP) data. Data was collected from forty-six diverse participants. Twenty-five were classified as having no ankle instability and twenty-one had at least one unstable ankle. The average absolute error in joint position sense was calculated as the measure of ankle proprioception and there was no significant difference in the average absolute error between the groups of high and low ankle instability. Further data analysis is still in progress. The medial-lateral root mean squared excursion and mean velocity of the CoP will be calculated to evaluate postural control. Intraclass correlation coefficients will be used to assess the reliability of the CoreX Therapy iPod app. To establish the relationship between ankle joint position sense and postural control, a linear regression of the ankle proprioception measures will be analyzed as predictors of the postural control parameters.
Research Project Title: High throughput 3D hydrogel assay for measuring matrix metalloproteinase activity

Student Presenter: Anthony Tomusko

Faculty Mentor: Abdulaziz Fakhouri

Faculty Mentor Department: Biomedical Engineering

Research Abstract: Matrix metalloproteinases (MMPs) are a collection of enzymes that are overexpressed in many types of cancers, and this overexpression is correlated with poor prognosis and decreased survival. Few techniques have been developed to measure MMP activity from cells cultured in three dimensional (3D) microenvironments, which mimics the in vivo environment. In order to overcome these limitations, we have developed a 96 well high throughput assay using 3D hydrogels to mimic cell response in their microenvironment. By characterizing this assay using 3D hydrogels, we are able to accurately measure MMP activity in cancerous cells, while saving time, money, and labor. The assay was first characterized by adding a commercial collagenase enzyme to the 3D hydrogels, which cleaved the synthesized fluorescent MMP degradable peptide. A fluorescent plate reader was then used to measure the MMP activity. The working range, sensitivity, and performance of the assay were studied, while also exploring the potential factors that may affect the overall assay. Performance of the assay was determined by calculating a statistical value known as the Z' factor, an analysis used to assess the signal to background noise ratio, was calculated for each collagenase enzyme concentration. At low collagenase concentrations, a Z' factor less than 0.5 was observed, indicating a marginal assay. However, at high concentrations, a Z' factor greater than 0.5 was observed, indicating the assay is suitable for high throughput screening. Additionally, factors including DMSO concentration, round bottom versus flat bottom cell culture plates, and differing the stiffness of the hydrogels were studied to determine their impact on the assay. Statistical analysis on different DMSO percentages showed no significant difference. Analysis of round bottom versus flat bottom plates consistently demonstrated higher coefficients of variability in flat bottom plates over the round bottom plates. Finally, the stiffness of the hydrogels was varied by changing the amount of crosslinker used for polymerization, yielding no significant difference as a function of hydrogel stiffness. By confirming the characterization and performance of the assay, a 3D microenvironment was created where MMP activity can be accurately measured and observed, enabling better in vitro models for applications like cancer drug screening.
Research Project Title: Mechanical analysis of endotracheal tube kinking

Student Presenter: Emily Young

Faculty Mentor: Tanya Nocera

Faculty Mentor Department: Biomedical Engineering

Research Abstract: Emily Young; Tanya M. Nocera, PhD; Joseph D. Tobias, MD; Ajay D’Mello, MD

Introduction: Endotracheal tube (ETT) malfunctions, such as kinking, can lead to procedural complications, physical injury to the patient, or even patient death. Previous reports have described manually kinking ETT tubes during in vitro experiments to determine the angle at which a kink occurs, the location of the kink, and the effects of a kink on ventilation. However, experimental protocols are lacking for testing ETT tubes in an objective and reproducible fashion. We sought to design an experimental setup for mechanical compression testing of ETT tubes that would permit better quantification of risks and outcomes of ETT kinking.

Methods: Mechanical compression testing of size 4.0 (inner diameter) oral ETTs was conducted using a Universal Test Frame (Test Resources, model: 100Q250-6) with 1000N load cell and four inch compression platens. Surgical tape was used to secure the ETT to the compression platens in a position simulating ETT placed in a supine patient. Compression was applied to the ETT at a constant rate of 60mm/min, beginning at an initial platen distance of 60mm. The load (N) on the device was plotted over the platens’ distance traveled (Δx), and the second derivative of the load (N'') was obtained to identify a change in compression resistance signifying a kink in the ETT.

Results: Load data obtained show a change in concavity, between Δx=15mm to 25mm, indicating that the ETT structural integrity is consistently compromised when a certain level of compression is applied in the experimental setup. In ongoing work, we will examine the sensitivity of this threshold to clinically relevant environmental conditions (e.g., temperature, prolonged force) and use this setup to evaluate airflow through a kinked ETT, to better characterize the impact of compromised ETT mechanical integrity on patient airways.

Discussion/Conclusion: We have established an objective experimental method for testing the mechanical integrity of ETTs. By creating a reproducible model of ETT kinking, we will be able to better define the risk of ETT kinking with various devices and conditions relevant to patient care.
Research Project Title: Cells on gels: micron-scale polyacrylamide gels for studies on GBM adhesion, morphology, and migration

Student Presenter: Caroline Miller

Faculty Mentor: Derek Hansford

Faculty Mentor Department: Biomedical Engineering

Research Abstract:

Introduction/Background

Glioblastoma Multiforme (GBM) is the most commonly diagnosed brain tumor and has a median survival time of 15 months, which is partly due to the cells’ highly migratory behavior. An ability to test individual resected tumors to classify the prognosis based on cell migration behavior is of great interest. A substrate that closely mimics the brain’s white matter tracts would allow for more clinically-relevant analysis of GBM cell migration, which could lead to new developments in prognosis and treatment.

Methods

A biomimetic environment was created using polyacrylamide (PA) with 3 different stiffnesses that were micropatterned with 2μm features to mimic the in vivo stiffness and fibrillar structures of white matter tracts. A liquid PA mixture was pipetted onto a sacrificial polystyrene (PS) mold with a 2μm line pattern, created by stamping a PS coated coverglass with a PDMS mold at high heat. A glass coverslip, modified for attachment of the PA, was placed on top of the PA mixture during polymerization. This protocol produced micron scale features on the PA gels of varying stiffnesses that were uniform in width and thickness. The gels were then treated with an adhesion-promoting protein (fibronectin) and seeded with cells at a density that allowed the observation of individual cell migration. After incubation for 36 hours, the cells were analyzed using microscopy and staining methods.

Results

After analyzing cell migration behavior, it was determined that the initial cell attachment and morphology was highly dependent on the substrate stiffness. The cells attached more quickly and exhibited higher degrees of elongation on stiffer gels. This demonstrated that stiffness greatly influences cell attachment and migration, emphasizing the need for substrates with the appropriate stiffness and pattern that properly mimics in vivo conditions.

Conclusion

The PA micromolding process can aid in analyzing disease-specific behavior and eventually patient-specific prognostic information. This protocol can be used to study GBM migration, and could be adapted to create substrates for studies on other cancers and diseases. This data could also aid in research on inhibiting migration of cancer cells, possibly by changing the stiffness of the environment the cells migrate on.
Research Project Title: An interdisciplinary effort to address microgravity-induced skeletal muscle atrophy in astronauts

Student Presenter: Michael Chung

Faculty Mentor: Peter Lee

Faculty Mentor Department: Cardiac Surgery

Research Abstract: Introduction:

Although it is widely known that extended spaceflight causes significant skeletal muscle atrophy in astronauts, the specific mechanisms that drive this process is still not well understood. Although previous experiments have shown that exposure to microgravity results in atrophy in isolated tissue-engineered skeletal muscle, we do not understand how muscle tissues sense the microgravity environment.

Methods:

Hence, we will be flying miniaturized tissue-engineered skeletal muscle constructs on the New Shepherd, a suborbital reusable launch vehicle created by Blue Origin. In the biology lab before spaceflight, we will optimize the tissue-engineering process in 96-well microplates to translate the results of the experiment into medically impactful applications. Specific contents of the tissue-engineered skeletal muscle such as C2C12 cell concentrations will be varied to test optimal force contraction and fiber formation, where fiber content will be measured via tropomyosin staining methods. Additionally, the tissues will be fixed with RNAlater, a RNAse inactivator, at the end of the four minute microgravity period to resolve the differential expression of key genes in comparison to ground controls. Although the suborbital flight is of short duration, we still expect small changes in gene expression directly resulting from exposure to the microgravity environment during our post-flight analysis. In the engineering lab, we will design, construct and test the necessary hardware for the suborbital flight. The novel technology includes a force transducer to stimulate muscle contraction, a camera system to collect real-time images, and a fluid injection system to fix the muscle tissues during microgravity. The goals are to demonstrate four specific matters: 1) showcase the maintenance of tissue-engineered skeletal muscle throughout and after suborbital flight, 2) demonstrate the fixation of tissues in microgravity through a fluid injection automated system, 3) exhibit a force transducer system to stimulate muscle contraction during suborbital flight, and 4) determine real-time passive and active force measurements of the tissue-engineered muscle tissues.

Conclusion:

The results of this project will be absolutely crucial in determining the mechanisms of skeletal muscle atrophy which will ultimately propel space medicine and technology that can be utilized to circumvent such atrophy for long-term spaceflight missions for astronauts.
Research Project Title: Parameterization and stability of rod-shaped DNA nanostructures

Student Presenter: Nickolas Andrioff

Faculty Mentor: Castro No

Faculty Mentor Department: Carlos

Research Abstract: Scaffolded DNA origami molecular self-assembly allows for the construction of custom-designed DNA nanostructures. It has been recently implemented for useful applications including drug delivery, force measurement, and biomarker detection. However, further development toward practical applications will require DNA nanostructure structural stability evaluation under harsh physiological conditions that include the presence of nucleases. Currently, there is a lack of available data that predicts the stability of DNA nanostructures in such conditions. Therefore, the objective of the current study is to evaluate how different structural characteristics of DNA nanostructures affect stability under physiologic conditions. Here, we have assessed the tolerance and degradation rate of DNA nanostructures under physiologically relevant factors such as varying levels of salinity and fetal bovine serum (FBS). Stability experiments were performed on a select panel of DNA nanostructures that share similar designs, but varied in a single feature such as surface area, crossover frequency, lattice cross section, scaffold routing, or number of overhangs. Structural stability of nanostructures was monitored across varying concentrations of magnesium chloride (0-20mM) and fetal bovine serum (0%-100%) during a 24-hour room temperature incubation period. Quantitative data was obtained via agarose gel electrophoresis coupled with a MATLAB program to measure the intensity of gel bands and monitor the long-term tolerance of each structure. A spectrophotometer was utilized to collect structure degradation kinetics data. This information was compiled to create an algorithm to predict the structural stability of DNA nanostructures based on their characteristics and to design stable structures suitable for any physiologically relevant environment. From our work, we created a database that DNA origami nanostructure designers can use to create an optimal structure for physiological experimental conditions more efficiently and conveniently.
Research Project Title: Developing engineering technology to study muscle atrophy

Student Presenter: Wilson Flores

Faculty Mentor: Lee Yes

Faculty Mentor Department: Peter

Research Abstract: Astronauts undergo significant muscle atrophy when in spaceflight for extended periods of time. Mechanisms that steer this development are not well understood. This investigation will further the understanding on how muscle tissues sense the microgravity environment leading to muscle atrophy. The experiment will allow miniaturized tissue-engineered skeletal and cardiac muscle constructs to enter microgravity for at least two minutes on a suborbital reusable launch vehicle to determine how expression of key genes change when compared to controlled muscle constructs in the laboratory. In order to perform this experiment, key engineering technology is being designed, built, and tested that will allow for real-time data capture on a payload. The autonomous payload will maintain the tissues in culture for at least 6 hours, measure real-time passive and active forces, stimulate the muscle tissues to contract, fix tissues to preserve mRNA, and return the tissues alive. The engineering team is currently designing and building a 96-well tissue-culture plate that will hold both skeletal and cardiac cells. The cells will be formed and suspended around two microposts built into each of the cell culture wells producing passive forces. They will be electrically stimulated, by means of parallel electrodes, to contract and generate active forces. A force measurement system will measure the real-time passive and active forces with a sensitivity of 5uN using a camera system to capture continuous video of at least 24 frames-per-second. At the end of the microgravity period, RNAseq will be added to some wells while the growth medium is removed. This will allow the cells to stay fixed and preserve the existing mRNA for post-flight analysis. The technology being developed for the payload will ultimately help astronauts spend longer periods of time in space.
Research Project Title: Texture estimation from discrete orientation data using bingham distribution

Student Presenter: Carl Ahlborg

Faculty Mentor: Stephen Niezgoda

Faculty Mentor Department: Materials Science and Engineering

Research Abstract: The properties of materials are functions of their internal structure. Most engineering materials, including metals, are polycrystalline and composed of microscopic crystals. The crystallographic texture, the description of the orientations of the crystallites in a material, is a key structural indicator of the deformation behavior. Estimating the orientation distribution function (ODF) of a sample allows materials scientists to identify the probability a crystal in a sample is oriented in a certain direction. The current process, which employs a Fourier series expansion over a generalized spherical harmonic basis, leaves much to be desired and is poorly understood by much of the community that uses it. Some limitations include bias introduced by ad-hoc parameters and poor accuracy for small sample sets. The purpose of this study is to develop an algorithm to estimate the ODF using a mixture model that would be free from ad-hoc parameters. To accomplish this, the algorithm uses a mixture of symmetrized Bingham distributions. Using these distributions, it employs a Markov Chain Monte Carlo approach to estimate the distribution and reevaluate the data to improve subsequent estimations. It also used a minimum message length (MML) criterion to prevent overfitting, or making too specific estimations based on insufficient data. With further development, this algorithm could provide a means to evaluate material properties better using small data sets by avoiding ad-hoc parameters and the uncertainty they bring.
Research Project Title: Effect of molybdenum on ductility dip cracking in nickel base weld filler metal 52M

Student Presenter: Stan Blados

Faculty Mentor: Carolin Fink

Faculty Mentor Department: Material Science and Engineering

Research Abstract: The nuclear industry has an increasing demand for thick cross-section walls from nickel-based alloys for structural and repair applications. Due to the high restraint and residual stresses developing in these welds, ductility dip cracking (DDC) is a major problem, especially when using high chromium nickel-based filler metals. Previous research has shown that alloying elements, such as niobium (Nb) and tantalum (Ta) decrease the susceptibility to DDC by the formation of carbides along the solidification grain boundaries. These carbides pin the grain boundaries in the weld metal and cause a mechanical locking effect, so that DDC formation by grain boundary sliding is mitigated.

The objective of this project is to determine the effect of molybdenum (Mo) on DDC in nickel based filler metal 52M. Mo is an alloying element in nickel-based alloys to increase high temperature strength. The influence of Mo on DDC is not well understood, and contradictory results have been reported. Microstructural characterization was done on weldability samples with different Mo content to evaluate the effect on carbide formation, grain size and hardness. Image analysis on light optical micrographs was used to determine the amount of carbides in the weld metal and the weld metal grain size as a function of the Mo content. Results so far did not show a conclusive correlation between Mo and the amount of carbides along the grain boundaries. Grain size measurements have shown that the Mo bearing weld metal exhibits a finer grain structure. Future work will be done using scanning electron microscopy (SEM) to identify differences in type and composition of carbide precipitation as a function of the Mo content. Hardness measurements will be performed to determine the effect of Mo on weld metal hardness.
Research Project Title: Engineering solid-electrolytes/electrode interfaces for all solid-state lithium-ion batteries

Student Presenter: Junbin Choi

Faculty Mentor: Jung-Hyun Kim

Faculty Mentor Department: Mechanical Engineering

Research Abstract: Nowadays, most commercialized portable electronic devices, such as cell-phones and laptops, use Li-ion batteries as their power source. Li-ion batteries are also being used by automotive companies to power electric vehicles (EVs). However, there is a strong need to make Li-ion batteries safer under abusive conditions, such as car accidents. To address this need, significant research has been recently conducted to utilize solid electrolytes in Li-ion battery cells for the next generation EV applications. In this study, I investigated several solid electrolyte and electrode materials to seek their optimal combinations in terms of chemical stabilities at electrolyte - electrode interfaces. The objective of this study is finding governing parameters that stabilize the interfaces and offer unhindered Li-ion transportations across the interfaces. Among various ceramic electrolyte materials, I selected Li1+xAlxTi2−x(PO4)3 (LATP) based on its good chemical stability in air and moisture. First, I synthesized the LATP powder by using sol-gel method, followed by sintering at 850°C for 5 h in air. The phase purity and particle morphology were characterized, respectively, by using X-ray diffractometer (XRD) and scanning electron microscopy (SEM). I investigated high-temperature stability between cathode materials and LATP by sintering their mixture in a range of 600°C - 900°C. The resulting powders were measured by XRD to identify their phase stabilities. This high-temperature sintering process is a necessary step for a fabrication of the solid-state batteries. Then, I examined electrochemical properties of the LATP - cathode composite by using coin-cells. In this presentation, I will discuss the effect of interfacial stabilities (i.e., LATP - cathode) on the physical and electrochemical properties.
Research Project Title: Investigation of intermetallics in hybrid weld joint

Student Presenter: Eric Brizes

Faculty Mentor: Antonio Ramirez

Faculty Mentor Department: Welding Engineering

Research Abstract: Car manufacturers are required to increase fuel efficiency by 50% to reach a target of 54.5 miles per gallon for passenger vehicles by 2025. Weight reduction, through implementation of low density alloys, will help manufacturers attain future emissions compliance. Welding multi-stacks of high strength steels to low density alloys furthers the automotive industry’s focus on weight reduction, while also increasing production rates. A hybrid joining technique consisting of a friction element weld through a layer of aluminum and into spot welded sheets of Usibor steel has been developed. Previous study of the joint revealed the formation of an aluminum-iron intermetallic layer between the friction element and Usibor steel. Energy Dispersive X-ray Spectroscopy (EDX) has identified the layer to be Al$_3$Fe. Intermetallics have a higher hardness than the surrounding metal and may alter the fracture mode and ultimately compromise structural integrity. The intermetallic layer should have been removed by the cleaning mechanism of the friction element weld. The purpose of this research is to investigate the formation of the Al$_3$Fe intermetallic layer and how to avoid it. Microstructural characterization will identify whether the intermetallic formed from the aluminum layer within the multi-stack or the silicon-aluminum coating of the Usibor steel. 3D modeling will determine if the position of the friction element in relation to the Usibor spot weld nugget influences intermetallic formation. Thermodynamic simulation will analyze the temperature profile during welding and discover when Al$_3$Fe is most likely to form. The results of this research will ensure higher quality friction element welds that meet the automotive industry’s performance specifications.
Research Project Title: Moisture impact on LiNiMnCo1-x-yO2 as cathode materials for lithium-ion batteries

Student Presenter: Liang Dong

Faculty Mentor: Jung Hyun Kim

Faculty Mentor Department: Mechanical Engineering

Research Abstract: Lithium-ion batteries (LIB) are in high demand for portable electronic devices and electrical vehicles today. Much attention has been paid to cathode material, since it governs the energy density of LIB. LiNiMnCo1-x-yO2 (NMC) materials with various molar ratios of Ni:Mn:Co are now popular options for cathode materials for its lower cost, less toxicity and higher specific capacity comparing to traditional cathode materials such as LiCoO2. There has been a critical issue of the NMC materials – its performance degradations in contact with moisture in air. Although this is a practically important problem, we have a lack of fundamental understanding about the failure mechanism. Based on literature review, we hypothesized that a high oxidation-state Ni3+ in NMC will readily react with moisture to lower its oxidation state into Ni2+ and lower the electrochemical capacity of NMC. To prove the hypothesis, we selected and investigated various NMC with different Ni contents: (1) LiNi1/3Mn1/3Co1/3O2, (2) LiNi0.5Mn0.2Co0.3O2, (3) LiNi0.6Mn0.2Co0.2O2, (4) LiNi0.8Mn0.2Co0.2O2. We stored each type of NMC powder under three different conditions: (i) dry glovebox, (ii) 2% moisturized chamber by volume, and (iii) water. Then, we characterized the samples by using X-ray diffractometer (XRD), transmission electron microscopy (TEM), and electrochemical performance testing from coin-type battery cells. With the same type of powder, testing results in all the three conditions were compared to find how the extent of moisture affects the powders. With the same storage condition, testing results of the four types of powders were compared together to find how the amount of Ni content affects moisture impact.
Research Project Title: Development of indentation to impact toughness relationships applied to temper bead qualification

Student Presenter: Daniel Keffer

Faculty Mentor: Boeing Smith

Faculty Mentor Department: Weld engineering

Research Abstract: Temper bead (TB) welding techniques are often used as an alternative to Post Weld Heat Treatments (PWHT) when welding hardenable steels during the fabrication or repair of equipment across several industries, such as the nuclear industry. Therefore, it is necessary to develop a reliable and reproducible test criterion that ensures that the technique was successfully performed and that it is not detrimental to the material and component performance (elevated hardness or poor toughness, for example). To ensure that the heat affected zone after TB procedure has adequate toughness, Charpy V-notch (CVN) tests are widely used under the ASME code requirements. These tests are time consuming and can become quite costly. In 2004 a provision was included in ASME Section IX, which allows for TB qualification via tensile, bend, and peak hardness measurements without requirements on impact toughness testing. However, the code does not specify hardness requirements or acceptance criteria for TB qualification. The goal of this project is to develop a correlation between microstructure, hardness and fracture toughness to determine the feasibility to use localized hardness measurements for TB technique qualification. This will be accomplished thru instrumented indentation and damage mechanics. The sole use of hardness tests alongside the thermal history and/or microstructure for qualification of TB techniques would be a faster, less expensive and a safer versatile technique to be implemented in industry.
Research Project Title: FEM modeling of local thermo-mechanical conditions during varestraint testing

Student Presenter: Salman Matan

Faculty Mentor: Carolin Fink

Faculty Mentor Department: Material science and engineering

Research Abstract: The Varestraint test is a useful tool in evaluating the weldability of an alloy, more specifically its resistance to hot cracking during welding. The test involves the deposition of a weld bead on a specimen, and at a predetermined point, the specimen is bent over a die mandrel of a specific radius. Blocks of different radii can be used to provide a series of welds subjected to different controlled magnitudes of augmented strain. When the applied augmented strain is above the cracking threshold for the alloy, cracking occurs in the specimen. The Varestraint test is one of the most established hot cracking tests and widely used in industry. However, little is known about the local thermo-mechanical conditions around the weld during testing that lead to cracking in the specimen. The applied bending is an external load and does not represent the actual conditions that are locally applied to the material in the vicinity of the weld pool. The objective of this study is to develop an FEM model of the Varestraint test in Sysweld software. Working tasks involve (1) the setup of the CAD model according to the actual test equipment, (2) purposeful meshing of the specimen geometry with finer mesh near the weld pool region, (3) implementing of the heat source and trajectory, (4) validation of the weld pool geometry by comparison with cross-sections from actual test welds, and (5) implementing the bending process in Sysweld. Expected outcomes from the FEM model are location specific temperatures and strain values near the weld pool. This information will help to determine local thermo-mechanical conditions for hot cracking in the Varestraint test. Current work includes the implementation and validation of the heat source.
Research Project Title: In-situ characterization of lithium-ion electrode polymers via atomic force microscopy

Student Presenter: Michael Lee

Faculty Mentor: Hanna Cho

Faculty Mentor Department: Mechanical and Aerospace Engineering

Research Abstract: The lifespan and long-term performance of a lithium-ion battery cell are contingent on the interphase forces exhibited by the constituent compounds. Atomic force microscopy (AFM) uses a microscale cantilever with a nanoscale tip to characterize the topology of a sample’s surface in addition to material properties such as elasticity and adhesion. By using AFM, the interphase forces exerted by polymer binder materials can be characterized, obtaining data critical to the selection of electrode materials for optimized battery performance. The current study examines the in-situ properties of industry standard binder polymers polyvinylidene fluoride (PVdF) and sodium alginate. A sample of each polymer was immersed an electrolytic solution selected to simulate the characteristics of the interior of an electrode. A cantilever with a low spring constant and a silicon tip was then used to measure the adhesive force exerted by the surface of each binder sample constantly, beginning at the time of immersion and lasting several hours. Trends in these adhesive forces over time were identified, and the effects of electrolyte exposure and cantilever selection on the data were examined. Use of this experimental methodology will facilitate further examination of interphase forces between the polymer binder and other electrode materials, as well as extend into study of the properties of binder material when exposed to in-operando conditions.
Research Project Title: Indirect magnetic force microscopy for ultrastructural histology

Student Presenter: Rachel Novinc

Faculty Mentor: Gunjan Agarwal

Faculty Mentor Department: Biomedical Engineering

Research Abstract: Pathological iron deposits are a hallmark of several neurodegenerative diseases and cardiovascular pathologies. Current techniques for detection iron deposits in histological sections primarily employ biochemical stains or immuno-staining for ferritin proteins, which offer limited (microscale) spatial resolution. Detection of iron deposits by exploiting their magnetic signals can serve as a label-free tool in histology. In our earlier work, we had demonstrated how the atomic force microscopy (AFM) based technique, magnetic force microscopy (MFM), can map iron-rich lysosomes in tissue sections at nanoscale resolution. MFM has thus far been performed using direct MFM (D-MFM), where multiple passes of the probe over the sample are required to identify magnetic interactions between the sample and probe. The purpose of this study was to develop a novel indirect MFM (ID-MFM) technique that requires only one pass over the sample, reduces possible probe contamination, and enables multi-modal microscopy. In Indirect MFM, an ultrathin silicon nitride window, commonly used for Transmission Electron Microscopy (TEM) is utilized as a barrier between the sample and the probe. As a first step towards use of Indirect MFM for histology, we performed D-MFM on ultrathin tissue sections typically used for TEM. Using MFM and AFM (as control) probes on sections ranging from 100 to 500 nm in thickness, we demonstrate that D-MFM is capable of detecting magnetic iron deposits in an ultrathin samples. For Indirect MFM similar sections were mounted on silicon-nitride TEM grids. Our results show how optimization of the window size and thickness is required for Indirect MFM imaging of ultrathin sections. ID-MFM holds the promise to serve as a high-throughput, ultrastructural, and multimodal technique for mapping iron in histological samples.
Research Project Title: Nitrogen input during button melting and nitrogen measurement in nickel base weld metal

Student Presenter: Gano Patel

Faculty Mentor: Caroline Fink

Faculty Mentor Department: MSE-WE

Research Abstract: The weldability of many nickel-based alloys is strongly affected by variations in composition. In particular, impurity elements such as sulfur (S) and phosphorus (P) are known to strongly influence weld solidification and solidification cracking. As a result, these elements are generally maintained at very low levels to improve weldability. The effect of interstitial elements, such as nitrogen (N) is less well understood. Nitrogen can vary widely in nickel base alloys depending on alloy type and melting practice. Previous research has shown a clear effect of N content on solidification cracking in nickel-based weld metals with low N heats showing superior resistance to cracking. However, the specific effect of N on cracking susceptibility remains unclear and needs to be further studied. Further work needs to consider different levels of N content in weld metal samples. This study aims to develop a technique using button arc melting to introduce N into nickel-based weld metal samples at different levels (low, medium and high) and with high reproducibility. Influencing factors include the amount of nitrogen in the shielding gas during melting, the arc time and the size of the melted sample. As a second objective, the feasibility of optical emission spectroscopy (OES) for consistently measuring N in the samples will be examined. The outcomes of this study will be invaluable for further investigating the effect of N on weld cracking susceptibility in nickel-based weld metals.
Research Project Title: Fabrication of liquid crystalline polymer networks retaining the blue phase

Student Presenter: Maxwell Venetos

Faculty Mentor: Timothy White

Faculty Mentor Department: Materials Directorate

Research Abstract: Blue Phase (BP) liquid crystals are of considerable scientific and technological interest for their photonic properties. BP liquid crystals offer optical isotropy independent of viewing angle and can be created without the need for an alignment layer. The application of a voltage to these phases induces a strong birefringence with a switching time between the dark state and induced state in the submillisecond range. These properties allow for the improved performance and simplified fabrication of liquid crystal based electronic optical devices. BP states typically have a temperature range of 1 Celsius degree, thus extension of the temperature range for BP liquid crystals is essential for their use in optical devices. Our group has extended the temperature range of the BP states via photopolymerization to form temperature stabilized polymer networks in the liquid crystal cells. BP mixtures were created using 62.2 wt% chiral monomer CM04151 and 37.8 wt% achiral mesogen ST05953 along with 1 wt% photoinitiator Irgacure-651. The mixture was placed inside a 20-micron polyimide coated cell and then placed in a heating stage at 120 °C under a polarized optical microscope. The mixture was slowly heated until phase change to BP and subsequently exposed to UV light to initiate photopolymerization. BP was observed in a temperature range of 116.5 °C – 115.3 °C and stabilized polymer films maintained BP at room temperature. Future work includes additional characterization of the liquid crystal networks via wide angle X-ray scattering to assure that we realized the blue phase and identify which variant. Using this project as a starting point, the group intends to explore the realization of a blue phase liquid crystal elastomer by using synthetic methods concurrently developed in the group.
Research Project Title: Comparison of denture base material processed by the traditional and a two-cycle method

Student Presenter: Gefei Wang

Faculty Mentor: Scott Schricker

Faculty Mentor Department: College of Dentistry

Research Abstract: [Background] Poly(methyl methacrylate) PMMA is an ideal material for the manufacture of denture bases because of the simple manufacturing process, low cost, light weight and color which match the color of gum tissues. However, compared to other dental materials, PMMA’s hardness, flexural strength, and ability to resist aging are relatively low. One way of improving the physical properties is to modify the processing procedure. The traditional technique is a one cycle heat-curing: the PMMA resin is heated gradually to 75oC and remains at that temperature for 9 hours. In the new method, after initial heating, the denture base is cooled down to room temperature followed by an additional step with 120oC and 15psi. The hypothesis is that this new process will have positive effect on denture base material’s physical properties. The object of this study is to compare the differences in the physical properties of materials processed by two methods and exam the effectiveness of the new method. [Method]The control group is processed by one-cycle method and experiment group was processed using the two-cycle method. The hardness, color stability, solubility in water and flexural strength were measured. The specimens were immersed in the beverages for a month and then color stability is measured via a spectrophotometer. The samples were thermo-cycled for 3000 cycles and the mass differences were decided. For flexural strength and hardness, the samples were stored in water before the measurement. The flexural strength was measured using Instron universal tester and hardness was measured using Vicker’s hardness test. [Result] It is shown that the two-cycle processed denture base is harder and less soluble than the one-cycle processed denture base. There were no statistically significant difference of color stability and flexural strength between the two groups. The result confirms that the second cycle increases the degree of polymerization. [Conclusion]This suggests that we can improve some properties of denture base material by using two-cycle method, which is environmentally friendly and low-cost.
Research Project Title: Advanced materials for outer space application: radiation-resistant perovskite photovoltaic cell

Student Presenter: Zeyuan XU

Faculty Mentor: Lei Cao

Faculty Mentor Department: Department of Mechanical and Aerospace Engineering

Research Abstract: Perovskite is any material with the same type of crystal structure as calcium titanium oxide (CaTiO3). The low cost and high sensitivity of hybrid perovskite single crystal make them ideal for radiation detection and solar energy conversion that have a wide application in defense, medicine, and outer space research. However, the stability of Perovskite under such harsh environment remains unknown. In this project, multiple perovskite thin-film photovoltaic cells were calibrated and then measured in situ under Cs-137 radiation in Nuclear Reactor Lab at Ohio State.

It turns out that the perovskite solar cells showed tremendous advantages over the traditional silicon one in radiation resistance. For the worst case, the perovskite photovoltaic cells decayed only 30% of the power under 2-month strong gamma-ray radiation.

The decay occurred mostly at the first 5 days and the performance of perovskite cells would slightly change afterward. It means that the radiation damage can reach saturation, which is perfect for long-time outer space utilization. Also, multiple hypotheses were suggested to explain the radiation saturation phenomenon.
Research Project Title: Development of LiNi0.5Mn1.5-xTiO4 as an advanced cathode for lithium-ion batteries

Student Presenter: Ge Zhu

Faculty Mentor: Jung-Hyun Kim

Faculty Mentor Department: Mechanical Engineering

Research Abstract: After their successful application in small electronics, lithium-ion (Li-ion) batteries have been developed in ever larger sizes to support the energy and power requirements needed for electric vehicles (EVs). To further extend the driving distance of EVs at lower cost, there has been extensive research efforts in developing next-generation battery materials with higher energy density. LiNi0.5Mn1.5O4 (LNMO) is a promising cathode material due to its high operating voltage of 4.7 V. However, LNMO has short cycle life issue attributed to its unwanted surficial reactions in contact with liquid electrolytes. As a solution, partial Ti substituting for Mn in LNMO was demonstrated to stabilize the particle surfaces and consequently improve the cycle life. The amount of Ti substitution, however, is limited because of unexpected capacity decrease with increasing Ti content, x, in LiNi0.5Mn1.5-xTiO4. We hypothesized that such a capacity reduction is caused by a decrease in electrical conductivity; Ti4+ has no electron at its d-orbital, and increasing Ti content in LiNi0.5Mn1.5-xTiO4 reduces the charge carrier concentration. Though the research, my objective is to examine this hypothesis by experiments, and propose a strategy to improve the specific capacity of the LiNi0.5Mn1.5-xTiO4. I first synthesized LiNi0.5Mn1.0Ti0.5O4 by a sol-gel method. I reduced the particle sizes of the resulting powder, and applied carbon coating that can improve the electrical conductivity between particles. I processed the resulting powders as a cathode for coin-type Li-ion battery cells, and assessed their electrochemical performance by using Arbin battery testing system. In this presentation, I will discuss about the effect of particle modification (e.g., size, conductive coating) on the electrochemical properties of LiNi0.5Mn1.0Ti0.5O4 as a cathode in Li-ion battery cells.
Research Project Title: Reconfigurable origami antennas based on E-textile embroidery

Student Presenter: Shreyas Chaudhari

Faculty Mentor: Asimina Kiourti

Faculty Mentor Department: Electrical/Computer Engineering

Research Abstract: Reconfigurable antennas capable of mechanically altering their physical geometry can adjust their operational characteristics in real-time (resonance frequency, bandwidth, radiation pattern, etc.). Thus, they can be used as a non-invasive way of quantifying deformation for wearable and structural applications, among others. Though flexibility and robustness of the realized antenna prototypes are critical, these requirements have not been concurrently achieved to date. As an alternative, this research aims to realize a new class of flexible and robust reconfigurable antennas that integrate the ancient art of folding paper, origami, with electromagnetism concepts and E-textile embroidery. A 16 cm × 1 cm folding accordion-dipole antenna was designed, and further fabricated via embroidery of silver-coated polymer E-threads. This structure enables extreme robustness, as attributed to the strong polymer core, as well as high conductivity, as attributed to the surrounding high-conductivity material. The relationship between antenna geometry and operating frequency / bandwidth was observed over the course of several folding studies. To do so, the antenna was placed upon a series of laser-cut Styrofoam fixtures that exhibited varying angles of inclination, and its reflection coefficient frequency response was measured via a Vector Network Analyzer (VNA). As the fold angle of the antenna increased over the range of 0 degrees (flat) to 60 degrees, the operating frequency correspondingly increased over the range of 627 MHz to 991 MHz. Concurrently, the antenna bandwidth ranged from 118 MHz to 85 MHz, respectively. These results indicate that the reconfiguration of our E-textile, origami dipole antenna enables more than a 55% change in resonance frequencies while retaining over 72% of the original 10-dB bandwidth. Overall, this research introduces a new class of reconfigurable, origami antennas that are based on embroidery of conductive E-threads. For the first time, the realized prototypes are not only flexible but also extremely robust when subjected to mechanical stress. Future research will focus on analyzing the radiation pattern of the presented antenna, and exploring alternative fold configurations for specific applications (e.g., monitoring the rehabilitation of patients in physical therapy, developing more effective crumple zones for automobiles, and detecting regions of uneven stress in bridges).
Research Project Title: Microstructural characterization and analysis of OFHC copper VFA weld interface in regards to grain size and orientation

Student Presenter: Taylor Dittrich

Faculty Mentor: Glenn Daehn

Faculty Mentor Department: Materials Science and Engineering

Research Abstract: In today’s climate of light weighting, the ability to effectively weld unconventional metals pairs is of extreme importance. In light of this need, understanding the methods and principles behind unconventional welding processes becomes a priority for future optimization and technological adaptation. One such process includes the work of OSU’s Impulse Manufacturing Lab, which studies metal working under high strain rates and utilizes a unique form of explosion welding to create strong welds between both similar and dissimilar metals. This process, known as Vaporizing Foil Actuator Welding (VFAW), is similar to more conventional explosion welding in that a flyer piece of metal is accelerated through a stand-off distance to reach a critical impact velocity that allows for intimate bonding with a target piece of metal. A thin aluminum foil is vaporized, and the subsequent pressure pushes the flyer into the target. While the mechanical and macroscopic properties of such welds have been heavily studied by the IML, many aspects of the microstructure are not well understood. In this project, those aspects will be explored in relation to the weld interface between pseudo-single grained copper sheets. Oxygen Free High Conductivity (OFHC) copper sheets of several thicknesses have been annealed to achieve desirable microstructures of large-grained copper (over 1.2mm in size) to study the weld interface with relation to single grains. By studying the weld interface with large grains, the exact mechanisms behind VFAW can be studied by analyzing grain orientation and size after impact at the interface. The working hypothesis is that VFAW occurs through a mixture of mechanical bonding, grain refinement, and local melting. Spot and patch welds of the various copper sheets will be analyzed using electron backscatter diffraction (EBSD) and orientation image microscopy (OIM) to study the morphology, texturing, grain refinement, and evidence of local melting at the interface. Additionally, Photon Doppler Velocimetry will be performed on the flyer sheet to determine the temporal and spatial evolution of the flyer before it impacts the target, which will aid in numerical simulation and help create a complete understanding of the process and structure relationships of VFAW.
Research Project Title: Evaluation of welding methods on the heat affected zone microstructures for coking vessels

Student Presenter: Kaushalya Putta

Faculty Mentor: Antonio Ramirez

Faculty Mentor Department: Materials Science Engineering

Research Abstract: In the oil refining process, coke drums are a fundamental tool in the process of breaking down long chain hydrocarbon molecules. Coke drums are enormous vessels that undergo cyclic temperature changes potentially spanning 400Â°C during operation. Temperature fluctuations can cause weakening around the welded joints of the vessel. Areas of weakened material can develop into cracks, resulting in a constant need for repairs. Repairs are performed by removing the cracks and redepositing material using arc welding techniques. Often, re-cracking occurs near the weld repair. Depending on the type of repair method used, the frequency of crack reoccurrence will differ and the correlation between repair method and susceptibility to cracking is not fully understood. Two characteristics associated with the repair method are the microstructure and the stress applied. The following work was conducted through microstructural characterization on several repair welds to analyze microstructural factors associated with different weld repair procedures on coke drums. The type of microstructure present affects how the cracks nucleate and grow. Microstructures vary depending on potential over tempering, presence of martensite, and grain morphology. Samples of the coke drums underwent metallographic preparation prior to analysis. Metallographic analysis was conducted on the samples to understand the microstructural features. In addition, a map of microstructural features is presented allowing a visual understanding of the weld microstructure. A complete analysis of the microstructures present in the repair weld of the coke drums will lead to an increased understanding of the occurrence of re-cracking.
Research Project Title: Parameter development of 4-stack resistance spot welding

Student Presenter: Isaac Luther

Faculty Mentor: Kimchi No

Faculty Mentor Department: Menachem

Research Abstract: The automotive industry is transitioning to the use of high strength boron steels to lightweight critical frame components. These steels pose weldability concerns because of their unique properties. In addition, joint geometries where these materials are used require welding multiple sheets of dissimilar thickness and joining to dissimilar materials. The research in this study focused on joining a four-sheet stack up consisting of three “thick” sheets of boron steel and one “thin” sheet of galvannealed steel. This stack of is representative of a pillar to roof assembly. Focus is on examining weld growth into the thin sheet of material, as that is the biggest challenge of this joint. Factors examined were resistance welding electrode material, polarity of the weld, pulsation of current, heat input per time, and force. Literature suggests that high current over a short period of time with adequate force yields the best results. Existing research has already proven the feasibility of welding this specific joint, however the exact effects of the variables are not entirely understood. Through metallography and microscopy of welded samples changing the input parameters of the weld setup, as well as usage of high speed video the process model has become further developed for this four-sheet stack up.
Research Project Title: Optimizing microstructure, strength and ductility of medium-entropy NiCoCr and Ni-base superalloy IN740H

Student Presenter: Leah Mills

Faculty Mentor: Mills No

Faculty Mentor Department: Michael

Research Abstract: High demand for structural materials in automotive and aerospace industries motivate the development of high entropy alloys and Ni-base superalloys that can withstand extreme conditions in-service by optimizing mechanical properties including yield strength, ductility, and work-hardening. This work aims to break away from the traditional trade-off between ductility and strength exhibited by most structural materials. Equiatomic (33% Ni-33% Co-33% Cr) NiCoCr medium-entropy alloy and Ni-base superalloy IN740H are the foci of this research. Medium-high entropy alloys are a new class of materials that contain high concentrations of multiple elements that do not separate into different phases. Ni-base superalloys utilize fine distributions of precipitates to provide strength at high temperatures. Current literature indicates that both exhibit remarkable work-hardening and elongation properties at lower (cryogenic) temperatures and the objective of this work is to explore the optimization of their microstructures for high temperature applications. Mechanical behavior following cold work and subsequent annealing treatments has been investigated and compared for the two alloys. The materials were provided by the Materials Science and Technology Division at Oak Ridge National Laboratory and Special Metals Corporation. Annealing conditions are established to induce recovery rather than recrystallization of the microstructures in order to preserve strength and ductility. Deformation induced twinning microstructures, in addition to nanoscale FCC to HCP phase transformations at twin boundaries, are unique to the NiCoCr alloy. The effect of γ' precipitates on annealing response and subsequent mechanical behavior is explored in IN740H. Varying amounts of pre-strain are induced in micro-tensile samples by cold rolling or electro-thermal mechanical tensile testing. Digital image correlation is used to map strain accumulation. Microstructures obtained by scanning electron microscope analysis are correlated to micro-hardness values and tensile test results. These relatively simple processing procedures are optimizing alloy microstructures for super strength and ductility performance when compared to other commercial alloys. This research may provide a transformative approach to meeting the persistent need for low-cost, high-performance structural materials.
Research Project Title: Stability and control of amputee-walking on slopes

Student Presenter: Aya Alwan

Faculty Mentor: Manoj Srinivasan

Faculty Mentor Department: Mechanical Engineering

Research Abstract: Walking on stairs or sloped surfaces is a common part of navigating our streets and buildings. Such walking may be more challenging for people with prosthetic lower-limbs. Studying sloped walking for amputees is especially important because a slope is often provided as an alternative to stairs for people with disabilities. Our research aims to investigate dynamic stability and control strategies of amputees wearing lower-limb prostheses when walking at different inclinations and walking speeds. We will do this by studying how deviations to the body’s center of mass, occurring due to small intrinsic perturbations, are corrected using foot placement and forces. The ultimate goal of this work is to improve the design and implementation of prosthetic limbs, as well as improve rehabilitation and quality of life for the amputees wearing prostheses. Six non-amputee subjects (controls) and six lower-limb amputees with an age range of 18-45 will be requested to walk on a treadmill for 3-4 minutes at different slopes and speeds. All subjects will participate with informed consent, with protocols approved by the Ohio State Institutional Review Board. Three-dimensional motion information will be collected using marker-based motion capture with four markers on each segment on both legs. For the zero-slope condition, ground reaction forces will also be collected with the help of force plates embedded in a split-belt treadmill. The motion and force data will be analyzed by fitting linear models between deviations in input body states and deviations in output controls like foot placement, ground reaction forces and stance times. We expect higher variability in body states for amputees as compared to non-amputee controls. For instance, we expect higher knee flexion when walking on slopes versus when walking on level ground and subsequently, higher signal-dependent variations in the knee flexion. We predict significant increase in the various control gains for amputees when compared to non-amputee sloped walking. We also expect the control gains to change with the slope and speed at which the amputee walks. Additionally, we expect that amputees will have greater center-of-mass error resulting from comparative lack of musculature in amputees compared to non-amputee controls.
Research Project Title: Conceptual evaluation of radon propellant for ion thrusters

Student Presenter: Brennan Barrington

Faculty Mentor: John Horack

Faculty Mentor Department: MAE

Research Abstract: Because the propellant on a spacecraft must also be accelerated, propellant mass increases exponentially with the total change in velocity for a space mission, drastically limiting feasible missions. For maneuvers in vacuum, ion thrusters offer much better performance, using strong electric fields to ionize and accelerate a propellant gas to very high speeds. Improving their performance still further would improve the utility of many space missions and reduce their cost.

Two properties determine the performance of an ion thruster propellant: the power required to vaporize and ionize it (which increases the spacecraft’s mass), and its mean atomic mass. As only one ionization is desirable, a smaller nucleus results in greater Isp, but less absolute thrust at a given voltage.

Xenon (Xe), with a boiling point of only 165 K, is typically used for this purpose, but it is energy-intensive to ionize, and must be stored in pressurized tanks. Radon (Rn) atoms are more massive than those of Xe, and ionizing them requires less energy. However, Rn is unstable; its longest-lived isotope has a half-life of only four days. Hence, this project investigates storing radioactive substances with half-lives on the order of years on the spacecraft as an extremely fine powder in a centrifuge, releasing radon propellant. A Stirling convertor system can use the resulting heat for power generation.

The feasibility, utility, and cost of use of this concept for a hypothetical Uranus orbiter is evaluated. The discharge losses, specific impulse, and thrust associated with each propellant were determined, and electricity production optimized as a function of distance from Sol. Then, the masses of the propulsion and electricity generation systems are considered, with structural analysis of the centrifuge apparatus. The final cost comparison includes all relevant aspects of each propulsion system.

Preliminary results indicate that the power-to-weight ratios of even the most advanced Stirling generators are insufficient to make them superior to solar cells until after the spacecraft would have already experienced most of its necessary acceleration. This suggests that the use of radon propellant will not be superior to existing methods, barring significant improvement in ASCs’ capabilities.
Research Project Title: Simulating UAV ingestion by a turbofan engine using LS-DYNA

Student Presenter: Ian Chamberlain

Faculty Mentor: Kiran D'Souza

Faculty Mentor Department: Mechanical and Aerospace Engineering

Research Abstract: Unmanned Aerial Vehicles (UAVs) pose a new threat to the safety of airplanes. Turbofan engines have been designed and tested to survive foreign object ingestions for decades. For example, turbofan engines are tested for their ability to withstand a bird strike. However, UAVs have components which are denser and stiffer than birds. These differences make it impossible to correlate the level of risk from a bird ingestion to a UAV ingestion of the same mass. To assess the risks that UAVs may pose in an engine ingestion scenario, researchers can use finite element software such as LS-DYNA to simulate collisions resulting from the ingestion of a UAV into a jet engine. The balance between computational cost and model fidelity is always a consideration for events as complicated as airplane-UAV collisions. The goal of this research is to increase the fidelity of future UAV ingestion simulations while also reducing the relative computational cost associated with the simulation. Fidelity of the simulation can be improved by creating better meshes which utilize hexahedron meshing, which is more accurate than the tetrahedron meshing that is simpler to implement. Computational cost can be reduced through a combination of LS-DYNA specific optimizations to the way simulations are run and by extending the material model utilized to handle larger element sizes. At this time, new hexahedron meshes of the nose cone and fan blades have been completed for fan rig model used for UAV ingestion research. Work is currently underway on validating the material model used for larger element sizes. Increasing the model’s element size validation will allow the use of nearly an order of magnitude fewer elements, vastly improving computational performance. The completion of this project will contribute to ongoing research being conducted on UAV ingestion into aircraft engines that will aid the FAA in their understanding of these air-to-air collisions and imposing the necessary regulations to keep air travel safe with the incorporation of an ever increasing number of UAVs into the airspace.
Research Project Title: Design and build a transformation mechanism for a quadruped robot

Student Presenter: Yupeng Cheng

Faculty Mentor: Haijun Su

Faculty Mentor Department: ME

Research Abstract: Quadruped robotic mechanism is a type of legged robotic structure, which uses four legs to move. Quadruped robots can move more stable and smoothly than wheeled robots on rough terrains; yet, wheeled robots can move faster on flat and less rough terrains than the quadrupeds. Therefore, either structure can fail to move properly once the terrains are inappropriate. The purpose of this research is to design and build a transformation mechanism for a quadruped robot, so it can transform between the quadruped type and the wheeled type freely depending on the terrain conditions. The research needs the knowledge and the techniques of dynamics, kinematics, materials, and machining. The mechanism is tested on one identical leg. Its validity can be confirmed once the testing proves the mechanism can transform the leg into either mode freely.
Research Project Title: Development of a micro-scale motion capture system for analysis of formicidae biomechanics

Student Presenter: Sarah Farou

Faculty Mentor: Sandra Metzler

Faculty Mentor Department: Mechanical and Aerospace Engineering

Research Abstract: Previous investigation has determined that ants are able to lift and support loads up to a magnitude of 1,000 times their body weight. The load path through the ant’s body passes entirely through the neck, one of the thinnest structures in diameter on the ant, before it is transferred and distributed to the rest of the body. In order to gain a better understanding of the structural and material properties of the neck tissues, previous research was completed utilizing mechanical loading studies and Scanning Electron Microscopy. SEM was utilized to analyze the location of material failure in the transition region between the soft tissue and the exoskeleton and the mechanical loading study was used to determine several mechanical properties of the neck region, including ultimate failure stress and overall elastic modulus, the experimental procedure employed in the mechanical loading study involved a centripetal loading mechanism which acted in a generally axial direction, but the method did not allow for precise measurement of either force or neck position at the time of failure. In addition, both the SEM and mechanical loading tests were performed post mortem, which did not allow for physiologically relevant positioning of the ant while lifting and carrying objects in a natural setting to be studied. The goal of this work is to explore the internal biomechanical loads of the ant neck throughout the typical physiological range of motion through in-vivo motion capture. In order to develop and validate a method of motion capture of these phenomena at a physiologically appropriate scale, two orthogonally located Go-Pro Silver 4 model cameras with macro lenses were utilized to capture relevant images of Camponotus pennsylvanicus (Carpenter) ants, which were then processed using Matlab image processing software.
Research Project Title: Characterization of heat transfer in serpentine passages using thermochromic liquid crystals

Student Presenter: Aditya Kulkarni

Faculty Mentor: Randall Mathison

Faculty Mentor Department: Mechanical and Aerospace Engineering

Research Abstract: Since the beginning of the 21st century, air travel has increased over 120% thereby creating a need for more efficient propulsion. Recent innovations in aircraft gas turbine technology have centered around cold section improvements such as geared fans and higher-pressure ratio compressors. However, improvements in the thermodynamic cycle of the engine that push turbine inlet temperatures ever higher remain an instrumental part in improving efficiency for future aircraft. At the Gas Turbine Laboratory (GTL), experiments using engine hardware are performed at scaled conditions to provide a better understanding of the flow physics and heat transfer in the high-pressure turbine section. The GTL has completed experiments utilizing enlarged versions of turbine blade serpentine passages employing the industry accepted isothermal copper panel method and the newer thermochromic liquid crystal (TLC) method. TLCs change color as they are exposed to a range of temperatures, and the heat transfer is derived from the rate of temperature change. Measurements with TLCs offer an advantage in that they are a 2-dimensional technique that result in a detailed map of heat transfer across the passage. This provides designers with the detailed data required to improve passage design by increasing heat transfer and reducing coolant flow. However, there is less confidence in the measurements from TLCs. This project proposes a new route to verify the solutions from the TLCs and correlate them to copper panel experiments. Previous work on this project centered around heat transfer algorithm verification and post-processing of full-scale rotating test section data and was presented at SURI 2016. This research expands upon the previous project by performing simplified single panel experiments using warm-band TLCs. The advantage of this project is the elimination of many variables present in the more complicated rotating experiment: fisheye distortion, glares, and inaccurate calibration of TLCs. This will be accomplished by a reduction in scale and measuring temperatures with infrared cameras to provide accurate in-situ calibrations. The results from this experiment will be compared to other small-scale copper panel experiments, the effects of turbulators will be analyzed in more detail, and further progress on calibration and post processing will be demonstrated.
Research Project Title: Full-field deformation and temperature measurement of epoxy resin PR-520 subjected to tensile loading

Student Presenter: Mark Konieczny

Faculty Mentor: Amos Gilat

Faculty Mentor Department: Mechanical and Aerospace Engineering

Research Abstract: Increasingly, aircraft engine manufacturers are turning towards composite materials for use in various engine components; more specifically the fan case surrounding the engine. The high strength, high stiffness, and low weight of composites make them a competitive alternative to traditional aircraft materials such as aluminum and titanium. Composites in fan case applications have become an important topic of research because regulations require that an aircraft engine case must be able to contain debris resulting from a blade out type engine failure. Once the impact characteristics of these composite materials are determined, a blade out engine failure can be simulated through a computational model, potentially reducing time and cost of manufacturing composite fan cases. The properties of the polymer matrix of a composite are important in impact situations when the force is applied out-of-plane with respect to the composite fibers since carbon fibers are not sensitive to the loading rate. The purpose of this research was to study the coupled effect of strain rate and temperature on the response of epoxy resin PR-520. This was done by measuring simultaneously the full-field temperature and full-field deformation of tensile tests conducted at strain rates of 0.01s\(^{-1}\), 1.0s\(^{-1}\), and 350s\(^{-1}\). 2D and 3D digital image correlation (DIC) was used for full-field measurement of deformation, and high speed infrared thermography was used for full-field temperature measurements. The testing was conducted on two test apparatus, a servo-hydraulic load frame for the low and intermediate rate tests, and a direct tension Split-Hopkinson bar for the high rate tests. The results show a coupling between temperature change and strain in the test specimens, with cooling occurring during elastic deformation, and heating occurring during plastic deformation. From the results it can be concluded that there is a dependence on strain rate for both the thermal and mechanical response.
Research Project Title: Finite element analysis of nonlinear micro-mechanical resonators

Student Presenter: Junfeng Li

Faculty Mentor: Hanna Cho

Faculty Mentor Department: Mechanical and Aerospace Engineering

Research Abstract: Micro/nano-electro-mechanical systems (M/NEMS) have been investigated and fabricated for decades. Advanced microfabrication techniques have the capability to integrate small mechanical structures, micro sensors, and micro actuators on a single piece of silicon plate. MEMS are wildly used for micro/nanoscale devices with moving elements and showing large capabilities for sensing, transduction, and actuation. Thus, tuning their frequency response is important to achieve high bandwidth operation and this is possible through various parameters and mechanisms including quality factor, stiffness, and forcing. Due to the small size and low damping of MEMS, these devices can be lead to the nonlinear regime easily while they were designed to be operated in the linear regime. As the nonlinearity of the micro/nano-mechanical resonators cannot be eliminated, this research seeks to take advantage of the nonlinear characteristics since applying intentional geometric nonlinearity on MEMS resonators had been proven as an effective approach to control the level of nonlinearity. The main objective of this research covers finite element analysis (FEA) of various micro resonators models and provides dynamic descriptions of their operations. Previously designed nonlinear micro resonators will be analyzed with the help of FEA, whose results can be used to verify the validity of the FEA approach by comparing the simulated dynamic frequency responses to experimental results. These nonlinear micro resonators can be further studied in detail to find out the origin of the nonlinearity. More FEA simulations will be conducted for theoretically possible nonlinear micro resonators to obtain some important trends that will be useful for future research.
Research Project Title: Computational analysis of heat transfer and combustion processes inside an internal combustion engine using CONVERGE CFD

Student Presenter: Kezhuo Wang

Faculty Mentor: Seung Hyun Kim

Faculty Mentor Department: Department of Aerospace and Mechanical Engineering

Research Abstract: Homogeneous charge compression ignition (HCCI) engines offer a combination of high thermal efficiency, low particulate and NOx emissions. However, the engine has relatively small power band and limited load range which limit its application and commercialization. Previous study show that the thermal in-homogeneity inside the engine cylinders can be used to mitigate the shortcomings mentioned above. This research focus on simulating the combustion and heat transfer processes in an internal combustion engine using the CONVERGE CFD software. The thermal stratification in the engine cylinder and the impacts of key operating conditions such as the composition of fuel-air mixture, in-take temperature and loading conditions are studied and characterized based on the simulation results.

To investigate and characterize the impact of different engine operating conditions, the case setup feature in the CONVERGE studio is utilized to simplify the simulation processes. For example, to investigate the impact of the fuel-air mixture composition and exhaust gas re-circulation, I will need to change the parcel species in the material setting category and make sure that the corresponding thermodynamic data and transport data are included in the simulation data base. I will also need to make sure that the reaction mechanism data for all the relating species is included in the simulation data base. Conjugated heat transfer simulation can also be conducted in CONVERGE studio to investigate the effects of cylinder wall heat transfer.

Currently, I’m investigating the impact of exhaust gas re-circulation and fuel composition on the combustion and heat transfer of HCCI engine. I’m expecting the research to conclude in April.
Research Project Title: Identification and analysis of noise sources in a computationally simulated three stream jet flow

Student Presenter: Nicholas Salamon

Faculty Mentor: Datta Gaitonde

Faculty Mentor Department: Mechanical and Aerospace Engineering

Research Abstract: The high-speed flow expelled by a jet engine is the primary source of noise attributed to aircraft operation. This jet noise reaches levels that can have a lasting harmful impact on nearby people. For this reason, and because of the ubiquitous nature of jet-powered aircraft, jet noise is a problem that needs to be addressed. One proposed noise mitigation technique is the addition of a third stream of flow to a typical turbofan engine, which only has two streams of flow (core and bypass). This third-stream would be placed between the fast-moving core and bypass flows and the stagnant ambient air. This has the potential to reduce turbulence produced in the transition between fast moving jet flow and slow ambient air. Because turbulence is the main contributor to noise produced by a flow, the addition of a third stream has the potential to significantly reduce jet noise. This research is an analysis of a dataset produced through a high-fidelity computational fluid dynamics simulation of three-stream flow exiting a jet engine. The simulated dataset is first validated though comparison with previous simulations and experimental data. Methods of numerical analysis are then used to determine the sonic characteristics of the simulated flow. These methods include fast Fourier transforms (FFT), short-time Fourier transforms (STFT), and method of wavelets. These analyses provide a characterization of the noise generated in the simulated three-stream flow. Relevant information on the power and frequency of continuous and transient noise events is reported alongside data on the time of their occurrence. The insights into the sonic qualities of three-stream jets produced in this study will allow future researchers to make judgments on the overall efficacy of the addition of a third stream as a jet noise mitigation technique.
Research Project Title: Quantifying the influence of parametric variations on the effectiveness of metamaterial energy dissipation mechanisms

Student Presenter: Peter Vuyk

Faculty Mentor: Ryan Harne

Faculty Mentor Department: Mechanical Engineering

Research Abstract: Metamaterial dampers with energy dissipation mechanisms of local buckling constituents have proven to be profound material systems in that they are resilient and lightweight and yet do not sacrifice effectiveness as energy attenuators. Applications of metamaterial dampers can be utilized across a variety of engineering disciplines due to the widespread needs for impact and vibration energy mitigation realized by lightweight materials, whether for embedding into engineered structures or for personal protective equipment. For the elastomeric metamaterial architectures studied in this research, clear needs exist to develop broad understanding on the quantitative relationships between the local beam architectures, loading conditions, and resulting energy dissipation mechanisms so that a broader application of such material systems may be illuminated. Therefore, this research seeks to create robust modeling framework to investigate this class of metamaterial’s critical dynamic response across a vast parameter space of characteristics relevant to vibration and shock mitigation. The primary characteristics of interest are the natural frequency of resonance, force transmissibility, pulse duration, critical force, and critical strain. Specifically, the effectiveness in using the proposed model framework lays in the relationship between varying geometric and scaling parameters, and the previously listed characteristics of damping mechanisms which employ beam buckling for energy dissipation. Using experimentally obtained data for quasi-static compression, impact loading, and shaker excitation studies, these models can be refined and tuned for greater accuracy when applied across a diverse scale or type of application. Further application of data analysis techniques to the experimentally obtained and model-derived behaviors will aid identification and quantification of similarities between the metamaterial under study, and an ideal damping mechanism’s response to a diverse range of loading types. With a predictive understanding of the elastomeric architecture’s behavior, these metamaterials can be utilized in a variety of engineered systems where lightweight solutions for protection against broadband vibration energies is desired.
Research Project Title: Large mistuning on the dynamics of multistage turbomachinery rotors

Student Presenter: Spencer Stahl

Faculty Mentor: Kiran D'Souza

Faculty Mentor Department: Mechanical and Aerospace Engineering Department

Research Abstract: In the turbomachinery field, a great deal of research has focused on understanding the effects of mistuning on the dynamics of each stage. Mistuning in bladed disks is due to the blade to blade differences that typically occur due to manufacturing tolerances and in-service wear. Mistuning greatly complicates the modelling of bladed disks since it is inherently random and requires a statistical analysis to be conducted to understand the full dynamics of a bladed disk design. Moreover, mistuning destroys the cyclic symmetry of the bladed disk, which prevents a cyclic analysis from being used to model the system. Cyclic analysis enables single sector models and calculations to be employed to analyze the full stage dynamics. A wide array of methods to efficiently (using single sector models and calculations) model the mistuning in these structures have been developed to account for small stiffness changes or geometric changes in the blades and even very large stiffness changes and geometric changes due to blends or dents. Typically, these analyses have been done on single stage models and have ignored the effects of the interaction of multistage and mistuning effects. Recently, a statistical analysis of small mistuning effects in multistage rotors has been conducted and shown the importance of multistage modeling. Additionally, a method to efficiently account for large mistuning in multistage rotors has recently been developed using Fourier Constraint Modes and Pristine Rouge Interface Modal Expansion method. The focus of this work is to better understand the combined effects of large and small mistuning on multistage rotors. This presentation will discuss how reduced order models of multistage rotors with both large and small mistuning can efficiently be created. It will also discuss the different effects of various types of large mistuning (e.g., dents, bends, blends) on the multistage dynamics.
Research Project Title: Active control of dynamic stall control over a NACA 0012 using plasma actuators

Student Presenter: Nicole Whiting

Faculty Mentor: Mo Samimy

Faculty Mentor Department: MAE

Research Abstract: Dynamic stall occurs in applications where airfoils are rapidly changing angle of attack, like rotorcraft or wind turbines. When the change is fast enough, flow over a pitching airfoil remains attached beyond the static stall angle. This results in the formation of a dynamic stall vortex on the leading edge of the airfoil. Once the vortex sheds and the flow separates, unsteady aerodynamic loads are produced. These loads can lead to fatigue and eventually structural failure, making it essential to mitigate the effects of dynamic stall. Nanosecond Dielectric Barrier Discharge (NS-DBD) plasma actuators have shown promise at mitigating dynamic stall and reattaching the flow over a NACA 0015 airfoil, a thick, symmetric airfoil, significantly reducing unsteady loads. A high-voltage nanosecond pulse drives the actuator and creates rapid, localized heating that results in a thermal perturbation. The thermal perturbation then excites the flow’s natural instabilities and generates coherent flow structures. Previous work has shown that high Strouhal number (non-dimensional frequency) excitation results in small structures that quickly develop, breakdown, and result in smooth, partial reattachment of the flow whereas low Strouhal number excitation results in large structures that are capable of fully reattaching the flow cyclically and lead to unsteady loads. This work aims at improving upon the previous work by making facility upgrades and using a thin airfoil to make the results more relevant to rotorcraft applications. A NACA 0012 airfoil is chosen because it is a well-documented, thin airfoil. Facility upgrades include integrating all systems into a National Instruments CompactRIO, this will allow for better synchronization between all control systems and measurement instruments. The airfoil pitching mechanism is being changed to a direct-drive servo, this allows for more accurate pitching angles over the previous setup, which used belts that could stretch and cause a phase delay. Previously the lift and drag on the airfoil were calculated by integrating pressure measurements which introduced error, therefore a load cell will be used instead to measure the force on the airfoil. Mitigating the negative effects of dynamic stall has the potential to increase the lifespan of blades and increase lift which will allow rotorcraft to fly higher, faster, or carry larger loads.
Research Project Title: Construction of reduced order model with MAX method for turbomachinery with large blends

Student Presenter: Zihang Li

Faculty Mentor: Kiran D'Souza

Faculty Mentor Department: Mechanical and Aerospace Engineering

Research Abstract: Abstract

Turbomachinery operate in harsh conditions and are sometimes damaged. When a stage of the rotor is made up of a blisk (an integrally bladed disk) as opposed to a bladed disk where the blades are separate from the disk, a blade cannot simply be replaced when it is damaged and therefore blends (missing parts along the leading or trailing edge of the blade) are left in the blade. The rotor’s dynamic status must be investigated even if it is damaged to ensure its performance and reliability. Predicting the dynamics of turbomachinery is challenging due to the very large model size in industrial models. Reduced order models (ROMs) have been developed for these systems. The ROM contains the same information of dynamic status of turbine rotor, but its size is tremendously lower than full model. Recently, the mode accelerated XXr (MAX) method has been developed for turbines with large blends. The MAX method uses relative coordinates to describe the motion of the blended structure to construct a ROM utilizing only single sector models (one damaged sector and one pristine sector) as opposed to requiring the full stage model. The MAX method drastically reduces the model size and time of analyzing the motion status. Hence, it will be an efficient way to be applied on industrial practice. Additionally, the MAX method is very modular and can accommodate multiple blends and frequency mistuning (blade to blade differences due to manufacturing tolerances and in-service wear). This research project is to build a ROM for a given turbine rotor with MAX method and use various method to check its validation. Then its final goal is to extend the MAX method, which heretofore has only been used for single stage bladed disks, so that it can be used to model multi-stage bladed disks that are the norm in turbomachinery and integrate the method with frequency mistuning methods. The result of this research will yield the ROMs of the given single stage bladed disks and multi-stage bladed disks as the efficient solution of analyzing large size model with blend structure.
Research Abstract: The OSU Aerospace Research Center (ARC) is home to the 6x22â€ Unsteady Transonic Wind Tunnel. Few other facilities like it exist; it is capable of producing high speed Mach oscillations in its test section with amplitudes on the order of tenths of a Mach. Unsteady operation is achieved by rotating bars called choke vanes, which rapidly alter the cross-sectional area of the choke point downstream of the test section. This results in an oscillating test section Mach number. The design of these choke vanes determines the Mach time history and is therefore crucial for any experiment using the tunnel. The purpose of this project was to automate choke vane design for any desired Mach time history.

The minimum and maximum Mach numbers of the desired time history dictate the maximum and minimum diameters of the choke vane cross-section, respectively; the curve between those diameters dictates the form of oscillation (sinusoidal, triangle, etcetera). A superellipse -- a more general form of ellipse, determined by four parameters instead of two -- was chosen as the basic shape for the design of choke vanes. Two of its parameters determine its major and minor axes lengths, while the other two determine the curve between those axes. Computational 2D optimization was used to find values for these latter two parameters that yield desired Mach time histories.

It was discovered that some sinusoidal time histories are impossible to achieve by any superellipse undergoing constant rotation speed. To address this issue, the angular speed of the choke vanes was allowed to vary as a sinusoidal function of the vanesâ€™ angular position. Adding this extra degree of freedom greatly expanded the range of achievable Mach time histories. Implementation of this functionality in the actual tunnel is currently underway.

The focus of research going forward is how to alter choke vane shape to counteract wave steepening effects, due to variations in the speed of sound in the unsteady environment. CFD code for predicting these effects was recently completed by another researcher, and will be used to inform choke vane design in the future.
Research Project Title: 1-D tolerance stack automate

Student Presenter: Kreteeka Chaudhury

Faculty Mentor: Jami Shah

Faculty Mentor Department: Mechanical and Aerospace Engineering

Research Abstract: In mass production, for ensuring interchangeability of parts and proper function, design engineer needs to specify the range of geometric and dimensional variations that is acceptable. This is done using Geometric Dimensioning and Tolerancing (GD&T) which has classified 14 different types of geometric characteristics needed for specification. When designers develop a GD&T scheme, they need to ensure that dependent dimensions such as clearances are within range to allow assembly and proper function. This requires analysis of the tolerance scheme. 3D tolerance analysis is a non-linear problem that cannot be expressed in closed form so various simplified methods have been devised to do tolerance analysis. One of them is called 1D minimum and maximum chart, which does tolerance analysis in one direction control at a time so it misses out in any couplings between the directions. However, it is still accurate for certain type of assemblies such as disk stack on a single shaft in a turbine. So, because of its simplicity it is a popular method used by many designers. However, the procedure is manual and requires mastering a large number of rules, each specific to a tolerance class to make the chart. The purpose of this project is to automate the 1-D tolerance analysis process by making a 1-D Tolerance Stack Automate that will have all the tolerance analysis rules embedded in it and will perform the stack calculations automatically, freeing the user from learning the rules. It is also capable of performing certain scheme on the correctness and consistency on designer's GD&T scheme in addition to the clearance region of interest. The tool has been made using MS Excel macros functions. Six files were made to incorporate all the rules depending on the number of user inputs required to perform the analysis and then each of these files were combined in one master file. It is currently being tested using different geometric parts so that each condition is evaluated. It is expected that the results from 1D chart performed in Excel will be 100% exact to those performed manually as both the approaches uses standard GD&T rules.
Research Project Title: Actuation method for a variable stiffness robotic link

Student Presenter: Ishan Mann

Faculty Mentor: Haijun Su

Faculty Mentor Department: Mechanical Engineering

Research Abstract: Soft robotics is an important milestone in the field of robotics research. Due to high compliance of soft robots, they can be extremely durable, less likely to cause damage to the surrounding environment, and hence much safer for use around humans. However, there are some limitations with highly compliant soft robots. The inherent flexibility of a soft robot makes it difficult to know the exact position of soft robot’s end effector, which compromises positional accuracy of soft robots. Also, high loads and quick acceleration cause a soft robot to flex, which limits the potential uses of soft robots over traditional robots. Previous research has shown that a variable-stiffness robotic arm link, which uses the concept of layer jamming can prevent the link from getting flexed when carrying high loads or during quick accelerations and deceleration by changing its stiffness. However, the limitation of positional accuracy still exists. The purpose of this study is to develop an actuation method for a variable-stiffness robotic link which can overcome the limitation of positional accuracy. To do this, wire driven actuation method will be studied, tested and integrated with layer jamming technique to make a soft robotic hand which can vary its stiffness. The soft robotic hand which will be made using the developed actuation method in combination with layer jamming technique should be able to lift specified objects with a predetermined contact force. The development of such an actuation mechanism, in combination with variable-stiffness robotic link will overcome the major limitations for a soft robotic link and expand the areas where soft robots can be potentially used over traditional robots to promote a safe workplace environment which involves human-robot interaction.
Research Project Title: A CFD investigation of morphing wing technology on a hybrid, unmanned, aerial and underwater vehicle concept

Student Presenter: Austin Petsche

Faculty Mentor: Clifford Whitfield

Faculty Mentor Department: Department of Mechanical and Aerospace Engineering

Research Abstract: Submarines that fly? Airplanes that swim? Impossible. These two extravagant concepts sound like something out of a James Bond movie. Well, the Defense Advanced Research Projects Agency (DARPA) doesn’t think so. In 2008, DARPA, the central research and development organization for the United States Department of Defense, released a challenge for designers to create a vehicle that both flies and operates underwater. With the intent of reaching a target quickly and stealthily, the proposed mission focused on combining high-altitude flight, low-altitude flight, and underwater navigation capabilities into a single entity. High-altitude flight would allow the vehicle to approach its target quickly. Low-altitude flight would allow the vehicle to get close to its target by hiding behind the curvature of the earth, therefore blocking radar and direct line-of-sight detection. And underwater navigation would allow the vehicle to get even closer to its target and to loiter in an area undetected. This research focused on designing a wing configuration capable of optimum performance in high-altitude flight, low-altitude flight, and underwater operation for a submersible unmanned aerial vehicle (SUAV). In addition to wing configuration design, a full conceptual design for the SUAV will be analyzed and presented. The computational fluid dynamics (CFD) software, XFLR5, provided pressure gradients, flow paths, and configuration performance metrics for each wing configuration considered in both the air and water mediums. Stability, control, propulsion, and sizing metrics were calculated with historical data and engineering methods acquired during undergraduate learning. Morphing wing technology comprised a bulk of this wing configuration research due to its promising leads into combining these performance characteristics. Although the multitude of unique wing-morphing configurations tested proved adequate, a fixed, reverse-delta wing configuration identified as having the ideal performance characteristics for each of the diverse mission segments. This study provides evidence that combining vehicle abilities in differing environments is possible and can equip the military with more effective methods of achieving low observability states.
Research Project Title: Autonomous orbital debris tracking using wireless sensor network collaboration

Student Presenter: Wilson Flores

Faculty Mentor: Mrinal Kumar

Faculty Mentor Department: Mechanical and Aerospace Engineering

Research Abstract: One of the biggest threats currently being faced in space exploration is a problem known as Space Situational Awareness (SSA). SSA is the ability to view, understand, and predict the physical location of space debris with the objective of avoiding collisions. Space debris, or orbital debris, is the collection of defunct human-made objects orbiting the Earth. Currently, the U.S. Space Surveillance Network is capable of tracking millions of objects larger than 1 millimeter in size using 20 sensor sites around the world. Moving at thousands of miles per hour, orbital debris is more probable to have high speed impacts between objects. Randomly distributed around Earth’s orbit, objects that do collide cause even more fragmentation debris, allowing the problem to grow. To minimize debris generation in Low-Earth orbit, it is required that debris is monitored with high precision. Although capabilities in monitoring debris already exist, being able to track smaller debris in the space environment will be important to future spacecraft design. The challenge that arises with orbital debris is predicting current and future debris trajectories. This investigation focuses on tracking a moving target using wireless sensors, in order to minimize uncertainty on the target’s physical location. This study will experimentally validate mathematical frameworks being developed by graduate students using robots in connection with a network of sensors within a modeled static environment in the laboratory. Expected results are that experiments will show that an autonomous decision can be made by robots, finding the best strategy to track a target. This optimal approach of tracking will be done using a combination of sensor data. This study will provide insight not only to autonomous space applications, but even areas in autonomous mission planning, such as rescue missions.
Research Project Title: Thermoelectric combustion chamber for micropower production

Student Presenter: Mark Verosky

Faculty Mentor: Joseph Heremans

Faculty Mentor Department: Mechanical and Aerospace Engineering

Research Abstract: Common modes of power production have an efficiency that is lower than most thermoelectric materials for power generation of approximately 1000 [W] or less. Thermoelectric materials generate electricity using a physical phenomenon known as the Seebeck effect. The Seebeck effect produces a voltage difference from the temperature gradient in a material. Therefore, by heating up one end of a material and keeping the other end at a lower temperature, a voltage difference is produced. The objective of this research was to create and test a portable means of power production from readily available thermoelectric materials and determine the efficiency and power produced by this device. This device has the additional benefit of not needing to be recharged. Construction of the device consisted of three main components: a small camping stove, butane fuel canister, and a thermopile constructed of type K (Nickel-Chromium / Nickel-Alumel) thermocouples. The thermopile also had the added bonus of acting like a flashback arrestor, preventing the flame from propagating back to the butane fuel canister. During testing, the butane fuel flowed out of the canister, through the thermopile and then ignited. This steady flow of fuel kept a consistent temperature difference between the two ends of the thermopile resulting in a constant output voltage of approximately half a volt. Integration of additional piles around the flame would yield even higher voltages. By creating a highly portable device that can create electricity on demand is incredibly valuable in areas away from the grid.
Research Project Title: Seabird conservation and censusing in the antarctic region: a systematic overview

Student Presenter: Joanne Ash

Faculty Mentor: Krissek Yes

Faculty Mentor Department: Lawrence

Research Abstract: Four main bird orders populate Antarctica and the surrounding ocean: Sphenisciformes, Procellariiformes, Pelecaniformes, and Charadriiformes. Seabirds are threatened on a global scale, due to threats such as climate change, fishery by-catch, and pollution. During a 10 day stint of Antarctic field research, a census was conducted on seabird populations. The census research contributed to the worldwide understanding of conservation through the bird collection database eBird and aided in the evaluation of how field results reflected the current seabird conservation statuses. Seabird census data was taken from a ship traversing the Drake Passage and the waters surrounding the Antarctic Peninsula. Observations were taken from the bridge of the ship four times a day for fifteen minute intervals along with detailed environmental variables, such as sea temperature, latitude, and longitude. All census data was submitted to the eBird database. A total of 922 birds were censused, with high frequencies of expected species such as gentoo penguins, Antarctic cormorants, black-browed albatrosses, and brown skuas, with overall census results presenting little deviation from the expected species counts. But with a small sample size and limited locations, no broad correlations between our studies and conservation statuses can be made. The data was compiled in eBird allowing for our contribution to benefit large-scale seabird conservation studies.
Research Project Title: The effect of allogrooming on social group dynamics in captive bonobos, Pan paniscus

Student Presenter: Chelsea Mascuch

Faculty Mentor: Benderlioglu No

Faculty Mentor Department: Zeynep

Research Abstract: Social allogrooming among the members of the same species serves important functions across taxa. Observed in a range of animals from insects to humans, allogrooming helps reduce disease transmission, maintain social structure, and increase societal bonding. In bonobos (Pan paniscus) and other primates, allogrooming is an important part of the social repertoire that reduces tension, which may arise as a result of aggressive acts directed at individuals, thereby increasing the chances of reconciliation and group harmony. Our study aimed at understanding the correlates of allogrooming in a captive bonobo population at the Columbus Zoo and Aquarium in Powell, Ohio. Drawing upon our previous research at the Zoo on bonobo dominance relationships, we investigated whether low-ranking individuals engaged in more grooming and were more selective in exhibiting this behavior. We hypothesized that individuals would spend more time grooming others that are higher-ranking than themselves, presumably to gain favor, or, elevate their own status. Fourteen bonobos (8 males and 6 females) were observed at the Zoo. Fifty hours of interactions were videotaped in enclosures recording the frequency and duration of grooming among individuals. The target and initiator of the grooming behavior and dominance status of the individuals were noted by using a behavioral analysis software to be subsequently exported to a statistical program. The analyses are ongoing. Although identified as separate species in 1929, bonobos remain relatively understudied due to their endangered status, their only ecological niche in war-torn Democratic Republic of Congo, and low numbers in captivity. This study can be used to inform further research concerning bonobo societies, as well as providing valuable insights into the group dynamics of other closely related social apes, such as chimpanzees and humans.
Research Project Title: The carbon footprint of "ecotourism" in the Antarctic

Student Presenter: Andrew Holden

Faculty Mentor: Davis No

Faculty Mentor Department: Thomas

Research Abstract: Introduction/Background:

Antarctica's icy, otherworldly landscape has been drawing increasing amounts of visitors to its shores over the last few decades. With a record number of 46,069 persons transported to the continent in 2009 (IAATO, 2010), an increased human presence in Antarctica has the potential to harm its vulnerable ecosystems. The Antarctic tourist industry prides itself on their “sustainable” practices and environmental activism, but the rapid industry growth has led to substantial emissions of CO2. The industry claims negative impacts are offset by the creation of “ambassadors” or individuals who will advocate for the extended protection of Antarctica. Our research takes measure of the relationship between the carbon footprint of ecotourism in Antarctica and the potential offset of the Ambassador Effect.

Methods:

This project was driven by the following question: “How does the ambassador effect offset negative impacts from carbon emissions?” To explore this question, we employed research methods built on existing research on the effects of ecotourism to the Antarctic in three significant ways; calculating the carbon footprint from air travel to the port city, Ushuaia, the shadow price of carbon emitted, and administering qualitative surveys designed to measure the effectiveness of the Ambassador Effect.

Results:

Our research results revealed the shadow price for the carbon emitted during the voyage totaled $279-$352 per passenger depending on travel distance. Survey results indicated no significant change from individuals that would result in offsetting CO2 emissions from the trip.

Conclusion:

Under the current standard operating conditions for tourism to the Antarctica, our results indicate the current practices are not sustainable due to its massive carbon footprint.
Research Project Title:

Student Presenter: Madison Zimmerly

Faculty Mentor: Benderlioglu No

Faculty Mentor Department: Zeynep

Research Abstract: Are bonobos really peace-loving? A study with captive populations
Research Project Title: Can roadsides function as bumblebee habitat?

Student Presenter: Audrey Bezilla

Faculty Mentor: Jessie Lanterman

Faculty Mentor Department: EEOB

Research Abstract: There are 16 species of bumblebee in Ohio, including the endangered Bombus affinis and others which have suffered serious decline in recent years. These environmentally and economically vital species have declined in part due to habitat loss and fragmentation; as such, there is the tendency to automatically view human-altered landscapes as unviable habitat for bumblebees and similar wildlife. However, this may not be the case when important habitat features can be maintained. Ohio’s extensive system of roadways offers vast stretches of wildflower-filled land for pollinators, including bumblebees. To determine whether roadsides offer bumblebee habitat comparable to more ‘natural’ settings, bee and flower data collected at 130 sites across Ohio from September-August 2017 were analyzed by one of five habitat types (roadside, natural field, planted wildflower meadow, shrubby successional, and ‘other’) to determine whether bumblebee diversity or abundance varied based upon this designation. Analyses were conducted using full surveys (90 mins), as well as with bumblebee communities rarefied down to a minimum of 20 individuals and 10 individuals in order to compare full surveys with a number of half surveys (45 mins). There was a statistically significant difference between mean bumblebee diversity of roadside sites ($H=0.55\pm0.28$) and ‘other’ sites ($H=0.91\pm0.21$) in full surveys, and between roadside sites ($H=0.56\pm0.3$) and shrubby successional sites ($H=0.3\pm0.27$) in the rarefied data set. There was also a statistically significant difference between mean bumblebee abundance (bees/min) of roadside sites (0.67±0.61) and planted wildflower meadows (1±0.77). Additional calculations were made to explore potential explanations for these differences, which revealed a statistically significant difference between floral diversity of roadside sites ($H=1.16\pm0.4$) and planted/shrubby successional sites ($H=1.36\pm0.49$, $H=1.50\pm0.34$), and negative correlations between bee diversity and percent forest cover in a 2000m radius. Differences between mean values of diversity/abundance for roadside sites and all other sites were statistically insignificant, indicating roadsides offer largely equivalent habitat compared to other habitat types. These data suggest roadsides are not inherently poor bumblebee habitat, and provide a viable location for pollinators to forage. Future studies could explore whether roadsides planted with more diverse pollinator wildflowers improve bumblebee habitat relative to their unplanted counterparts.
Research Project Title: Evaluating basin-specific early growth rates as a Lake Erie walleye stock discrimination tool

Student Presenter: Taylor Brown

Faculty Mentor: Stuart Ludsin

Faculty Mentor Department: EEOB

Research Abstract: The ability to accurately assign individuals to their source population is necessary to manage fisheries composed of discrete subpopulations. The Lake Erie walleye (Sander vitreus) metapopulation is composed of several discrete spawning stocks in the lake’s three basins, with most spawning occurring in the west and east basins. The ability to discriminate among the major walleye subpopulations is vital in understanding their relative contributions to overall harvest and in helping predict population dynamics amidst future climate change. For example, maintaining the stability of both the east and west basin walleye populations could lead to greater resiliency and stability in future climate regimes. However, the relative contribution of east basin individuals to lakewide recruitment and harvest remains poorly understood. Variations in life-history traits between subpopulations, such as basin-specific early-life growth rates, may provide a novel means of stock discrimination. The objectives of this study were to determine if basin-specific differences in early-life (i.e., larval) growth rates exist and to evaluate the potential for early-life growth rates to be used as a stock discrimination tool. Age-0 walleye from the west (n=15) and east (n=31) basins were collected in August and September 2016 and otoliths were extracted. Daily growth rings on sagittal otoliths were counted to 21 days and weekly growth rates (μm/week) were measured. The effects of basin and week on growth rates were evaluated using a generalized linear mixed model. Our results demonstrate that early growth rates are a poor potential stock discrimination tool as growth rates did not differ between source populations; however, growth rates significantly increased from weeks one through three. Future work will examine if growth in older life-stages may still be utilized as a stock discrimination tool. This study furthers our understanding of potential walleye stock discrimination tools and will help inform future and ongoing research dedicated to improving sustainable fisheries management for Lake Erie walleye.
Research Project Title: Cranial morphology of heteromyid rodents is indicative of locomotion.

Student Presenter: Andrew Brown

Faculty Mentor: Jonathan Calede

Faculty Mentor Department: EEOB

Research Abstract: Rodents are the most diverse order of mammals on the planet. 40% of living species of mammals belong to this order. This species diversity is associated to a great diversity of ecologies, including locomotor habits. Previous works have studied the relationship between locomotion and cranial dimensions. They found that skull morphology is related to locomotion in rodents but this research has been limited to arboreal and burrowing animals. I expand upon this scope by exploring the link between skull morphology and locomotion in terrestrial rodents. I focus on the family Heteromyidae (kangaroo rats, spiny pocket mice, and their relatives) to limit potential taxonomic signals in my data and because heteromyids display a wide range of locomotion – semi-fossorial burrowers, animals hopping on all four limbs, some hopping only on their hind limbs, and some strictly ambulatory. I included 28 cranial measurements for 161 specimens representing 5 genera and 12 species. I analyzed the data using a canonical variate analysis correcting the data for body size to focus on skull shape. The results show a relationship between certain cranial characteristics and locomotion habits. Bipedal jumpers are characterized by large skulls with broad cheek bones and expanded ear bones, supporting large ears to aid in evading predatory hawks, owls, and snakes. Quadrupedal jumpers have deep skulls with broad palates and long lower jaws. Semi-fossorial heteromyids have thick and broad noses, useful in digging for seeds, and burrowing to avoid coyotes, bobcats, and other predators. Ambulatory species display long noses, skulls, and jaws, allowing them to more easily forage for the larger seeds they show preference for. The relationship between locomotion and skull morphology appears mediated by the functions of the ear, nose, and mouth regions. This reflects the sensory adaptations of heteromyids in navigating their habitats, as well as the wide range of seeds, grains, fruits, and insects each species may consume. The correlation between skull shape and locomotion in modern heteromyids offers the opportunity to investigate the ecology of fossils for which no postcranial skeleton is preserved.
Research Project Title: Examining carry-over effects in resident and migratory sparrows using feather corticosterone

Student Presenter: Adam Cupito

Faculty Mentor: Chris Tonra

Faculty Mentor Department: School of Environment and Natural Resources

Research Abstract: Many factors influence a bird’s likelihood of survival, including access to food, quality of habitat, and protection from predation. This study is aimed to assess winter survival rates in relation to corticosterone, a hormone that regulates stress responses in birds. Winter is a stressful season with high mortality rates, so high levels can be incorporated in feathers when they are replaced during molt. Molt, the annual replacement of feathers, is energetically costly and occurs prior to the winter season. An acute or chronic stress response during molt might have a carry-over effect onto survival rates during the subsequent winter season, known as a seasonal interaction. We examined survival rates in populations of migratory White-throated Sparrows (Zonotrichia albicollis) and resident Song Sparrows (Melospiza melodia) in an urban wetland. To measure corticosterone levels during molt, we mist-netted and banded sparrows at the Olentangy River Wetland Research Facility and collected tail feathers. To calculate winter survival rates for individuals we used Program MARK, which assigns a survival rate to each bird and related this to corticosterone levels during molt. These results will allow us to determine if survival rates vary among individuals in accordance with corticosterone hormone levels, providing further insight on potential carry-over effects from molting to winter seasons. This will ultimately allow us to explain what is affecting survival rates and better understand how seasons interact to influence population dynamics.
Research Project Title: Fibronectin-binding protein A qualities in Staphylococcus aureus

Student Presenter: Megan Broughton

Faculty Mentor: Steven Lower

Faculty Mentor Department: School of Earth Sciences

Research Abstract: The bacteria Staphylococcus aureus have been found to cause infections in cardiovascular implants in humans. However, this infection does not consistently occur in all patients with circulating S. aureus in their blood. The adhesion of S. aureus bacteria to the host ligands that coat the cardiac implants has been studied recently and it has been suggested that fibronectin-binding protein A (FnBPA), is responsible for the attachment of S. aureus to host ligands. FnBPA is a cell wall anchored protein in S. aureus that is known to interact with the host ligand fibronectin (Fn), a glycoprotein of the extracellular matrix. Particularly, the presence of non-synonymous polymorphisms (SNPs) in the FnBPA gene were associated with infections of the cardiovascular devices and these variations confer a greater adhesion to Fn. We believe that these SNPs are the reason only some people with S. aureus bacteria developed an infection in their implant. To further explore the adhesion qualities of FnBPA with Fibrinogen (Fg) a second host ligand that could mediate S. aureus adhesion, seven FnBPA variants with the reported SNPs were constructed in a model bacterium, Lactococcus lactis a surrogate with no expression of adhesins. First, to verify comparable composition, we evaluate the growth curves of these seven variants and three wild-type strains of L. lactis using spectrometry. The growth rates of each were calculated and compared at 600 nm over a period of 12+ hours. Our results showed that all the FNBPA variants present similar growth rates, with the exception of the negative control and L. lactis expressing FnBPB. Atomic force microscopy (AFM) was used to investigate the relationship between various FnBPA mutants and Fg. Through this technique, we were able to directly quantify the bond strength between Fg and FnBPA. AFM uses a flexible cantilever and an optical lever detection system to measure the force necessary to break the bond between Fg and FnBPA. The data was collected and then analyzed using a computer macro system. Finally, we were able to determine that not all of the tested mutations enhanced binding to Fg. Further testing is being done to analyze the degree of favoring adhesion of S. aureus to Fg.
Research Project Title: The role of the spermathecae in females of the Northern House Mosquito, Culex pipiens

Student Presenter: Victoria Colin

Faculty Mentor: Megan Meuti

Faculty Mentor Department: Entomology

Research Abstract: ABSTRACT FOR THE 2018 OHIO STATE DENMAN UNDERGRADUATE RESEARCH FORUM

The Role of the Spermathecae in Females of the Northern House Mosquito, Culex pipiens

Victoria Colin and Megan Meuti

The Ohio State University

Spermathecae are receptacles that are found in the reproductive tracts of female insects such as mosquitoes that allow females to store sperm. Antioxidant enzymes like Superoxide Dismutase-2 (SOD-2), Catalase, and Glutathione S-transferase (GST) promote sperm longevity and storage by protecting sperm from oxidative stress. Culex pipiens, commonly known as the Northern House Mosquito, is the major vector of West Nile Virus. Adult female mosquitoes can lay 50-200 eggs per oviposition leading to over 800-1000 mosquito offspring in a lifetime. However, females of this species enter an adult, reproductive diapause in response to short day lengths where they divert their resources from reproduction to survival, failing to take a blood meal or develop their eggs. In contrast, male mosquitoes do not survive winters. Therefore, it is pivotal that females store and protect the sperm for the 3-6 months that they are in diapause so that they can lay fertile eggs that following spring. To better understand how anti-oxidative enzyme levels are affected by the diapause status and relative age of female Cx. pipiens, we will measure the levels of SOD-2, Catalase and GST mRNA in their spermathecae using quantitative Real Time PCR. We hypothesize that levels of SOD-2, Catalase and GST will be higher in mature and diapausing Cx. pipiens. This work is important because it will provide information on the preservation of sperm and could shed light on control of mosquito populations and disease transmission.
Research Project Title: Effects of pesticides applied during almond bloom on post emergence mortality rate of honey bees

Student Presenter: Ann Chessler

Faculty Mentor: Chia Lin

Faculty Mentor Department: Entomology

Research Abstract: Almond crops rely on honey bees for pollination of their flowers. The primary objective of this study is to characterize the effect of insecticides and fungicides applied during almond bloom on developing honey bee larvae. Honey bee populations are decreasing at an alarming rate worldwide, with no obvious cause. Without honey bees, we would not only see a decrease in almond production but a hit to a major agricultural market. What is the cause of this increased mortality in honey bees? The experimental design consisted of 8 separate trials of bee larvae artificially reared on diets treated with three insecticides (chlorantraniliprole, diflubenzuron, and methoxyfenozide) in combination with fungicides commonly applied with these insecticides in a tank-mix (propiconazole, iprodione, boscalid, and pyraclostrobin). Bees were allowed to emerge naturally. After emergence, their mortality was tracked for several days and recorded. It was determined that four chemicals, either alone or in combination, had the greatest effect on mortality (less than or equal to 50% survival on day one). These chemicals are chlorantraniliprole, iprodione, propiconazole, and diflubenzuron. With this information, chemists can generate new formulas for pesticides and fungicides that are still effective but safe in combination.
Research Project Title: Evaluation of DNA extracted from timber rattlesnake (Crotalus horridus) cloacal and blood swabs for microsatellite based genotyping

Student Presenter: Aaron D'Amore

Faculty Mentor: Bill Peterman

Faculty Mentor Department: ENR

Research Abstract: The timber rattlesnake (Crotalus horridus) is an endangered species in Ohio, having experienced dramatic declines since European settlement. Today, populations continue to decline due to a multitude of factors, including disease, habitat loss and fragmentation. These changes result in a loss of genetic diversity, which can potentially influence future population persistence. In the past, researchers have used blood extractions as a way of retrieving reliable, high-quality DNA from snakes such as the timber rattlesnake. However, these phlebotomies can often be invasive, stressful, and even harmful. To maintain the health of each individual and the overall genetic diversity of the species, it is extremely critical to obtain DNA in the simplest and least invasive manner possible. Cloacal swabs have been used in the past as a way of obtaining DNA from tortoises while causing little to no harm. In this study, we tested this method with rattlesnakes. Using cloacal and blood swabs from 14 timber rattlesnakes we extracted DNA using Chelex 100 as a medium. We then compared the concentration and quality of the DNA in each sample using a NanoDrop 2000c. Our results show that the concentration of DNA produced by blood and cloacal DNA extractions was not significantly different, however, the quality of DNA from blood extractions was significantly higher (p-value <0.001). Using PCR, we found that the DNA quality of cloacal swabs was sufficient for amplification of species-specific microsatellite markers. We are now genotyping individuals using fragment analysis to detect potential allele dropout in lower quality DNA. Moving forward, we will use these genotypes to conduct population genetic analyses of our population to better understand genetic diversity and relatedness in our snakes.
Research Project Title: Relative presence and absence of novel microbial symbionts in the gut of the American cockroach (Periplaneta americana)

Student Presenter: Jonathan Foltz

Faculty Mentor: Zakee Sabree

Faculty Mentor Department: EEOB

Research Abstract: New techniques and technology in studying bacteria has provided a better understanding of their influence on their environment and drastically changed the way in which many systems are viewed. This idea is especially true when looking at host species and their microbial, gut symbionts as they heavily influence the development and health of their host. Studying organisms that have complex gut microbiomes, containing thousands of species, can be difficult as they can typically vary based on diet. The American cockroach (Periplaneta americana), however, provides an ideal model for these systems because it possesses a complex, yet stable, gut microbiome. This project aims to aid in understanding these host-microbe interactions by providing the relative presence and absence of 14 novel bacteria isolated from the gut of the American cockroach. This was done by harvesting the guts from 3 adult, wild-type cockroaches, extracting their DNA, and testing for presence and absence by means of dPCR. I found that, while three were relatively rare, many of the isolates were found consistently across all 3 individuals. This project serves as the basis for further presence and absence work and for studying the benefits of these symbionts provide for the host species by contextualizing their distribution amongst wild populations.
Research Project Title: Testing mosquito surveillance trap in Los Robles, Jinotega, Nicaragua

Student Presenter: Helena Fox

Faculty Mentor: Rebecca Garabed

Faculty Mentor Department: Veterinary Preventive Medicine

Research Abstract: In Nicaragua, vector-borne diseases have become a growing public health concern. Outbreaks of dengue, chikungunya, and Zika in Nicaragua were reported in 2016 by the Nicaragua Ministry of Health (MINSA), and while the number of cases of these diseases in 2017 have decreased, these vector-borne diseases remain endemic in some areas of Nicaragua and pose a risk for future epidemics. MINSA has attempted to combat disease spread through surveillance, public outreach, and prevention. In order to aid in vector surveillance, a mosquito trap was previously designed and tested in a laboratory setting that targeted gravid female mosquitoes. This research poses the question: Can this designed mosquito trap be utilized as a low-cost surveillance technique in Los Robles, Jinotega, Nicaragua for mosquito vectors of emerging infectious diseases. The mosquito trap design was recreated and tested in three different environments with four different attractants in Los Robles, Jinotega, Nicaragua. Environments for the traps were near humans, near animals, and near the lakefront of Lago de Apanas, a known mosquito-heavy location by locals, while the attractants utilized were guinea pig feed in water, light, lactic acid in water, and Fabuloso cleaner in water, an attractant recommended by locals. Eighty-four traps were placed in total, with seven different locations used for each of the three environments. Traps were checked for mosquitoes 24 hours after placement and 48 hours after placement, and then the traps were removed. While this trap design was reported to have captured mosquitoes in a laboratory setting, no mosquitoes were captured by the traps in this field experiment.
Research Project Title: Measuring the effects of cattle ranching on forest island structure and mammal/nocturnal bird populations in the Bolivian Beni Savanna.

Student Presenter: Johnathan King

Faculty Mentor: Matt Davies

Faculty Mentor Department: School of Environment and Natural Resources

Research Abstract: Introduction: I completed my studies on the Barba Azul Reserve in Bolivia. Seasonal flooding and drying create small forest islands surrounded by the vast savannah. My research was aimed at discovering the differences between the structure in forest islands where cattle ranching is present and not present. I am specifically interested in how these differences in forest structure affect the corresponding endangered mammal and nocturnal bird inhabitants.

Methods: I conducted vegetation and wildlife surveys collecting data about the forest and organisms. For the vegetation surveys, I took four forest line transects from each side of the reserve. In each, I recorded a shrub intercept along 100-meters, took 20 points of vegetation height and density measurements, recorded adult trees in a 400-meter square plot, recorded saplings in a 200-meter square plot, and recorded seedlings and ground cover in five 4-meter square plots. To collect data on the mammal and nocturnal bird populations I performed two types of transects. I completed a dusk transect from about 4:45-6:15pm, in each forest, recording all mammals I saw along with the time and location. I performed this in multiple forests in the north and south side of the reserve. For the nocturnal birds, I completed night transects; following the same procedure as the dusk transects, from 8:30-11:30 am. I recorded bird calls and practiced lamping to locate birds in the canopy.

Results: I found a rather stark difference in the structure of the sub canopy and shrub layer between forest with ranching and forest without ranching. The forest islands with ranching lacked adequate forest regeneration. The key palm tree species of the region, the Motaku, had very few seedlings surviving to maturity. Most of these seedlings were trampled by the cattle. The encounter rate of mammals and nocturnal birds decreased in the forest islands where ranching was present.

Conclusion: My research shows extensive cattle ranching in the forest islands halt the regeneration of the forest. Without regeneration, the sub-canopy and shrub layer becomes clear. Clearing results in greater risks and less habitat for the mammals and nocturnal birds that have traditionally lived in these habitats.
Research Project Title: The oldest semi-aquatic rodents in North America: evidence from the ankle morphology of two fossil beavers (Rodentia, Castoridae)

Student Presenter: Christian Harris

Faculty Mentor: Jonathan Calede

Faculty Mentor Department: Evolution, Ecology, and Organismal Biology

Research Abstract: Although modern beavers are well-known semi-aquatic rodents, the fossil record of the beaver family is rich in burrowing forms. In fact, despite a long evolutionary history stretching back to almost 37 million years ago, the oldest known semi-aquatic beaver in North America, which is also the oldest known semi-aquatic rodent on the continent, is only around 18 million years old.

Recently, fossils of a new group of beavers, called Microtheriomys, were uncovered in Oregon. They are known only from partial jaws and teeth and their phylogenetic affinities suggest that they may be semi-aquatic. In the absence of preserved skeletons, this hypothesis has remained untested.

I here present new fossil remains of Microtheriomys from Montana that are 29 million years old. Specifically, I present the first postcranial remains for Microtheriomys: two astragali. The astragalus is the ankle bone connecting the tibia to the foot and previous research has showed a link between its shape and the locomotion of rodents.

I expanded upon a previous analysis of modern rodent ankle morphology and built a dataset of 16 measurements of the astragalus for 87 specimens representing 55 species, 45 genera, and 24 families. This dataset includes rodents with various locomotions including arboreal, jumping, running as well as generalist rodents and, critically, burrowing, semi-fossorial, and semi-aquatic rodents. I incorporated these data, and measurements from the fossils, into a canonical variate analysis to predict the locomotion of the extinct beaver Microtheriomys based on the shape of its astragalus. I find that the 29 million year old fossils resemble most closely modern semi-aquatic rodents. This is evidence for a semi-aquatic rodent over 10 million years before current evidence. This suggests the presence in Montana of habitats that supported semi-aquatic species despite evidence for the contemporaneous aridification of the environment.
Research Project Title: The effect of diet on avian cecum size and intestinal absorbancy rate

Student Presenter: Stephanie Hempfling

Faculty Mentor: Jacqueline Augustine

Faculty Mentor Department: EEOB

Research Abstract: Diet and physiological demands of species effect the morphology of digestive systems. The morphology of birds’ intestines and cecum critically impact their survival and reproduction, and they influence absorption and enzymatic breakdown of nutrients. The purpose of this study was to determine if birds with herbivorous diet have a well-developed ceca and faster intestinal rate compared to insectivores or omnivores. The birds were salvaged, frozen, thawed and then weighed before skinning. The “sausage” method was used to determine absorbancy rate of the intestine and the mass of the cecum (if present) was measured and both were expressed as a percent of the body mass. The diet of the birds was based on gizzard contents and literature. Logistic regression was used for cecum analysis with diet as the independent variable, and binary order (Passeriformes vs non-Passeriformes) and the presence of a cecum were dependent variables. Mixed effect model was used to analyze how intestinal absorbancy, percent of 4-centimeter intestine, and percent intestine + cecum varied with diet as the independent variable, and binary order as a random effect. Presence of a cecum related to binary order, but not diet. The intestinal absorbancy, percent of 4-centimeter intestine, and percent intestine + cecum did not vary with diet. Hence, my hypothesis that herbivores should have more complex gut morphology and faster absorbancy was not supported, contrary to previous studies which did document such trends. Rather, this study suggests that gut morphology was affected by binary order rather than diet. The scope of this study allowed for comparisons between Passeriformes and non-Passeriformes. Future work should examine a more comprehensive diversity of taxa.
Research Project Title: Transit rate of food in germ-free and germ-typical American cockroaches

Student Presenter: Madeline Herrmann

Faculty Mentor: Zakee Sabree

Faculty Mentor Department: EEOB

Research Abstract: In the microbial ecology field, most research focuses on the physiological effects of microbiota on human health. However, these studies are confounded by the inability to control for many factors in such complex organisms. This work in the Insect-Microbial Symbiosis Lab aims to correlate the effect of bacteria on morphology and physiology with a simpler system, the American cockroach (Periplaneta americana). This organism shows tight relations with symbiotic bacteria, making it a helpful model for host-microbial research. The adaption to utilize gastrointestinal microbes allows animals to extract nutrients that the organism cannot obtain on its own, and past research has shown that there are a variety of changes that occur when P. americana is raised with a microbial-free gut.

To determine the effects of bacteria on the rate of food passage through the digestive tract, Germ-Free and Germ-Typical cockroaches were raised through 4 molts. Germ-Free insects were reared using sterile procedures from pre-hatching through dissection, and the Germ-Typical controls were orally inoculated with feces from a parent colony. Development-controlled cockroaches were fed a dye with fluorescent microbeads, and were dissected at 4 or 5 hours. The proportion of the gut that the fluorescent beads travel gives an estimation of food motility.

Analysis shows that Germ-Free insects show a faster rate of food transit measured by percent of gut traveled per hour, compared to Germ-Typical controls (p = 0.0373 using a Mann-Whitney U test). This proportional analysis corrects for the variance in gut length between individuals to reflect the anatomy of the gut.

Results suggest that the presence of a normal gut microflora slows the rate of food passage through the gut. Whether these results are based in differences in morphology or physiological needs requires further investigation. These findings have broader implications for research into the effects of bacteria on gut development and food digestion.
Research Project Title: Recovering the evolutionary history of the humped-nose mice (Hybomys) and relatives using the IRBP gene

Student Presenter: Adriana Jurich

Faculty Mentor: Ryan Norris

Faculty Mentor Department: Biology

Research Abstract: The Hybomys Division, subfamily Murinae, includes three genera of mice found only in the African tropical forests. These are Stochomys (1 species of target rat), Dephomys (2 species of defua mice), and genus Hybomys (7 species of hump-nosed mice). Most researchers claim that Hybomys consists of two subgenera: Hybomys from Central African forests and Typomys from West Africa. In this experiment, we sequenced the IRBP gene from members of the Hybomys Division representing at least one species from each genus and from related members of Muridae. The DNA was used to build a phylogenetic tree that was used to evaluate the evolutionary divergence of the Hybomys Division. The results showed that Hybomys, Dephomys, and Stochomys were closely related. However, Typomys diverged from the other members of the Division much earlier in evolutionary history than the others. Biogeography supports our findings. Due to divides in the forest across West and Central Africa, the habitats of Hybomys and Typomys remain separated. We conclude that Typomys and Hybomys should be separated into separate genera, because they are not as closely related as originally thought.
Research Project Title: Comparison of arthropod diversity and distribution in urban repurposed landscape in orders Hemiptera and Acari

Student Presenter: Jacob Holley

Faculty Mentor: Yvan Delgado De La Flor

Faculty Mentor Department: Entomology

Research Abstract: The influence of urban development on ecological diversity has resulted in limited species variation within cities. During the industrial era within the united states the clearing of land and the construction of homes to support growing cities caused loss of habitat and diversity of species. The focus of this experiment is to analyze samples of insects found within urban zones, which vary in landscape, to project the results of stimulated ecological diversity on Acari and Hemiptera populations. 16 vacant lots within Cleveland, OH were chosen for this experiment with half being turned into prairies and the others being treated as normal plots of land with grass grown on it only. The normal plots were mowed regularly to keep consistent with their treatment by the city of Cleveland. Prairies were allowed to grow without regulation. Four soil samples from each plot were collected using pitfall traps and four soil samples were collected using suction from vacuum. Soil samples were analyzed in lab and filtered for all macroscopic and microscopic arthropods. More diversity was found within prairies which contained flowering plants and long grasses of which provided needed nutrients and shelter greater than open lots. A higher density of Acari and in relation Hemiptera were found in prairies even if the same species were observed in the vacant lots. Prairies provide key components that promote taxonomic variety and abundance of insects in the orders Acari and Hemiptera. The results of the experiment exemplify the value and ability of creating plant-diverse greenspaces within city-scapes to promote ecological diversity.
Research Project Title: Causes and consequences of sex ratio variation in the parasitoid wasp Pelecinus polyturator

Student Presenter: Hannah McKenzie

Faculty Mentor: Norman Johnson

Faculty Mentor Department: entomology

Research Abstract: Pelecinus polyturator (Drury) (Hymenoptera: Pelecinidae) is a parasitoid wasp that oviposits into larvae of scarab beetles (Coleoptera: Scarabaeidae). Pelecinus polyturator is highly variable in morphology across its range in continental North and South America. The species can be divided into two distinct groups: a northern population and a southern population separated by a gap between 23° N and 28° N. The northern population is composed almost exclusively of females, while the southern population is bisexual. The primary objective is to test the hypothesis that the sex ratio difference indicates that these two populations represent distinct species. Additionally, we test the hypothesis that the sex ratio distortion results from the cytoplasmic incompatibility caused by symbiotic microorganisms of the genus Wolbachia. Genetic variation across populations is assessed with sequences of the cytochrome oxidase 1 (cox1) gene. Sequences of wsp and ftsZ genes indicate that there is a single Wolbachia strain associated with Pelecinus throughout its range, but this is a strain that does not generate skewed sex ratios.
Research Project Title: Distinguishing species with DNA and behavior: A comparison of two sibling Trachymyrmex ant species in novel environments

Student Presenter: Amy Luo

Faculty Mentor: Rachelle Adams

Faculty Mentor Department: Evolution, Ecology and Organismal Biology

Research Abstract: Organisms use behavioral strategies to survive in their environments, and when faced with a novel or unexpected situation, species often differ in their response. This tendency applies to fungus-growing ants (Hymenoptera: Formicidae: Attini), which have evolved behaviors to cope with competitors, predators, and parasites. Trachymyrmex zeteki (Weber, 1940) sensu stricto is a fungus-growing ant species from Central America. The species has been taxonomically ambiguous since it was first described, and morphological, molecular, and chemical differences suggest that there may be a cryptic sibling species (Cardenas et al., in prep). The goal of this project is to provide behavioral and molecular data that will strengthen the separation of T. sp. n. from T. zeteki. Workers were individually removed from their nests and placed into a novel environment to test their behavioral response. We measured the response through three variables: (1) time to initially emerge from the refuge, (2) number of 1cm2 squares entered, and (3) time spent under the refuge after the initial emergence. Additionally, a Cytochrome Oxidase I gene molecular phylogeny was built. We found a significant difference in the number of squares entered, suggesting that tempo varies between species. The phylogeny also shows a clear separation of species. These results support the species delimitation between T. zeteki and T. sp n. Continued study of the behavior of these species (i.e. heterospecific and conspecific encounters) may be useful in understanding how ants cope with novel situations.
Research Project Title: A new species of Gregorymys (Mammalia, Rodentia, Geomyidae) from the Fort Logan Formation of Montana

Student Presenter: Emma Miller

Faculty Mentor: Jonathan Calede

Faculty Mentor Department: EEOB

Research Abstract: Pocket gophers (family Geomyidae) are the most abundant burrowing rodents in North America today and possess an equally rich fossil record. Gophers of the subfamily Entoptychinae were the dominant burrowing rodents across the western United States (US) during the Arikareean time period, ca. 26 to 23.5 million years ago (Ma). One specific genus of entoptychine rodents, Gregorymys, includes both the oldest and youngest entoptychine gophers. This diverse genus includes nine known species. I here present new material of Gregorymys including complete dentitions, skulls, and jaws from the circa 28 million years old Fort Logan Formation of Montana. My quantitative analysis of the morphology of the skulls and jaws of three specimens as well as an analysis of their phylogenetic affinities support these fossils as a new species, the tenth within Gregorymys.

The new species can be differentiated from all known taxa by a suite of characters. Among them, the new species is much larger than Gregorymys riggsi; it is smaller than G. veloxikua and G. tavenneri. The ratio of the length of the diastema of the dentary to the length of the lower tooth row of the new species is significantly larger than in G. kayi and G. larsoni. The proportions of the upper fourth premolar of the new species are significantly different from those of the upper fourth premolars of G. formosus, G. douglassi, and G. curtus. The anterior surface of the lower incisor is flattened of the new species unlike in G. riograndensis and G. veloxikua. This new species is also unique within Gregorymys in having a shallow medial groove on the anterior surface of the upper incisor.

The presence of a new species of Gregorymys in Montana around 28 Ma is the oldest evidence of a gopher of this genus in the Rocky Mountains. It dramatically extends westwards the record of Gregorymys and suggests that, although not dominant across the western US until about 26 Ma, entoptychine gophers were already diversifying during the early part of the Arikareean.
Research Project Title: Beetles (coleoptera) and pill bugs (isopoda) in vacant lots and urban prairies

Student Presenter: Lauren Mckinney

Faculty Mentor: Yvan Delgado de la Flor

Faculty Mentor Department: Entomology

Research Abstract: Beetles (coleoptera) and pill bugs (isopoda) in vacant lots and urban prairies

Lauren Mckinney, Yvan Delgado de la Flor, and Mary Gardiner

Abstract

Cleveland, Ohio has experienced protracted economic decline and significant population loss in the last several decades. As a result, residential properties are foreclosed, abandoned, demolished by the city, and turf grass is planted. Vacant lots are sites dominated by turf grass and weedy vegetation, and mowed every month, while urban prairies are sites high in plant diversity and vegetation structure including flowers. Our hypothesis is that prairies will support a larger number of beetles and pill bugs than vacant lots. We collected arthropods from two treatments: eight vacant lots and eight urban prairies for a total of 16 sites. In each site, we sampled arthropods using a large vacuum for about 30 seconds for a total of 64 samples. Specimens were sorted and identified using a dissecting scope; we focused specifically on beetles (Coleoptera) and Pill bugs (Isopoda). We expect to find that urban flowering prairies will support more diverse and abundant beetle and pill bug communities, because these sites provide more resources such as decomposing plants and prey items to pill bugs and beetles, respectively. We aim to provide alternative ways to utilize vacant lots that enhance desired ecosystem services, and increases biodiversity in urban green spaces. In conclusion we hope that it will show that even though it is an empty lot, it can still benefit us all instead of it just sitting there costing the city some money.
Research Project Title: Variation in organ size between migratory and non-migratory birds

Student Presenter: Erin Place

Faculty Mentor: Jacqueline Augustine

Faculty Mentor Department: EEOB

Research Abstract: Introduction/Background: Migration status has been observed to influence organ size. Previous studies have shown that compared to non-migratory birds, migratory birds have larger heart mass, pectoral muscle mass, gizzard mass, and intestine mass. The purpose of this study was to determine if migratory species had larger heart, pectoral muscle, gizzard, proventriculus:gizzard ratio, intestine, liver, and proventriculus size than non-migratory species. Methods: Thirty-one species of birds were salvaged, frozen, thawed and weighed. The heart, proventriculus, gizzard, pectoral muscle, liver, intestines, and cecum were dissected and weighed. We conducted a standard least squares regression test to determine whether organ size, calculated as percent of body mass, varied among long-distance migrants, short-distance migrants, and non-migratory birds. Taxonomic Family was a random effect in the analyses. Results: Only the proventriculus:gizzard ratio varied with migration status, with non-migratory birds having lower values than migratory birds. Therefore, my hypothesis that organ size should be larger in migratory birds was not supported. My results are similar to other studies that found that the proventriculus:gizzard ratio is smaller in non-migratory species than migratory species. Conclusions: Differences between the current study and previous studies may be due to the number of species examined, the types of species examined, or the inclusion of additional covariates such as diet in previous studies.
Research Project Title: Effects of diapause history on brain RNA of Sarcophaga bullata

Student Presenter: Emma Waight

Faculty Mentor: Julie Reynolds

Faculty Mentor Department: EEOB

Research Abstract: Sarcophaga bullata are one of many insect species which undergo pupal diapause. Diapause is a period of dormancy characterized by metabolic depression and developmental arrest, which helps insects and other animals survive winter. One aspect of diapause in S. bullata is a maternal effect. The offspring of any female that has undergone diapause are unable to undergo diapause themselves, even when reared in a diapause inducing environment. In order to investigate whether differences in micro and messenger RNAs in the brains of the flies could be linked to the maternal effect, I extracted total RNA from brains dissected from adult females that had gone through diapause and those that had not. I used quantitative RT-PCR to measure microRNAs, small non-coding sequences of RNA which contribute to gene regulation, which were the primary focus of the study. I found significant differences for several microRNAs including miR-100, miR-277, miR-275, and miR-124. MiR-124 in particular was approximately twice as abundant in flies with a history of diapause than in those that did not go through diapause. Mir-124 is connected to regulation of circadian rhythms, and these results show it may also tie into the regulation of diapause and the maternal effect on diapause in S. bullata flies.
Research Project Title: Evolution of color pattern elements in Sciuridae

Student Presenter: Alec Sheets

Faculty Mentor: Andreas Chavez

Faculty Mentor Department: Evolution, Ecology and Organismal iology

Research Abstract: Introduction

Many of the hypotheses surrounding the evolution of mammalian coloration were proposed by the first naturalists near the turn of the century. Modern evolutionists seeking to address these hypotheses must contend with one of two issues: using human perception to quantify aspects of mammalian coloration, which can be subjective and difficult to reproduce; or to use reflectance spectroscopy, which often yields a low-resolution representation of the mammal.

Methods

The present study employs a computer pipeline, as well as a custom interactive application to programmatically extract data from standardized photographs of museum specimens. This pipeline measures several elements of mammalian color pattern, including vibrancy, lightness, pattern complexity and pattern aspect ratio. These data are collected across the entire organism, as well as the face and body separately. The application enables easy collection of data describing color contrast between the organisms’ dorsal and ventral regions as well as contrast across its face. Data is being collected from over 1,200 photos of approximately 150 species representing the Sciurid phylogeny. Sciurids were selected as the system of study due to their tremendous phenotypic diversity ranging from dull gray and brown to brilliant orange and purple. Data will be analyzed using a phylogenetic regression to determine if there are evolutionarily significant correlations between elements being measured and the species’ life history, ecology and phylogeny.

Results

These data will allow the testing of several hypotheses including the hypothesis that many animals are darker on their back and lighter on their stomach so that they appear more two dimensional when being illuminated from above. This comes from some of the first naturalists to study animal coloration and is the widely accepted explanation for the most common phenomena in animal coloration. If this is true, I predict that ground squirrels, which spend most of their time with the sun above them, will display this characteristic far more often than tree squirrels, which spend their time in varying orientations. This methodology will allow evolutionists to address the some of the earliest questions about mammal coloration thoroughly and reproducibly.
Research Project Title: Hymenoptera and Collembola communities in vacant lots and planted prairies across urban green-spaces in Cleveland, Ohio

Student Presenter: Alden Siperstein

Faculty Mentor: Yvan Delgado De La Flor

Faculty Mentor Department: Entomology

Research Abstract: Urban ecology studies the unique biomes formed within cities and the organisms that exist across distinct human-disturbed habitats. Occasionally, conditions within cities offer survival for many insect species no longer able to thrive in the wild. Since the 1950s, the population in Cleveland has declined significantly leading to the creation of vacant lots. This represents a good opportunity for biologists to study insect populations shift overtime. Our study examines how spring tails (Collembola), and wasps and ants (Hymenoptera) differed between vacant lots and city prairie sites in Cleveland, Ohio. We hypothesize that urban prairies support more diverse arthropod communities than vacant lots. We collected our specimens from 8 vacant lot sites and 8 prairie sites in July of 2017. Vacant lots were dominated by turf grass and mowed monthly, whereas prairies were sites with diverse plant communities monthly annually at the end of the growing season. In each site, four samples were taken using vacuum filtration for a total of 64 samples. Arthropods were then sorted and identified to order and hymenopterans to class. We expect to find that city prairie sites are more likely to support a wider richness and abundance of Hymenoptera, and higher population density of Collembola. Hymenopterans provide important services in urban areas by predation of pest species, pollination, and seed dispersal, while Collembola provide decomposition and soil enrichment services which benefits urban gardens. There is a potential for certain arthropod classes and orders that thrive in urban sites important for conservation and ecosystem services.
Research Project Title: Survey determining prevalence and intensity of infection of wild bee parasites within Ohio pollinator communities

Student Presenter: Alyssa Wheeler

Faculty Mentor: Reed Johnson

Faculty Mentor Department: Entomology

Research Abstract: A diversity of wild bees were collected from ten areas around Ohio and tested for three broadly pathogenic taxa: microsporidians, trypanosomatids, and nematodes. Functionally, numerous members of these taxa are known to be gut parasites negatively associated with pollinator health. For example, the microsporidian Nosema apis causes dysentery within honey bees, the nematode Sphaerularia bombi is associated with bumble bee queen mortality, and the trypanosomatid Crithidia bombi interferes with the ability of bees to differentiate flowers with nectar from those without. The presence of each parasite was determined in the dissected midguts of honey bees (Apis mellifera), bumble bees (Bombus impatiens), leaf-cutting bees (Megachile spp.), squash bees (Peponapis pruinosa), and a newly invasive potter bees (Anthidium) using PCR. Guts were removed and DNA was isolated using a phenol-chloroform extraction. The intensity of infections was determined using qPCR with the use of universal primers. Samples containing high parasite abundance will be sequenced using capillary sequencing to determine the taxonomic identity of parasites. This research will provide information regarding prevalence and intensities of host parasite interactions and determination of host range overlap across wild bee taxa.
Research Project Title: Post conflict behavior of a predatory stimulus on perturbed groups of Neolamprologus pulcher

Student Presenter: Antonia Tribuzzo

Faculty Mentor: Ian Hamilton

Faculty Mentor Department: EEOB

Research Abstract: Cooperative behaviors have been observed in many social species and can serve to promote an individual’s or a group’s overall fitness. With cooperation, the opportunity for conflict can also arise and can have lasting effects on a social group’s dynamics as well as change the social landscape of a group considerably. Research in regards to the effects of conflict duration have shown influence due to group size, individual size, predation risk, and oxytocin among other factors. However implications of the post conflict resolution behaviors may also be important to group dynamics as well due to the possibilities of group dissolution or individual injury when conflicts are not managed or resolved. After conflict occurs, there may be damage to relationships or physiological changes to individuals. Whether and how individuals and groups use behaviors to mitigate the lasting effects of conflict is poorly explored in most taxa, with the exception of primates, corvids, and wolves. Here within, we examined post conflict behaviors of a highly social African cichlid fish, Neolamprologus pulcher, in order to determine effects of predatory stimulus on a perturbed social dynamic situation. We then compared these perturbed groups to stable groups undergoing the same predatory stimulus. We predicted that there would be a higher proportion of submissive behaviors from subordinate individuals and aggressive behaviors from dominant individuals. We also predicted that the difference between removal and control groups declines over time post perturbation. The groups’ behaviors were observed in terms of relation to the intragroup dynamics as well as to the predatory stimulus. Fifteen minute observations were taken during perturbation and stimulus, and then one and three days post stimulus. All aggressive, submissive and affiliative behaviors were recorded. The ways in which these conflicts are resolved may be indicative of statuses of group stability or instability, specifically the occurrence of aggressive or submissive behaviors performed by dominant or subordinate individuals. This research gives insight to the understanding of whether and how groups of individuals with differing interests are able to mitigate the costs associated with conflict and group instability.
Research Project Title: Effects of habitat patch size on urban salamander population genetics (Plethodon cinereus)

Student Presenter: Andrew Wilk

Faculty Mentor: William Peterman

Faculty Mentor Department: School of Environment and Natural Resources

Research Abstract: Amphibians have become one of the most imperiled taxa on the planet due to their relative sensitivity to environmental disturbance. A major cause of disturbance and fragmentation is urban sprawl. Due to an increasing human population and a more quickly rising urban population, historic forest patches are becoming more reduced and fragmented. Although it has been shown that habitat fragmentation and reduction have adverse effects upon various species, their effects on salamander populations have been understudied. In a previous study examining urban, terrestrial salamander populations (Plethodon cinereus), we found no correlation between population density and habitat patch size. Rather, abundance depended more on microhabitat conditions such as leaf litter depth, canopy cover, and slope aspect. In this study, we reexamined these same populations to investigate potential links between habitat patch size or abundance and population genetics. Population genetic theory predicts that population genetic parameters, such as allelic richness, heterozygosity, and inbreeding will be related to population size. Therefore, I hypothesized that heterozygosity and allelic richness would be reduced in small habitat patches and in low abundance populations, while levels of inbreeding would be increased. However, preliminary analyses suggest little to no relationship between patch size or abundance and any of these population genetic measures in urban salamander populations.
Research Project Title: Elephant sovereignty: remapping the politics of nature & nation in the Okavango-Zambezi basin

Student Presenter: Matthew Schneider

Faculty Mentor: Thomas McDow

Faculty Mentor Department: History

Research Abstract: Next to humans, elephants (Loxodonta africana) are the most influential socioecological agents across southern Africa’s grassy plains. Nowhere on the continent are African elephants as abundant as they are in the Okavango-Zambezi basin, and the scale and spatial over-concentration of this region’s elephant population became the primary impetus for the 2011 establishment of the Kavango Zambezi Transfrontier Conservation Area (KAZA TFCA). Said to be the largest mixed-use conservation zone in the world, the KAZA TFCA joins together five nations in southern Africa—Angola, Botswana, Namibia, Zambia, and Zimbabwe—to collaboratively manage their shared riverine ecosystem and more evenly distribute wildlife (particularly elephants) across a fragmented biogeographic landscape. My research is based on three months of ethnographic fieldwork I conducted in and around the KAZA TFCA zone, entailing more than 30 semi-formal interviews and immersive participant-observation in southern African conservation spheres. With this paper, I consider how notions of sovereignty, whether control over territory or control over life and death, are reworked in KAZA’s conditions of postcolonial, transnational, and multispecies entanglement. In particular, I question the position of elephants within KAZA’s model of “transfrontier” environmental governance, mapping elephant movement across the TFCA’s many boundaries, physical and conceptual. Ultimately, I argue that elephants themselves have forced novel configurations and conceptualizations of nature, nation, and sovereignty in the Okavango-Zambezi basin.
Research Project Title: Mapping and confirming new genes in Arabidopsis involved in formation of distinct cellular domains on pollen surface

Student Presenter: Prativa Amom

Faculty Mentor: Anna Dobritsa

Faculty Mentor Department: Molecular Genetics

Research Abstract: Pollen wall exine is placed in species-specific patterns around pollen grains to protect them and facilitate plant reproduction. In the pollen of the model species Arabidopsis thaliana, exine is deposited non-uniformly, always resulting in the formation of three longitudinal gaps not covered by exine. These gaps are called apertures, and they help pollen to control its moisture content and allow emergence of the pollen tube during pollen germination. The precision with which apertures are formed, and the fact that their patterns are diverse across species, make pollen apertures a powerful model for studying how cells specify and develop extracellular domains. Previously, only one gene, INP1, had been known to influence pollen aperture formation in Arabidopsis. In order to identify other genes involved in this process, a genetic screen was performed on mutagenized plants. Five complementation groups defective in aperture formation have been found, and positional cloning isolated gene candidates for four of these groups. To confirm the identity of two of these genes, for mutant groups macaron and donut, and to initiate their characterization, multiple constructs containing wild-type versions of these candidate genes were created with the addition of YFP and transformed into each mutant population. T1 plants containing the constructs were selected and assessed for rescue of the wild-type phenotype.
Research Project Title: Investigation of the spatial distribution of plant species in coastal ecosystems at community and metacommunity scales, and their effect on plant-pollinator dynamics

Student Presenter: John Green

Faculty Mentor: Carol Landry

Faculty Mentor Department: EEOB

Research Abstract: Category: Ecology

Title: Spatial distribution, species composition and diversity in Bahamian coastal plant communities

Student presenter: Johnny Green

Faculty advisor: Landry, Carol

Abstract: There are six distinctive coastal plant communities in The Bahamas which are determined by their distance from the ocean, substrate composition and degree of disturbance. These coastal plant communities are dynamic, ever subject to change by the forces of nature. This is particularly true in The Bahamas where tropical storms and hurricanes are frequent. The coastal plant communities are important ecologically for their buffering and stabilizing effect, protecting the inland communities by aiding in dune formation and helping to retain sediment. In order to better understand these different communities, we collected data to determine the spatial distribution and species composition within four of the six coastal community types. We did this by setting up seven 100 m² plots, two in the Coccothrinax-shrub community, two in the beach-foredune community, two in the rock terrace community, and one in the shrub-thicket community. Each plot’s plant composition was determined, and the canopy area of each plant species was measured. We estimated species richness with a modified version of the Shannon’s index, in which we used the proportion of the total canopy area of each species with respect to the total canopy coverage, for each plot. We also calculated an evenness index for each community as the quotient of the Shannon’s index and the natural logarithm of the number of species for each plot. Though more sampling needs to be done to determine the plant diversity and composition of these communities, our preliminary results show that the Coccothrinax-shrub and shrub-thicket communities have the greatest canopy coverage and diversity. Their evenness index was also the largest of all communities.
Research Project Title: Effects of cadmium contamination on pollination services

Student Presenter: Rachel McLaughlin

Faculty Mentor: Frances Sivakoff

Faculty Mentor Department: Entomology

Research Abstract: Urban agriculture has grown in popularity across many cities throughout the world. Many of these cities have industrial pasts, resulting in soils contaminated with heavy metals such as lead (Pb), cadmium (Cd), and copper (Cu). Heavy metals are known to adversely affect human health, but their effects on the pollinators that provide critical pollination services to urban agriculture are largely unknown. Previous work has found Pb contamination decreases the length of bee visits in sunflowers, but it is unknown whether similar results on pollinator behavior could be expected from Cd contamination. The objective of this study was to understand the effects of Cd contamination on the pollination services provided by bees. Sunflowers grown in Cd-contaminated soil are expected to receive fewer pollination services than those grown in control soil, resulting in lower seed set. Mature sunflowers grown in the greenhouse in three soil treatments (uncontaminated potting media, and media with either 10 ppm or 50 ppm Cd, N = 24 for each treatment), were placed into the field and left open to pollination for six hours on three days. Additional flowers from each soil treatment were either hand pollinated (N = 24) or pollinators excluded (N= 24) to compare seed set to those naturally pollinated. Currently all test plants are being maintained in the greenhouse to allow seeds to mature. Generalized linear models (GLMs) will be used to determine if heavy metal contamination influenced pollination services (sunflower seed count, sunflower seed weight).
Research Project Title: Assessing hybridization in invasive purple loosestrife

Student Presenter: Alex Miller

Faculty Mentor: Steve Hovick

Faculty Mentor Department: Evolution, Ecology, and Organismal Biology

Research Abstract: Purple loosestrife is a non-native plant that was brought to North America from Europe and Asia. There are two species of purple loosestrife that are important to this experiment; Lythrum salicaria and Lythrum virgatum. Lythrum salicaria came to North America through ships’ ballast and as an ornamental plant around the 1830s and has naturalized into the wild populations, crowding out natives. It is currently illegal to sell in Ohio and most other states. Lythrum virgatum was introduced more recently through the horticultural industry as a supposedly sterile cultivar that would be a safer alternative to L. salicaria. However, L. virgatum has been shown to cross pollinate with co-occurring naturalized populations of L. salicaria and produce viable seeds. This crossing is an example of interspecific hybridization, a process that has been linked to increased invasiveness in other plant systems. The goal of the current experiment is to establish genetic markers using SRAP (sequence-related amplified polymorphisms), a PCR-based genetic marker system, that can be used to distinguish between the two species. Here we describe the identified markers and test their ability to differentiate between the two species and their hybrids. Development of these markers will be useful for examining naturalized, invasive loosestrife populations for evidence of hybridization.
Research Project Title: Assessment of smallholder urban and peri-urban dairy production with zero-grazing practices in Kampala, Uganda

Student Presenter: Taylor Klass

Faculty Mentor: David Barker

Faculty Mentor Department: Horticulture and Crop Science

Research Abstract: Many people in Kampala, the capital city of Uganda, own a few dairy cows to provide milk and income for their family. Most of these dairy farmers feed their cows with a system called zero-grazing, where the cows are confined and feed is brought directly to the cows. This research project evaluated the smallholder dairy system in urban and peri-urban Kampala, Uganda. Research studies have been conducted on specific parts of smallholder, non-grazing dairy farms in Africa before. However, this project was unique in the fact that it focused on the urban, smallholder dairy farming system as a whole. The main objective of this research project was to collect information from urban and peri-urban dairy farmers that could be used to better understand their production systems and how they can be improved to benefit the farmers and their families. 10 farms that use zero-grazing practices to feed their dairy cows were surveyed. Each survey included four different parts: Feed analysis, cow evaluation, milk yields, and milk marketing. This project showed that many of these farmers struggle with the same challenges, which include feed scarcity, herdsmen, vet, and inseminator unreliability, and lack of capital. The dairy cows in Kampala are not getting enough feed, which results in low milk production levels and reduced fertility. Each family interviewed recognized the nutritional importance of the milk they collect and consume. Where there is lack of good management knowledge, education can help. However, the bigger problem for these smallholder farmers is the lack of support and capital to put into practice beneficial management procedures for their cows. This project provided much needed information on the smallholder, urban dairy system in Kampala as a whole and showed the small amount of education and empowerment needed to make these farmers more productive and resilient.
Research Project Title: Adsorption of organophosphates using activated carbon from seed waste

Student Presenter: Caleb Mathias

Faculty Mentor: Thomas Mitchell

Faculty Mentor Department: Plant Pathology

Research Abstract: A constant concern in modern agricultural production is pesticide runoff. Pesticides can leach into groundwater or be released into the atmosphere and return as contaminated rainwater. One method of mitigation is in the form of activated carbon, which possesses a net negative charge and functional groups which allow for the adsorption of chemicals from water. For this study, pyrolized seed was treated with phosphoric acid to increase the porosity of the char. This increased porosity leads to a greater surface area, and thus more room for the pesticide molecules to bind.

To test the adsorptive capacity of the acid-treated seed biochar, three organophosphates were prepared at various concentrations for equilibrium and kinetic adsorption experiments. Parathion, malathion, and diazinon were reacted with the biochar and samples were taken using a syringe with a 0.2μm filter then examined via HPLC analysis to determine the concentrations left in the solution by utilizing the area under the produced curve. These samples were also compared with those of a control activated carbon source, F300 carbon from Calgon. The pesticides were chosen due to their heavy usage in agriculture and the carbon source was chosen as it does not have as much literature surrounding it as the other sources of activated carbon do. Initial kinetic studies have shown that the acid-treated seed approached a concentration of 0.000 PPM at a faster rate than the F300 for parathion and diazinon, with the malathion solution reaching 0.5901 PPM at 24 hours for the acid-treated and 0.000 PPM for the F300.
Research Project Title: Tracking Xanthomonas gardneri infection of tomato fruit

Student Presenter: Margaret Moodispaw

Faculty Mentor: Sally Miller

Faculty Mentor Department: Plant Pathology

Research Abstract: Bacterial diseases are a problem for crops worldwide. Bacterial pathogens spread quickly, are not easily managed, and disease severity can vary, depending on the developmental stage of the plant. Specifically, the genus Xanthomonas encompasses 27 species that collectively can infect more than 400 different plant hosts. Bacterial spot is a devastating disease in the United States, and it is usually associated with four different species of Xanthomonas (X. euvesicatoria, X. vesicatoria, X. perforans, and X. gardneri). In Northeast Ohio, Xanthomonas gardneri is common. Bacterial spot is most commonly a seed-borne disease but can also be transmitted by water splashing and mechanically. However, little is known about how the seeds become infected. The goal of this study is to determine if broken trichomes on tomato fruits can be a point of entry for the bacterial pathogens, in our study Xanthomonas gardneri. Also, the colonization and movement of the pathogen was tracked over time to evaluate the eventual infection of the seeds. This study was conducted by inoculating with a transformed bioluminescent strain of Xanthomonas gardneri tomato fruits of three different sizes (small, medium and large) and different trichomes density. To track the bacterial population during the infection process we utilized an in vivo Imaging System (IVIS). Also, seeds from infected fruits will be extracted and assessed for the presence of the pathogen. IVIS imagining will be used to determine if the seedlings are infected. Preliminary results indicate that small fruits can be infected and the bacterium is present in the locular cavities and, thus, on the seed coat. Future data will be generated for the other two classes of fruits (medium and large). These results will help to understand how the seeds become infected and, consequently, spread the disease.
Research Project Title: Exploring innovations in soil moisture and UAV-borne sensing to serve Ohio agriculture

Student Presenter: Nischay Soni

Faculty Mentor: Bryan Mark

Faculty Mentor Department: Geography & Byrd Polar and Climate Research Center

Research Abstract: Agriculture is at the root of how mankind has developed and revolutionized our existence. According to the USDA, the agriculture, food, and other related industries represented 5.5 percent of the U.S gross domestic product in 2015. Farmers are consistently presented with both challenges and opportunities, from climate change to advanced technology. Right here in Ohio, farmers have a strong desire to continue to produce high quality food, make it more accessible those who sleep hungry, while maintaining sustainability and a profitable practice. Indeed, agriculture remains a critical sector of the economy of Ohio.

The mission of the State Climate Office of Ohio (SCOO) is to serve as data stewards to connect Ohioans with weather and climate information necessary to improve lives, and agriculture is an important part of our mission. Recently through a Connect and Collaborate grant, SCOO applied resources toward the development of the Fertilizer Application and Resource Monitor that allows farmers to freely access future and past precipitation forecasts. This resource provides farmers with high-resolution guidance to better manage (timing) fertilizer and manure applications. This ultimately saves time and money for the farmers by reducing nutrient runoff, which also creates a healthier water ecosystem throughout the state.

Within this framework, additional aid can be achieved with more accurate soil moisture monitoring. SCOO utilized funds to purchase and install soil moisture monitoring equipment at two depths (5 and 10 cm) at four locations in Ohio - part of the OARDC Ag Weather network. An undergraduate student helped install sensors and collect additional data using handheld soil moisture probes. Here, we present the first data recorded from this equipment. To begin to explore the spatial heterogeneity of the soil moisture around the station, another student has begun to explore the areas around the sensors using multispectral imagery mounted on an Unmanned Aerial Vehicles (UAV). Creating a platform for farmers to remotely sense their surrounding region helps them to maximize profits by understanding their land layout, gives them the confidence to invest by studying and researching certain statistical data (precipitation, temperature, nutrients), in turn helps maintain a healthy food-production ecosystem.
Research Project Title: Hyraxes in human landscapes of the Arabian desert

Student Presenter: Annalee Sekulic

Faculty Mentor: Sarah Ivory

Faculty Mentor Department: Anthropology

Research Abstract: By observing temporal changes in vegetation, we can better understand how vegetation is altered by natural and anthropogenic processes. Arid landscapes have long harbored humans, whose long-term anthropogenic impacts have been difficult to disentangle from the effects of climate change. As climates change, environments and available resources for subsistence are altered. Human responses may include social changes (e.g., group size, territorial behaviors), which feed back into desert vegetation. Due to the lack of lakes from southern Arabia, there is no easy access to proxy records of ancient vegetation after 8000 cal. yrs. BP. My research uses plant and seed fragments found within fossilized latrine deposits of desert rock hyraxes (Procavia capensis) to study the vegetation changes in the Dhofar Region of Oman. The desert rock hyrax is a small, shy herbivore which grazes in a close radius to its nest. Its diet reflects a small area. The hyrax’s latrine deposits over a long time can assess the vegetation in one location.

This study tests the hypothesis that there have been vegetation changes within the Dhofar over the past 1500 years BP. From 5 middens samples, I extracted identifiable thorns, seeds, stems, and small insects. I use incident light microscopy and digital camera to compare specimens with modern reference material and to document unknown specimens into types. By identifying the fragmented macrobotanical plants, I will assess the past vegetation of the region.

While there are differences among fossil latrines, they also reflect desert flora. The oldest latrine is composed of 0.38% of identifiable plant mass and the most recent latrine is 0.59% of identifiable plant mass. By weighing and separating the samples, I found that Ziziphus leucodermis and Aerva were both in the oldest and youngest macrobotanical samples. These plants, are also abundant in the fossil pollen found in the middens and are plants common in the modern flora. I recognize many distinct types and categories of taxa that provide quantifiable proxies of desert vegetation. To date the latrine deposits, I rely on radiocarbon ages from 3 of the 5 latrines. These ages establish a timeline spanning from modern day to 1500 years BP. My preliminary analysis of plant matter suggests that the plant vegetation in these locations has changed over the last 1,500 years. My results further suggest that there is no large structural change, such as rain forests to deserts, but there is change within the composition of taxa.

Overall, these comparisons between pollen data and macrobotanical identifications suggest that the vegetation, of the Dhofar Region, developed for more arid climates and has remained relatively stable despite small changes in climate and human land use.
Research Project Title: Optimization of transplantation protocols for the endangered species, running buffalo clover

Student Presenter: Jonathan Kubesch

Faculty Mentor: David Barker

Faculty Mentor Department: Horticulture and Crop Science

Research Abstract: Introduction: Over the past 30 years, conservationists discovered and protected wild populations of endangered running buffalo clover, Trifolium stoloniferum. Currently few researchers call for ex situ conservation or intervention studies despite the high fatalities of field translocations in Ohio and neighboring states. Low survival rates in these cases doom the clover’s already small populations, and thus an improved intervention strategy is imperative.

Methods: Stolon segments were collected from three protected locations in Ohio during spring 2017 (permit ODNR CP-2017-5). The sampled material typically comprised of a rooted node, two to four meristematic nodes, and the active stolon tip. Stolons were planted in site-inoculated greenhouse media, and made prolific vegetative propagation during May-October, 2017. Replanting to the original sites occurred during October/November, 2017. Each location comprised a generally uniform area of about 100 sqm that was free of any natural RBC plants. This minimized potential disturbance of the original population. Transplants comprised of ‘large’—approximately 3-4 months old; and ‘small’—approximately 4 weeks old plants. The greenhouse-grown plants were field acclimated for 2 weeks before planting. Transplants were planted in 1m grid spacing, with half receiving a 19-19-19 fertilizer treatment. Stolon number and length of each transplant was measured in situ; thus easing spring growth monitoring. The statistical analysis comprised of a completely randomized 3-way factorial design: 20 genotypes x 2 fertilizers (none vs 2.4 g per plant) x 2 plant sizes (large, 3-4 months old vs small, 4 weeks old). Additional replication was provided by plants in a buffer strip surrounding the study.

Results: In total, 94, 77, and 102 transplants were planted at Bosch Hollow, Shawnee Lookout, and Miami Whitewater Forest, respectively. The 77 transplants at Shawnee Lookout comprised 22 different genotypes, an average of 2.1 stolons per plant, and an average of 13 cm per stolon. The transplants at Miami Whitewater Forest comprised 20 different genotypes, an average of 1.9 stolons per plant, and an average of 4 cm per stolon.

Conclusion: Preliminary analysis of populations suggests that RBC can easily be clonally propagated from field-sampled stolons. The specimens resulted from, i) the high (approximately 80%) of stolons nodes that produced roots and branches, and ii) continued stolon extension, producing new nodes thus new plants.
Research Project Title: Efficacy of cleaning interventions for domestic and professional kitchen surfaces

Student Presenter: Kevin Mo

Faculty Mentor: Illic No

Faculty Mentor Department: Sanja

Research Abstract: Introduction:

Food safety continues to be of the highest importance to public health. While consumption in restaurants continues to grow in the US with one half of total food expenses in 2013 spent on food away from home, foodborne illnesses linked to restaurant contamination continue to be high. In foodservice, surfaces can easily become contaminated with human pathogens from raw foods or food handlers. Effective cleaning of food contact and dining surfaces is essential to prevent contamination. Novel microfiber single use cleaning towels are available at the market for use in foodservice. However, their efficacy in removal of human pathogens is not known.

Objective:

Determine the effectiveness of a novel microfiber towel in removing of Listeria monocytogenes and Salmonella spp. from kitchen surfaces: stainless steel, bamboo and pressed paper.

Methods

A total of 18 treatments were completed to test removal rates of Listeria monocytogenes cocktail and Salmonella spp.. Coupons (5cm²) of stainless steel, press paper, and bamboo surfaces were spot inoculated with either L. monocytogenes inoculum or Salmonella inoculum. Each dried contaminated coupon surface was wiped with a one-use microfiber towel with either water, 200 ppm quaternary ammonia, or dry microfiber towel. After wiping, the removal rates from contaminated surfaces were measured. Each treatment was repeated 8 times. Pathogen concentrations were calculated and data was analyzed in Excel and SPSS. Non parametric tests were used to compare the groups.

Results:

Water wipes were more effective in removing all types of bacteria from surfaces than dry wipes (P<0.001). There was no increase in efficiency when quaternary ammonia was used (P=0.238). Water wipes removed L. monocytogenes and Salmonella from stainless steel with similar efficiency (P=1.000). Stainless steel was easier to clean than pressed paper (P<0.001); greater cleaning effectiveness from stainless steel and bamboo was observed (P=0.217) for all types of bacteria.

Conclusions:

Overall the most successful treatment was removing L. monocytogenes from stainless steel using a water moist wipe, and the least successful treatment was removing Salmonella from pressed paper using a dry wipe. Further studies should be done to gather more information on how it performs under different conditions.
Research Project Title: Development and characterization of a children's beverage using by-products from the dairy industry.

Student Presenter: Ayna Arora

Faculty Mentor: Rafael Jimenez-Flores

Faculty Mentor Department: Food Science and Technology

Research Abstract: The study aims to develop a children’s beverage repurposing 2 dairy by products, namely acid whey from cottage cheese production and buttermilk. This beverage will serve as a healthier alternative to other products that provide little nutrition. The by-products being researched have high nutritive value due to the presence of protein and milk phospholipids. However, they have undesirable flavors and currently have no significant use in the dairy industry, and through this beverage formulation, they can be used in a potentially profitable manner. This research aims to achieve this beverage by improving the organoleptic properties of these by-products through physical processing to increase palatability. The acid whey has been treated using two methodologies in order to improve the organoleptic properties by reducing volatiles present, and is mixed with spray dried buttermilk and held at 70C for 1min to result formulations with 10%, 11% and 15% total solids. Treating acid whey at 52C at 80mbar pressure to achieve a 33% volume reduction increased the solids content by 4.48%. However, as a consequence, the acid was concentrated which resulted in non-desirable organoleptic properties such as poor texture due to precipitation of buttermilk. Conversely, acid whey treated by ultrafiltration to achieve a 50% volume reduction using a membrane with a molecular weight cut-off of 10 kDa, increased the solids by 0.75% (retentate) and a lower acid content and better organoleptic properties compared to the sample treated by low pressure evaporation. Acid whey and buttermilk beverage samples at 11% total solids were perceived to have the most acceptable textural properties, regardless of the processing of acid whey. Further research will pursue combining the two methodologies to obtain a low-acid and low-volatile profile to yield better organoleptic properties.
Research Project Title: Savings program reduces financial pressures of low-income families with food insecure children

Student Presenter: Madeleine Drost

Faculty Mentor: Cäzilia Loibl

Faculty Mentor Department: Consumer Sciences

Research Abstract: Background: This study investigates whether the Individual Development Account (IDA) program, a federally-funded asset-building program, can relieve the financial pressures experienced in families with food insecure children. Two research questions were assessed: Which financial pressures are associated with children's food insecurity? Can graduation from the IDA program attenuate the association of food insecurity and financial pressures among families whose children are food insecure?

Methods: In 2013, a phone survey was conducted of 405 households with children in seven states who graduated or dropped out of the IDA program in the past seven years. Eleven outcome variables assessed financial management skills and financial pressures related to saving (4 measures), borrowing (5 measures), and material deprivation (2 measures). The survey used the established U.S.D.A. questions to measure children's food insecurity.

Results: Children in 250 IDA families were food secure, children in 72 were marginally food insecure, and children in 83 were severely food insecure. Regression results showed that families with marginally food insecure children who were able to complete the IDA program (instead of dropping out) were better able to save and pay bills on time, were more likely to hold a savings account, had lower amounts of loans from family, and had to be less frugal. Further, graduates of the IDA program whose children were severely food insecure were better able to save, pay bills on time, had to be less frugal, had lower credit card balances, better access to bank loans, and were better able to afford expenses of everyday living when compared to program dropouts with severely food insecure children.

Conclusions: Our findings show that if families with marginally food insecure children had been able to complete the IDA program, they had reduced financial pressures with regard to 4 of 11 indicators of saving, borrowing and deprivation. Families with severely food insecure children also had reduced financial pressures with regard to 5 out of 11 indicators of borrowing and material deprivation. Our study thus documents the benefits of the IDA program's financial education, one-on-one credit repair, regular savings and asset purchase requirements for even the most financially fragile families.
Research Project Title: In vitro analysis of mushroom proteases that may tenderize beef

Student Presenter: Jing-Wei Lee

Faculty Mentor: Eric England

Faculty Mentor Department: Meat Science

Research Abstract: Meat tenderness is an important characteristic that influences consumer purchasing decisions. Protease extracts from pineapple, ginger, papaya and kiwi have exhibited proteolytic activity to tenderize meat products. Unfortunately, many of these proteases have broad activity that can over-tenderize the meat and negatively affect texture and quality. Therefore, identification and evaluation of other proteases capable of tenderizing beef is necessary. Previously, mushrooms have been shown to enhance flavor and nutritional composition of meat dishes, as well as having beneficial antioxidant and health effects. Mushrooms also contain a variety of proteases that were analyzed in this study for their ability to denature beef proteins using an in vitro model system. Eight mushroom varieties were tested including white button (white immature Agaricus bisporus), crimini (brown immature Agaricus bisporus), portobello (mature Agaricus bisporus), shitakke (Lentinula edodes), enoki (Flammulina velutipes), oyster (Pleurotus ostreatus), king trumpet (Pleurotus eryngii), and brown beech (Hypsizygus tessellatus). Mushrooms were homogenized in a 20 mM Tris buffer (pH 8.0), filtered, then centrifuged. Afterward, purified bovine myofibrils were combined with the crude mushroom protease extracts and incubated at 25°C. Samples were collected at 0, 30, 60, 240, and 1440 min. After, myofibrillar proteins were solubilized and separated using SDS-PAGE. Density of protein bands were quantified and compared between the time-points. The data indicated that all eight mushroom varieties proteolyzed myofibrillar proteins including actin and myosin. Therefore, these results support the possibility that mushroom proteases may be able to tenderize beef, forming the basis for future research trials.
Research Project Title: A comparative study of color change assessment for frozen ground beef patties using traditional colorimeter and digital image analysis

Student Presenter: Xiang Li

Faculty Mentor: Dennis Heldman

Faculty Mentor Department: Food Science and Technology

Research Abstract: Color change of beef is a major quality concern since a loss in redness indicates protein oxidation. Compared with traditional colorimeter methodologies, digital image processing techniques not only saves in labor costs but also results in more objective measuring results. The goals of this study were to determine if a traditional colorimeter methodology and digital image processing software correlate with each other, then to determine the most precise method. The hypothesis was that the greater area analyzed in the image processing technique would result in a lower sample to sample variance than the traditional colorimeter while overall color scores will correlate.

Frozen beef patties were stored at three temperatures with three freezers replications at each temperature. Data collection and analysis were conducted once a month, and L*a*b* coordinates were recorded in triplicate using a Minolta colorimeter on three patties from each replicate under each temperature. Digital images were captured on 6 beef patties of each replicate using a Cannon EOS T6 camera. RGB data (mean and standard deviation) was obtained through ImageJ with Region of Interest (ROI) selections representative of the patty. Comparison of the two methods was conducted by analyzing the variance present in the redness values between the three replicate freezers at a given storage condition then summarizing the variance of multiple conditions.

Standard deviation data of redness scale for both methods were obtained already for 9 specific conditions (-10°C, -15°C, -20°C; Month 1, month 2, month 3). It was averaged and the comparison showed that the average of standard deviation was 0.7 for colorimeter a* value and 2.9 for RGB red histogram.

Colorimeter a* value produced more precise results, which was opposite to the hypothesis. The less variability of colorimeter a* value could be an alert that this method was missing color variations present away from the measuring locations.
Research Project Title: The effects of dietary fat intake on endothelial dysfunction in hypertensive women

Student Presenter: Mallory Jackson

Faculty Mentor: Cindy Anderson

Faculty Mentor Department: Nursing

Research Abstract: High fat diets lead to low-grade systemic inflammation, a known cause of endothelial dysfunction and hypertension. Current research suggests that dietary modifications, including increasing unsaturated and lowering saturated fat intake, effectively treat hypertension. Adherence to recommendations to promote heart health can be low and influenced by factors such as age. This study was designed to examine associations among dietary intake of heart-healthy (i.e., monounsaturated, polyunsaturated) and heart-unhealthy (i.e., saturated) fats and endothelial function in hypertensive women as well as the predictive value of age for dietary fat intake. This secondary analysis utilized data obtained from a pilot study designed to examine indicators of vascular function in chronic hypertension. A convenience sample of 11 women aged 30-60 years was enrolled. The Diet History Questionnaire II (DHQII) was used to measure typical fat intake over a 30-day period. Endothelial function was measured using an Endo-PAT (Itamar Medical; Israel) and based on reactive hyperemic index (RHI). Spearman rank-order correlations were examined to determine the relationships among age, dietary fat intake, and endothelial function (α=0.05). Mean dietary intake of monounsaturated, polyunsaturated, and saturated fats was 23.199 grams 12.217, 13.4 grams (SD 9.0), 18.7 grams (SD 8.3), respectively. Monounsaturated (rs=0.50, p=0.12), polyunsaturated (rs =0.49, p=0.13), and saturated fat intake (rs=0.49, p=0.13) showed a trend toward improved vascular function, though no statistically significant association was identified. Greater age was associated with significantly less polyunsaturated (rs =-0.60, p=0.05) and monounsaturated (rs =-0.66, p=0.03) fat intake and marginally less saturated fat intake (rs =-0.48, p=0.14) intake. This study advances understanding of the influence of dietary fat consumption, which can be adapted as an early intervention to endothelial dysfunction and by extension, hypertension and cardiovascular disease. Dietary fat intake was not associated with endothelial function though this study was limited by small sample size. Future studies examining the relationship between dietary fat intake, vascular function and the role of unmodifiable factors such as age are warranted.
Research Project Title: A comparison of the use of food records and added sugar intake with lean and obese postmenopausal women

Student Presenter: Madelyn Joviak

Faculty Mentor: Tonya Orchard

Faculty Mentor Department: Human Nutrition

Research Abstract: Introduction

Accurate records of added sugar (AS) intake are difficult to keep. Valid and reliable biomarkers of added sugar consumption are needed to study its relationship to disease. This project’s objective is to test the ability of a dietary biomarker, urinary sucrose, to detect changes in AS intake in lean compared to obese postmenopausal women.

Methods

Healthy, postmenopausal women were recruited from the Franklin County area; 15 lean (BMI 18.5-24.9 kg/m2) and 15 obese (BMI ≥30 kg/m2) women were enrolled. This study used a pre-post test, single group design. An initial visit was conducted to determine eligibility, obtain informed consent, and collect anthropometric, demographic, and lifestyle data. Participants completed two separate 24-hour food records of usual dietary intake followed by fasting morning urine collections. Record collection days were one week apart, and a sugar-sweetened beverage was added to usual intake on the second day. The Nutrition Data System for Research (NDSR) was used to analyze food records. Urinary sucrose excretion was analyzed using a modified enzymatic assay.

Results

Lean participants had a mean (SD) age of 61.1 (5.26) years, BMI of 23.4 (2.04) kg/m2, and Leisure Activity Score of 41.0 (29.4). Among lean participants, 100% were white, 53% were married, 47% worked full-time, and 73% never smoked. Obese participants were 58.9 (4.56) years old, with BMI of 37.96 (5.42) kg/m2, and Leisure Activity Score of 28.7 (23.6). Among obese participants, 87% were white, 67% were married, 27% worked full-time, and 67% never smoked. Initial analyses show pooled fasting urine samples for lean participants contain mean (SD) sucrose levels of 0.063 (0.095) g/L on Day 1 and 0.028 (0.020) g/L on Day 2, while samples from obese participants had 0.023 (0.019) g/L on Day 1 and 0.020 (0.016) g/L on Day 2. Research is in progress to evaluate urinary sucrose excretion and dietary intake of AS between lean and obese participants.

Conclusion

Urinary sucrose levels are detectable among lean and obese healthy postmenopausal women using an enzymatic assay, and may hold promise as a possible biomarker for AS consumption. Future research is needed to validate this method among additional populations.
Research Project Title: Consumer acceptability of blueberry confections formulated with blueberry extract and lyophilized whole blueberry powder

Student Presenter: Haley Orwig

Faculty Mentor: Yael Vodovotz

Faculty Mentor Department: Food Science and Technology

Research Abstract: Functional food products (FFP) have been shown to enhance overall health and aid in disease prevention. FFP’s, aside from delivering the intended health benefit, need to be sensory acceptable so that they are regularly consumed. Confections make excellent FFPs and delivery vehicles for bioactives due to their high consumer compliance, and their ability to deliver a consistent composition of phytochemicals even after processing and storage. Blueberries contain polyphenols, primarily anthocyanins, which have been shown to have anti-inflammatory properties and other health benefits. However, most of the pre-clinical evidence regarding the health benefits of blueberries have been seen using a phytochemical-rich blueberry extract, not the whole fruit. When assessing possible blueberry sources in a functional confection, whole lyophilized blueberry powder was selected, delivering equivalent phytochemical profiles without the chemical off-flavors attributed to the extract. It was hypothesized that confections made with lyophilized whole blueberry powder would be preferred to the confections made with blueberry extract. Therefore, the objective of this study was to conduct a sensory analysis of the two confections, including a paired preference test and an acceptability test using a 9-point hedonic scale rating overall liking, aroma, fruit flavor, bitterness, graininess, texture, and sweetness (n=75), with a significance level of \( \alpha=0.05 \). Results of the preference test showed no significant preference among the two blueberry confections, with 43 individuals preferring the whole blueberry powder confection and 32 individuals preferring the blueberry extract confection. No significant differences were seen among hedonic scores except in graininess (p= 0.015) and average overall liking scores of both confections fell in the “like slightly” category (powder= 6.33, extract= 6.21). In conclusion, both the extract and powder confections were sensory acceptable for use in future clinical trials, but more work needs to be done comparing shelf stability and phytochemical uptake in humans.
Research Project Title: Nutrient intakes among a pediatric cohort meeting the AND/ASPEN diagnostic criteria for malnutrition

Student Presenter: Angela Parillo

Faculty Mentor: Holly Estes

Faculty Mentor Department: Medical Dietetics

Research Abstract:

Introduction/Background: Pediatric malnutrition may be widely under-recognized due to inconsistency of diagnostic standards. In 2014, the AND/ASPEN published a consensus statement proposing a new set of diagnostic criteria in order to establish a universal approach. The purpose of this study is to apply these criteria to determine the prevalence of pediatric malnutrition, while analyzing nutrient intakes across age groups and malnutrition indicators.

Methods: A cross-sectional analysis from the 2005-2014 National Health and Nutrition Examination Survey of 12,611 children ages 1-13 years. Body measurement data included weight, length/height, and mid-upper arm circumference. Data was analyzed using Epi Info and compared to AND/ASPEN diagnostic criteria for malnutrition using a single data point. Dietary intake was assessed by 24-hour recall. Data was weighted to determine estimates that were representative of the national population. A one-way analysis of variance was used to compare nutrient intakes across age groups and malnutrition status.

Results: Of the total sample, 11.0% had indicators of mild malnutrition, while 2.4% had indicators of moderate/severe malnutrition. One-year-olds had the highest prevalence of malnutrition, with 21.0% and 4.1% meeting criteria for mild and moderate/severe malnutrition respectively. Though most mean nutrient intakes exceeded recommended intakes, the percentage of children not meeting nutrients recommendations was problematic across all age groups and malnutrition indices. Vitamins E and D were the nutrients most frequently under-consumed across all age groups and malnutrition categories. Among one-year-olds, the most frequently under-consumed nutrients were vitamin D, vitamin E, and iron. Iron intakes improved with age, while percentages of children not meeting RDAs for calcium and zinc increased with age.

Conclusion: Malnutrition was prevalent in the nationally-representative sample. Across all age groups and malnutrition categories, many subjects did not meet the DRIs for key nutrients, particularly vitamin E and vitamin D. While this is concerning among the general U.S. pediatric population, poor nutrient intake may lead to further growth deficits in those already indicating malnutrition. Further research is needed to determine effective interventions for improving diet quality among pediatric populations to optimize growth.
Research Project Title: A literature review assessing the impact of food insecurity on early childhood mental health: an emphasis on ADHD

Student Presenter: Stacy Lu

Faculty Mentor: Irene Hatsu

Faculty Mentor Department: Department of Human Sciences

Research Abstract: As of 2016, there are 6.5 million children in the United States living in food insecure households, yet there exists limited research describing the psychiatric consequences of this public health crisis. The World Food Summit defines food security as “the ability to access sufficient quantities of safe and nutritious foods for an active and healthy lifestyle at all times.” Thus, food insecurity exists when the opposite is true—lacking food availability, access, utilization, and stability. Currently, there is limited research exploring associations between food insecurity and early childhood mental health disorders such as Attention-Deficit Hyperactivity Disorder (ADHD). Symptoms of inattention, hyperactivity-impulsivity, and aggression are characteristic of ADHD, which affects approximately 5 percent of children. Early childhood exposure to environmental stressors related to food insecurity could be associated with predisposing or exacerbating ADHD symptoms in children, yet literature exploring this relationship is scarce. Research in this field lacks validated and reliable assessments to accurately measure mental health symptoms, making it more difficult to investigate connections with psychological diagnoses such as ADHD. None of these studies use full food insecurity questionnaires to capture the children’s food insecurity status separately from that of the household. Additionally, many of these studies do not control for variables that may impact the relationship between food insecurity and mental health, such as socioeconomic status, race, age, and parental education. The purpose of this review is to address the gap in literature of food insecurity and early childhood ADHD symptom prevalence and severity. Literature for this review was pulled from PubMed, and the Ohio State University library database, with a focus on food insecurity and children’s symptoms of inattention, hyperactivity-impulsivity, and aggression, which may be indicative of an ADHD diagnosis. Our primary aim is to advocate for future research that may further characterize this complex relationship and inspire future community or public health interventions addressing food insecurity in children with ADHD.
Research Project Title: Corn: a cultural shift in American identity due to severe food insecurity

Student Presenter: Dana Outcalt

Faculty Mentor: Jeffrey Cohen

Faculty Mentor Department: Anthropology

Research Abstract: The story of Thanksgiving is a more complicated and complex story than the tale of peaceful beginnings that is typically associated with the Pilgrims' meals shared with Native Americans. The story of the pilgrims' first years included tragic death, severe food insecurity and a politically charged meal that brought enemies together. The first Thanksgiving is a tale of a dramatic shift in American identity and culture as pilgrims struggled to survive in a harsh, unfamiliar world. Corn, a food source associated with poverty, simplicity and demeaned as "native" and unworthy of European palettes became a central staple in the diet and a central feature in a shared American identity. Yet, it was the death of half the pilgrim's colony and their lack of preparation (as they faced starvation and uncertainty) that introduced corn to the American diet. Today, corn has become interwoven into our diet and American consumerism. My poster documents this surprising and dramatic shift and follows the corn as it goes from a hated food source to become an integral iconic part of the American identity.
Research Project Title: Investigating the impact of functional pretzel snack on satiety in postmenopausal women with metabolic syndrome

Student Presenter: Daniel Sosh

Faculty Mentor: Yael Vodovotz

Faculty Mentor Department: Food Science and Technology

Research Abstract: Snacking makes up a significant portion of caloric intake and has been associated with contributing to the obesity epidemic. One possible solution is a nutritious functional snack food, designed to prolong satiety (state of fullness and inhibition of continued eating). Nutrient composition and physical properties of the food have an important role in satiety. Specifically, soy has unique physicochemical characteristics which prolong satiety and long-chain fatty acids such as linoleic acid have shown to inhibit gastric emptying. Therefore, three functional pretzels (wheat-control, wheat-safflower oil, and soy-safflower oil) were developed to evaluate the impact of high-linoleic safflower oil with and without soy on satiety. We hypothesized the synergistic combination of soy and high-linoleic safflower oil in a functional pretzel would prolong 6-hour post-prandial satiety in overweight, postmenopausal women (n=18) with metabolic syndrome. The two objectives of this study were: 1. To measure postprandial satiety over 6 hours with each of the three pretzels using blood glucose and vertical visual analogue scales (VAS). 2. To evaluate changes in apparent viscosity using rheometry of three pretzels during a 6-hour ex-vivo, gastric digestion. Although no significant difference was found in blood glucose AUC among the three pretzels, blood glucose at 120 minutes during soy-safflower oil pretzel intervention showed significantly lower blood glucose levels (95±3.1 mg/dL) than wheat-control (111±5.2 mg/dL) and wheat-safflower oil (112±6.3 mg/dL). Among the nine attributes of satiety investigated, paired t-test showed soy-safflower oil significantly suppressed hunger compared to wheat-control (p=0.0001) or compared to wheat-safflower oil (p=0.0016). Apparent viscosity of gastric digested pretzels are currently being correlated with clinical findings. The lower glycemic response and prolonged satiety demonstrate soy and high-linoleic acid safflower oil containing functional ingredients show promise in decreasing satiety. Incorporation of these functional snack foods into the diet could increase satiety and improve snacking behavior.
Research Project Title: Bitter taste sensitivity and naringin concentration on consumer preference of agar confections

Student Presenter: Milena Rajcevic

Faculty Mentor: Vodovotz Yael

Faculty Mentor Department: Food Science and Technology

Research Abstract: Early studies have shown that diets rich in naringin may potentially ameliorate obesity by enhancing $\beta$-oxidation of fatty acid. Evidence shows individuals with bitter taste sensitivity avoid bitter fruits and vegetables such as naringin-rich foods like grapefruit and arguably, those with bitter taste sensitivity may have a greater risk of obesity. In recent decades, US consumption of grapefruit has experienced a dramatic decline largely from consumers’ misconceptions on their food-drug interactions. Therefore, five functional confections (apple, low and high dose tomato or grapefruit confections) with varying concentrations of naringin (0 to 206mmol/l) were developed to investigate their consumer acceptance and assess the impact of bitter taste sensitivity on scoring attribute intensity. We hypothesize consumers with a higher bitter taste sensitivity will have a greater preference/acceptance for confections having lower quantities of naringin. The following objectives will be met: 1. To evaluate consumer acceptance of five confections using a 9-point Hedonic scale in bitter and non-bitter tasters. 2. To discern if bitter taste sensitivity affects attribute intensity scoring in quantitative descriptive analysis (QDA). Once IRB approval was obtained, adult men and women (n=75) were asked to evaluate consumer acceptance and characterize attribute intensities using QDA. Dried paper strips of 6-n-propyl-thiouracil (25 and 50mmol/L) were used to stratify bitter tasters. An exploratory K-means cluster analysis was used and resulted in 5 clusters ranging from super sensitive bitter tasters (SSBT) to non-bitter tasters. Independent of bitter tasting status, apple confections were the most preferred (p≤0.05) and accepted (p<0.001) while high-dose grapefruit was the least. Hedonic scores for apple confection provided by SSBT were significantly greater (p=0.033) than other bitter tasting groups. Although the differences in the QDA scores were modest among bitter taster groups, bitterness intensity scores for low and high dose grapefruit confection were significantly higher (p≤0.05) in SSBT than in any other. The results obtained provide insight into bitter taste sensitivity with naringin-rich foods while increasing consumer acceptance and clinical adherence for future use. Integrating naringin-rich ingredients such as tomato into a functional confection increases the availability of naringin-rich food products for future clinical trials and eventually to the functional food market.
Research Project Title: Perceptual differences of aromas delivered through the orthonasal and retronasal routes

Student Presenter: Margaret Stegman

Faculty Mentor: Christopher Simons

Faculty Mentor Department: Food Science and Technology

Research Abstract: Aroma can be perceived through two routes: orthonasal (through the nose) and retronasal (through the mouth). The stimuli elicit signals that eventually reach the same receptors in the olfactory epithelium. However, previous studies suggest there is a perceptual difference between the two routes although the results are inconclusive. In this study, a matching paradigm was designed to control for memory bias and isolate the potential perceptual difference between aroma delivery routes. Panelists performed four matching paradigms of four different strawberry flavors (candy, woody, ripe, and green). The similarity of the four strawberry flavors required panelists to profile each sample to identify acute differences. This increased the cognitive demand required to complete the match. Subjects were given the four strawberry reference standards and told to either smell the sample orthonasally or taste it retronasally. Subjects then matched each reference to one of the four other blind-coded samples by either smelling or tasting congruently (same method) or incongruently (different methods). The retronasal samples consisted of 30 mL aqueous solutions in 2oz black sample cups, while the orthonasal samples consisted of 10 mL aqueous solutions in a capped glass vial wrapped in aluminum foil to minimize visual differences. When matching the reference to unknown samples using congruent evaluations, the panelists performed similarly in the orthonasal and retronasal tests (p=0.450) indicating they could correctly identify matching flavors. Performance significantly decreased when performed incongruently (p<&lt;0.002), suggesting there is truly a difference in perception when the same aromas are delivered via different routes. More knowledge regarding how people perceive aromas and flavors, and how these stimuli relate to one another, will enable the food industry to better optimize the sensory properties of foods and beverages.
Research Project Title: Geospatial analysis of food purchasing and consumption patterns in Leon, Nicaragua

Student Presenter: Francesca Scali

Faculty Mentor: Julie Field

Faculty Mentor Department: Anthropology

Research Abstract: Food insecurity (FI), or the inability to access sufficient quantities of nutritious and culturally valued foods, is a dynamic condition which can cause and perpetuate various health concerns. The frequency at which households are able to access and afford to shop for food is an important consideration regarding FI. Drawing upon data collected in 2012 by researchers from The Ohio State University and the Autonomous National University of Nicaragua - Leon, this study examines the geographic nature of FI at the household and community levels. Very few analyses of FI have been conducted in Central America, none of which have examined the geospatial patterning of FI. The focus of this study is to explore how the frequency of food shopping for the household influences the diversity of foods consumed, physical measures of health in children, and perceived food insecurity in mothers. Using GIS as a means of symbolizing and statistically analyzing the spatial aspects of these data, households in rural areas are shown to shop for food less frequently, report consuming less fresh vegetables and fruits, and report higher levels of perceived food insecurity. These patterns help to explain the high clusters of anemia in rural areas, while other measures of health indicators appear more dispersed.
Research Project Title: Introduction of complementary foods to premature infants during the first year of life

Student Presenter: Hallie Straka

Faculty Mentor: Deborah Steward

Faculty Mentor Department: Nursing

Research Abstract: Introduction/Background: During the first year of life, questions arise as to when complementary foods should be introduced to premature infants. Debate centers on whether actual age or corrected age should be used. Guidelines specify that complementary foods should be introduced between 4-6 months corrected age. Mothers are usually the decision-maker in relation to the introduction of complementary foods. What is unclear are the factors that influence maternal decision-making. The purpose of this study was to understand maternal reasoning in relation to the introduction of complementary foods to their premature infants. The Theory of Planned Behavior guides exploration of the psychosocial influences on the behavioral intention of mothers to introduce complementary foods to their premature infant.

Methods: A secondary analysis was conducted of interview data from 21 mothers who participated in a study to understand mothers’ intentions to feed their premature infants. In the original study, mothers of very low birthweight (birthweight less than 1500 grams) infants were recruited prior to discharge from the neonatal intensive care unit. Mothers were interviewed when their infants were at 1, 4, 8, and 12 months corrected age. All interviews were transcribed verbatim. Three key concepts from the Theory of Planned Behavior guided the secondary analysis of the interview data: behavioral beliefs, normative beliefs, and control beliefs.

Results: Overwhelmingly, mothers introduced complementary foods earlier than recommended. Maternal behavioral beliefs centered on the benefit to their infants. Perceived benefits included enhanced sleeping at night, improved growth, and remaining “full” longer. The influence of normative beliefs was demonstrated by strong reliance on the advice of peers including friends and relatives. Few mothers followed the pediatrician’s recommendations. Mothers’ control of introducing complementary foods was influenced by interpretation of their infant’s readiness cues, concern over infant hunger, and trust in their own judgement.

Conclusion: Mothers believe that they know what is best for their infant and make decisions based on this principle. Research is needed to understand why mothers readily follow the advice of peers and are reluctant to follow established guidelines.
Research Project Title: Anthocyanins' Behavior in a Lotion Base at Various Concentrations

Student Presenter: Zihan Zhang

Faculty Mentor: M. Monica Giusti

Faculty Mentor Department: Department of Food Science and Technology

Research Abstract: Anthocyanins are natural colorants with potential health-promoting properties such that they act as anti-oxidative, anti-inflammatory, and anti-carcinogenic compounds. A recent study found that application of lipstick rich in anthocyanins could potentially provide UV protection and anti-aging benefits, which could positively affect the skin. As lotion can be applied multiple times a day, it could be a potential vehicle for anthocyanin dermal delivery. However, little research has been done on color and stability of anthocyanins in lotions. The purpose of this experiment was to understand the behavior and color expression of anthocyanins from different sources in lotion and to determine the amount of different pigments necessary to display attractive colors. Anthocyanins are more stable and show red color in acidic condition (lower than 3) and as the pH value increases, the color of anthocyanins will fade. As the lotion base was mildly acidic (pH 4.5 to 6), low tinctorial strength was predicted since anthocyanins favor the formation of colorless forms.

In this experiment commercially produced elderberry, bilberry, red cabbage, black carrot and purple corn powders with different anthocyanin compositions were added to the same lotion base in different concentrations. Reflectance color readings were taken with a colorimeter with settings: reflectance specular included, D65 illuminant, and 10-degree observer. CIE-Lab scales were used to analyze the color of the lotion bases and based on the data.

The results showed that all the pigments behaved differently depending on the colorant used, exhibiting different pink-red hues (hue angles of 0.8° to 359.75°) in the lotion base and different saturation levels of color (Chroma ranged from 28.4 to 48.73). Yet, all pigments followed similar patterns. For all pigments, lower than 0.009% w/w of pigments were needed to show intense color and to obtain the saturated Chroma and hue, which showed a much higher tinctorial power than expected.

The results showed that low concentration of anthocyanins was needed to show appealing color in the lotion base. Obtained information can help with determination of the concentration range of an anthocyanin in lotion bases while introducing anthocyanins into new products.
Research Project Title: Reliability and validity of the Expanded Food and Nutrition Education Program (EFNEP) nutrition education survey

Student Presenter: Salam Tiba

Faculty Mentor: Carolyn Gunther

Faculty Mentor Department: Human Sciences

Research Abstract: Background: There is need for valid and reliable tools to assess nutrition and physical activity outcomes in low-income, racial minority children who are at increased risk for obesity.

Objective: The purpose of this study was to determine the validity and reliability of the Nutrition Education Survey (NES), a tool designed to assess diet and physical activity behaviors of participants enrolled in the Expanded Food and Nutrition Education Program (EFNEP), a federal nutrition education program that serves low income families.

Methods: Students in grades pre-K-5th at public elementary schools in low-income neighborhoods of Columbus, Ohio participating in a larger observational study were invited to participate. Data was collected at three time points “beginning (b0) and middle (t1) of summer, and at the beginning of the following school year (t2). Dietary intake and physical activity behaviors were assessed with three 24-hour dietary recalls and Garmin VivoSmartHR activity trackers, along with the EFNEP NES. Reliability was assessed using Cronbach’s Alpha tests for internal consistency. Construct validity was assessed using Pearson correlation tests comparing NES questions to dietary intake and physical activity data.

Results: 62 children representing 42 families enrolled. Mean age was 6.96 ± 0.33. 83.8% reported being Black, and 69.4% were low-income. At baseline, mean daily steps, intensity minutes, and resting heart rate were 8005.33 ± 515.53(n=44) steps, 63.35 ± 15.59(n=36) minutes, and 66.93 ± 2.17(n=41) beats/minute, respectively. 70.9% of participants reported doing physical activity most days or everyday with 50%, and 61.3% reporting an hour or more on weekdays and weekend days. Participants reported engaging in screen time for 3+ hours on weekdays and weekends was 55.7% and 49.2%. Acceptable reliability of the survey was observed with an α=0.75 for all survey items and α=0.67, 0.60, and 0.63 for the nutrition, food safety, and physical activity constructs, respectively. Validity analyses for each time point and nutrition data analyses are forthcoming.

Conclusions: Preliminary data suggest that the EFNEP NES may be a reliable survey for reporting child nutrition and physical activity behaviors.
Research Project Title: Comparative punctate tactile sensitivity reveals human tongue is more sensitive than fingertip

Student Presenter: Morgan Whitecotton

Faculty Mentor: Christopher Simons

Faculty Mentor Department: Food Science and Technology

Research Abstract: The tongue is what helps us participate in conversation and enjoy the food we eat. Yet, its sensitivity to tactile stimuli has not been characterized as completely as other systems, such as the fingertip. Moreover, little work has been done comparing sensitivity of the tongue to other tissues. The purpose of this study was to determine the relative tactile sensitivity of the tongue versus the fingertip to provide insight into the tongue’s mechanosensitivity and neural mechanisms. It was hypothesized that subjects would be better able to discriminate between stimuli with their tongue than their fingertip. Relative tactile sensitivity of the fingertip and the tongue was evaluated in healthy individuals (n=30, 14m/16f, aged 19-28) using the forced-choice, up-down staircase method. In separate conditions, each subject was asked to discriminate between two punctate stimuli (F=0.0044-0.010N) when presented to their finger or their tongue using a Luneau Cochet-Bonnet Aesthesiometer (Western Ophthalmics Corporation, Lynnwood, WA). Reversals were averaged for each condition to obtain just noticeable difference (JND) thresholds and compared using a two-tailed, paired t-test (α = 0.05). The force needed to evoke a JND was significantly (p=0.018) smaller in the tongue (0.0061±0.000096 N) compared to the fingertip (0.0067±0.00022 N). This agrees with the original hypothesis that people were better able to discriminate between stimuli with their tongues, therefore concluding that the tongue is more sensitive. While the reason for the tongue’s heightened sensitivity is unknown, it may reflect the closer proximity of mechanoreceptors to the lingual surface compared to the fingertip allowing for easier discrimination of punctate stimuli. This experiment lays the foundation for other experiments comparing the sensitivity of the fingertip and the tongue, such as roughness and point-and-edge detection, with the overall goal of determining the mechanisms behind texture perception associated with the consumption of foods and beverages.
Research Project Title: Transportation and distribution of food banks and food pantries

Student Presenter: Yidi Wu

Faculty Mentor: Neal Hooker

Faculty Mentor Department: John Glenn College of Public Affairs

Research Abstract: According to data from U.S. Department of Agriculture’s “Household Food Security in the United States in 2014,” Ohio had the third lowest food security across United States. To ease food insecurity, some non-profit, charitable organizations, such as food banks and pantries, distribute food to those who have difficulty purchasing enough to avoid hunger. They act as food storage and distribution depots for smaller agencies in different locations. Although there are many agencies offering food, some people still do not have access to this food because of consumer’s transportation constraints or the organization’s distribution schedule. The purpose of this research is to identify factors related to food insecurity and propose a plan to reduce these problems. This is achieved through exploratory county-level analysis, from 2010 to 2017, to investigate the relationship between food insecurity and other variables such as the number of children, household income, and unemployment rate. Moreover, this research discusses the impact of Supplemental Nutrition Assistance Program (SNAP). The research data come from the Census Bureau, U.S. Department of Agriculture, and food banks within Ohio. Preliminary results show that household’s income is slightly negatively correlated and unemployment rate are positively correlated with the food insecurity rate. Based on these results, it will be easier for agencies to predict the future trend of people with food insecurity. A recent innovation in SNAP, which builds on the cooperation between local grocery stores and Amazon may help those with food insecurity. Findings from this research offer food banks, food pantries, government agencies, and local non-profit organizations more directions to alleviate food insecurity problems.
Research Project Title: Market station

Student Presenter: Erin Achille

Faculty Mentor: Susan Melsop

Faculty Mentor Department: Department of Design

Research Abstract: Market Station is a realistic proposal for a design of an existing historical building in Columbus, Ohio. This research will present the needed concept, programming, and visual design of this space. Fire Station No. 6 located on West Broad Street in Franklinton is the perfect fit for this nonprofit grocery store. The programming in this building will help to alleviate the economic and social issues in the area by addressing the food desert problem. Having a healthy community starts with every individual's personal well-being. By placing a resource for groceries and education in this location, Market Station will be able to reach out to individuals on a personal level. Everyone must eat and what one eats affects his or her mood, energy level, and overall health. By improving all these things, residents will perform better at their jobs and have healthier, happier lives. The market will cater especially to those residents who live beside the building in Franklin Station, a residential community that houses adults with disabilities, and adults who have experienced homelessness. These residents will have easy access to healthy food year-round by just walking next door. Hydroponics and aeroponics will be used in the interior space to grow plants in an urban setting. These sustainable methods are labor-efficient and accessible. Residents and students will be invited to grow and harvest these plants as hands-on learning for academia and for potential employment. Through cooking, farming, and bringing a fully stocked market to this area, Market Station will be able to feed hungry people healthy plant-based meals. Not only will close residents be attracted to the market, but anyone will be able to dine-in and purchase fresh food to experience what Market Station has to offer. The local grocery store will be the "go-to" place because they will sell everything they make from their cooking and urban growing classes.
Research Project Title: Uncovering a legacy: transmission of the Hawkins Technique

Student Presenter: Marissa Ajamian

Faculty Mentor: Karen Eliot

Faculty Mentor Department: Department of Dance

Research Abstract: After World War II, Americans wanted to return to a traditional life. While many dance artists pushed against this normative culture, Erick Hawkins (1909-1994), a modern dance choreographer and pedagogist, rarely did. Through the creation of the Hawkins technique, Hawkins upheld the normalcy policies of the Cold War era using his ideals of beauty and "natural," kinesthetically correct, dance. This tenet of finding beauty in moving the body with efficiency, ease, and Hawkins' perception of kinesthetically correct movement created a distinct movement quality. This movement quality rejects the extreme tension that is required to execute movement in the Graham technique, the dance technique created by Hawkins' teacher, Martha Graham. By rejecting effort and tension as expressive modes, Hawkins' went against the beliefs of the modern dance canon.

The purpose of this project is to historically contextualize Hawkins' pedagogy while also showcasing how the Hawkins technique has been disseminated by current Hawkins' teachers. To facilitate this project, I completed historical secondary research on Hawkins and completed an advanced course on Dance Modernism. I also interviewed current teachers of the Hawkins technique. These interviews showcased how current artists are making choices and changing the Hawkins technique or leaving it untouched. With the intersections of historical research and the beliefs of current Hawkins instructors, I have found that the anatomical and philosophical theories, not specific exercises, are the most important aspects of the Hawkins training. Current Hawkins teachers uphold Hawkins' dance philosophies; some more strictly maintain the Hawkins exercises, while others approach the technique with new somatic influences. Nevertheless, the throughlines of Hawkins' philosophies remain at the core of the artists' teaching practices. While Hawkins has been minimized in the modern dance canon, his influence and impact are significant to understanding the trend towards somatic and anatomical approaches in dance training. His work also showcases the importance of the dissemination of pedagogical philosophies, not just the exercises used in dance technique classes. This project highlights the importance of examining the transmission of dance teachers' legacies as well as, the significance of the study of dance pedagogy.
Research Project Title: Progressing the image to the word: a critical study of the cut-ups

Student Presenter: Zachary Botkins

Faculty Mentor: Jolie Braun

Faculty Mentor Department: Special Collections and Area Std

Research Abstract: In this study, I examine the intentions, the misperceptions, and the practicality of Burroughs' cut-ups. By first exploring the origins of the cut-ups and then their methodology, I contextualize the argument presented within the paper. I attempt to capture the overlooked essence of the cut-ups: reunification of word and image. The context of the argument comes from Burroughs' own words, pulled directly from the CCNY class transcripts and lecture notes made available to me through the RBML. The purpose is to study the literary merit of the cut-up technique as a method of breaking Aristotelian thought patterns. Even further, it highlights the cut-ups as a study of the relation between the signifier and the signified, and the abuse of this relationship, within major news publications. I began by studying Burroughs' affinity with Egyptian hieroglyphics and his understanding of their relation to the process of signification. I began to pinpoint the arguments with lecture notes and class transcripts. By studying the origins of the cut-ups and their progressively changing methodology, I was able to create a historical trajectory of their place within Burroughs' life. I became interested in studying how Burroughs taught students, and what he taught them about the use of the cut-ups in the literary field. I was also fortunate to get to interview James Grauerholz, Burroughs' editor, and close friend. I discovered that the cut-up technique enables readers to break the Aristotelian thought patterns and the physical act of cutting and rearranging text allows readers to examine the implications of words chosen for headlines, and how the layout of a page directly determines the placing of those words, especially in the case of "Yellow Journalism." Further, the various alternative methods of the cut-ups offer previously unseen insight into Burroughs' desire for an actual relationship between an idea and a word. Through a study of the character "identikits" found in the CMS collection, alongside Burroughs' obsession with hieroglyphics language, the paper discovers Burroughs' intention with the cut-ups: to transcend the word to reach a language composed of images that offer no misinterpretations, and therefore, no mass confusion and propaganda.
Research Project Title: Biblio-archaeology: a codicological inventory, condition survey and preservation needs assessment of pre-modern codices and incunabula in the rare books and manuscripts collection of the OSU Libraries

Student Presenter: Danielle Demmerle

Faculty Mentor: Eric Johnson

Faculty Mentor Department: OSUL Rare Books and Manuscripts Library

Research Abstract: For the Undergraduate Summer Library Research Fellowship, I conducted condition surveys, a codicological inventory and preservation needs assessment of 48 pre-modern codices and 98 incunabula in the Rare Books and Manuscripts Library (RBML) of the OSU Libraries. In my proposal I planned to assess all physical features, general condition and the preservation needs of each item under the supervision and guidance of OSU Libraries’ Book and Paper Conservator, Harry Campbell and the OSUL RBML Curator, Eric Johnson (my supervisors). I researched the fundamentals of building and operating a condition survey by reaching out to those who have had years of experience in conservation. I quickly became accustomed with the subject matter and created a reference document of descriptive elements that guided me through each evaluation which I adapted into my condition survey design.

Upon the completion of the condition surveys I created a catalogue that would help organize 146 bound items from the RBML and guide faculty and students through the data. While it is designed to provide concise information, the individual condition surveys of each item can provide greater (or additional) detail.

Condition work for special collections often go overlooked, but I was able to create a strong foundation for the recorded conditions of bound medieval manuscripts and incunabula in the RBML. I look forward to the hands-on conservation work that Harry Campbell has pre-approved for the manuscripts and incunabula that are in need of attention as part of my job as a student assistant technician in the Conservation Unit. I am hopeful that the condition and needs assessment survey I designed specifically for the RBML will become standard practice, and continue to be used to record physical aspects for future acquisitions, as well as provide an informative source for augmenting item records in the OSUL online catalog.
Research Project Title: Changes in diet and dental health in the San Pedro de Atacama Oases

Student Presenter: Bronte Cunningham

Faculty Mentor: Mark Hubbe

Faculty Mentor Department: Anthropology

Research Abstract: Introduction: The Atacama oases, in Northern Chile, have been occupied by agropastoralist societies from 2500 BP until the arrival of the Spaniards in the 16th century. Between 400 and 1000 AD, the oases were under the influence of the Tiwanaku State, which exerted political and economic influence in much of the South-Central Andes. Several studies have explored the impact that Tiwanaku had on the Atacameño life-style. Methods: The present study complements this research line by analyzing aspects of oral health from four archaeological sites from the Atacama oases: Coyo 3, Quitor 6, Solcor 3 Non-Elite, and Solcor 3 Elite. The prevalence of dental caries, abscesses, antemortem tooth loss, and average tooth wear were calculated separately for males and females, and total for different parts of the dental arcade (anterior, posterior, superior, inferior, right, and left), to test if there are significant differences in oral health, and therefore in dietary practices, between the sites. Prevalence differences were tested using Chi-Square test and Analysis of Variance. Results: The results show significant difference in total presence of dental pathological conditions throughout the entire dental arcade between males and females at all sites, suggesting differential access to food between the sexes. In addition, all sites had significant differences between the posterior and anterior sections of the dental arcade and two sites, Coyo 3 and Quitor 6, had significant differences between the superior and inferior sections of the dental arcade. Conclusion: These results suggest that the populations represented in these sites had significantly different diets and/or food preparation habits.
Research Project Title: American anarchisms: a content analysis of English-language American anarchist periodicals leading up to the first Red Scare

Student Presenter: Eli Guidry

Faculty Mentor: Andrew Martin

Faculty Mentor Department: Sociology

Research Abstract: Intro.

Previous social movement scholars have noted the inadequacy of traditional sociological models for explaining the activity of radical social movement organizations. Some have suggested that researchers should examine the motivations and actions of RSMO’s through the frames that activists themselves provide. Towards that end, as well as to study fine-grained schisms within radical social movements more broadly, this project examines three prominent English-language periodicals from the American anarchist movement of the early 20th century, specifically in the span of 1914-1917. 1917 saw the stifling of America’s burgeoning anarchist movement due, in part, to the legal persecution and eventual exile of two of its most important figures, Emma Goldman and Alexander Berkman, both of whom maintained publications (“Mother Earth” and “The Blast” respectively, both of which, alongside Hippolyte Havel’s “Revolt” are examined in this project) which were unable to survive without them.

Anarchism, among radical leftist movements, is especially useful for those studying political framing due to the propensity of anarchist movements to spawn a relatively large breadth of ideological thought (and, with it, numerous political frames).

Methods/Results/Conc.

By analyzing issues of the three aforementioned periodicals (including the entirety of "Revolt" and "The Blast", as they both started and ended within the time period for this analysis), I show that, while all three agree on basic questions of political theory (opposition to the state and capitalism, anti-militarism, a privileging of the lower-class, working individual as the central political subject), they nevertheless varied in tone and focus, as well as on certain subtle ideological issues.

The formation of these differences was not an entirely unconscious process, as the primary editors of all three periodicals kept in close contact with one another. Both Berkman and Havel spent time working on Mother Earth’s editorial staff, in fact. Additionally, the periodicals shared certain contributing authors between them. The differences in ideological framing between periodicals, then, reflect not only the personal beliefs of the staff involved (most notably the editor), but an intuitive effort to fill a certain cultural role (in terms of tone, focus of content, audience, etc.) within the American anarchist milieu that others periodicals were not.
Research Project Title: The Columbus, Delaware and Marion interurban- challenges and opportunities associated with legacy infrastructure on urban form today

Student Presenter: Javier Melendez-Galinsky

Faculty Mentor: Amber McNair

Faculty Mentor Department: City and Regional Planning

Research Abstract: Columbus was once a city where railroads, streetcars and interurban rail lines traversed the city extensively, connecting urban neighborhoods, suburbs and cities in the regional periphery. At their peak in Central Ohio during the early 20th century, there were nine interurban lines that connected Columbus with its satellite cities to the North, South, East and West. As personal automobiles became the norm for American transportation, these interurban lines were decommissioned and occasionally replaced with roadways. The goal of this research is to understand the roadway design challenges and opportunities that persist today on streetscapes that were once interurban rail lines.

My research focuses on one interurban line, the Columbus, Delaware and Marion Interurban (CD&M), which operated from 1903 until 1933. The methodology includes an historical inventory and analysis to accurately map the CD&M line over the course of its operational service life. Then, I use spatial analysis to overlay current maps of the area, comparing the street networks of today with the historical rail network. With this map, I choose a sample of locations and design a field assessment survey to collect key data about the streetscape. Finally, I analyze the collected data to characterize whether features of streetscapes that were once interurban rail differ from streetscapes that were not.

At the conclusion of this study, it is expected that results will identify features of today’s streetscape that can be attributed to the legacy of former interurban infrastructure. These lasting effects may include unusually wide turnouts, more public right-of-way on street corners, or more frequent status as an arterial or collector roadway. With knowledge gained from this research we might be better equipped to plan for complete streets design, bike lanes, transit initiatives, or emerging smart city technologies on Columbus’s former interurban streetscapes.
Research Project Title: Pork Chop Hill

Student Presenter: Avery Kaminski

Faculty Mentor: Zachary Matusheski

Faculty Mentor Department: History

Research Abstract: My research is on Pork Chop Hill. Pork Chop was one of the final battles of the Korean War. Pork Chop was the final offensive that was launched by the Chinese Military in July 1953. Pork Chop Hill was a military outpost that was located in front of the US main line of resistance. When the initial Chinese assault started, only one Company defended the outpost. By the end of the battle, five battalions of US forces were deployed to the outpost in order to counter attack an entire Chinese division that was trying to take it. The battle resulted in the Chinese forces taking the hill and the US military withdrew and abandoned the position. In the chaos of battle, hundreds of Americans went missing. My research will compare this battle to those fought during World War I. This comparison will help educate scholars on the scale of the attack. My poster will also help contribute to the ongoing search effort for troops that are still missing in action. The location of the battle was controlled by the Chinese after the US withdraw and is currently in the demilitarized zone. Through my research, I have identified last known locations of companies and personal that defended the outpost.
Research Project Title: Age, place of residence, education and perceived sources of success in life in Poland, 1988 - 2013

Student Presenter: Alexandra Richey

Faculty Mentor: Kazimierz Slomczynski

Faculty Mentor Department: Sociology

Research Abstract: In stratification research, even that conducted in Eastern Europe, most examine objective determinants of privileged structural position, or what could be called, â€œsuccess in life.â€ There is comparably little social psychological research in Eastern Europe on the determinants of what people believe are the factors that influence success in life â€“ such as ambition, hard work, luck, or knowing the right people. This research is meaningful in the context of the huge ideological change from Communism to democratic capitalism that has occurred since 1989. I examine 25 years of the Polish Panel Survey (POLPAN 1988 to 2013) to investigate the effects of age, place of residence, and education on the perceptions people have about the sources of success. Using confirmatory factor analysis, I grouped sources of success into the categories of meritocracy which includes respondents’ evaluations of the importance of ambition, hard work, a good education, and talent and friends/family which includes evaluations of knowing the right people, political connections, coming from a rich family, and luck. My hypothesis is that support for meritocracy would increase with years of education and would be stronger among both urban residents and the young. Support for the friends/family dimension will be strongest among the old. I employed multivariate regression analysis and found that Poles living in urban areas perceive friends/family as less important for success. Support for friends/family decreased and meritocracy increased as years of education increased. Contrary to my hypotheses, older Poles perceive meritocracy as a more important source of success in life.
Research Project Title: Second World competition in Vietnam: analyzing the implications of the Vietnam War on Sino-Soviet relations

Student Presenter: Jonathan Schulman

Faculty Mentor: Nicholas Breyfogle

Faculty Mentor Department: History

Research Abstract: This project examines how the Soviet Union and China competed with each other during the Vietnam War, despite both backing the communist North Vietnam. The goal of this thesis is to discuss the ideological split between the USSR and China leading into the Vietnam War, with a subsequent analysis on how this rift manifested itself in each country’s involvement in Vietnam. This research predominantly draws upon primary source documents, including meeting notes, memorandums, and international communications, from a variety of historical and national security archives. This project argues that China sought to use the Vietnam War to turn their militantly anti-imperialist agenda from rhetoric to action, which conflicted with the Soviet Union’s less aggressive stance of “peaceful coexistence.” These competing viewpoints, from the countries the North Vietnamese referred to as their “two big brothers,” played not only an important role in North Vietnam’s war strategy, but also in the Soviet Union and China’s policies and attitudes toward each other. This project examines the Vietnam War’s effects on Sino-Soviet relations both during and after the war, from the polemical attacks between the two to the creation of Interkit, a Soviet-established organization created to constrain China’s international influence. Through an analysis of Sino-Soviet competition in Vietnam, this project will contribute new knowledge on how the three superpowers—the United States, the Soviet Union, and China—interacted in Vietnam, transforming Sino-Soviet relations.
Research Project Title: Civil war violence and inter-generational trauma: a case study of Sri Lanka

Student Presenter: Julia Shakesprere

Faculty Mentor:

Faculty Mentor Department:

Research Abstract:
Research Project Title: Statement or history: spatiotemporal distribution of confederate monuments in the Deep South

Student Presenter: Brigid Ogden

Faculty Mentor: Julie Field

Faculty Mentor Department: Anthropology

Research Abstract: The recent political movement to remove icons of the Confederate States of America from public areas in the United States has sparked an interest in the patterns of their location and dedication. This interest strongly centers on the debate of whether these icons represent a neutral regional heritage or the perpetuation of racism and revisionist history. This paper aims to explore whether or not the location of Confederate monuments in deep South states correlates with other population demographics in the same area, specifically race and age. In addition to population demographics, the correlation between Confederate monument density and the number of lynchings and racial hate crimes in the same county was also examined using ArcGIS hotspot analysis. In analyzing these patterns, light can be shed on where these monuments are being built, which kinds of communities are building them, and what kinds of behaviors and actions surround them. It is the hope of this project that the results obtained will be used to take an objective eye to the types of monuments we create in our country, and how they affect the communities where they are present.
Research Project Title: Recent trends in the fight against organized crime in Mexico: Continuity and change

Student Presenter: Sidney Tobias

Faculty Mentor: Sara Schatz

Faculty Mentor Department: International Studies

Research Abstract: Since President Calderón launched the Mexican Drug War in 2006, the country has been engulfed in levels of violence comparable to contemporary war zones in the Middle East. A variety of strategies aimed at countering organized crime have been undertaken by the Mexican government, however they have met with little success. The purpose of this study is to analyze the dynamics of organized criminal violence and the state's attempts to respond and bring the situation under control. Evaluating the progression of reforms undertaken by the Mexican government, we find that a lack of institutional capacity continues to undermine such efforts and contributes to high levels of impunity and disparity in firepower between the state and organized crime. The impact of these factors is amplified by counter-productive security policies, including kingpin targeting, rural neglect, and the uneven deployment of the military in a law enforcement capacity. Finally, high levels of corruption and infiltration of state institutions by organized crime hinder efforts to meaningfully bolster institutional capacity. This analysis of the dynamics underlying violent organized crime and its relationship with the state illuminates why Mexico continues to face record levels of violence and how policy to combat this epidemic must evolve if it is to be successful.
Research Project Title: Planting perthes: agriculture & mechanical loading in a pre-contact female

Student Presenter: Devon Reich

Faculty Mentor: Melissa Clark

Faculty Mentor Department: Anthropology

Research Abstract: Seventeenth century pre-contact Ohio witnessed the intensification of agriculture and dietary transition to less nutritious foods. Meanwhile, fairly rudimentary tools, such as hatchets and shovels made from stone and animal bone, increased individuals’ vulnerability to workload-related injuries. One such Native American population found at the Grantham cemetery site in Northeastern Ohio along the southern shore of Lake Erie, dated circa 1650 AD, had nearly transitioned fully to sedentism. The purpose of this study was to diagnose a pathological condition of the right femoral epiphysis exhibited in an individual and interpret this condition within the context of agricultural intensification in pre-historic Ohio. Sex was assessed according to Buikstra & Ubelaker 1944, and the auricular surfaces of the ilium and pubic symphseal surfaces were examined to estimate age. Stature was estimated according to Scuilli et al., 1990. The individual was estimated to be a middle-aged female with a height ranging between 142.9 cm (4'8") and 151.6 cm (5'0") with noted femoral asymmetry. The right femur showed a shortened femoral neck, "mushrooming" of the femoral head, and a necrotic lesion on the epiphysis. The maximum width of the left femoral head was 8.8 mm greater than that of the right. These are indicative of Legg-Calvé-Perthes disease, unique in both females and non-European populations. Perthes disease occurs as the result of an occluded blood supply to the femoral head, resulting in avascular necrosis of the bone and eventual fracture. An immature skeleton would likely be unable to bear the loads applied to it, thus susceptible to occlusion of the blood supply and trauma. The transition to agriculture characteristic of this individual’s population resulted in both less nutritious diets, a leading cause of skeletal immaturity, and increased work load. Perthes is also consistent with other observations that support heavy agricultural work loads such as increased robusticity and joint damage. The northern latitude of the Grantham population and climate served as higher risk factors for this individual.
Research Project Title: Polycarp of Smyrna: historical enigma and literary legacies

Student Presenter: Michelle Sdao

Faculty Mentor: David Brakke

Faculty Mentor Department: History

Research Abstract: Saint Polycarp of Smyrna, a second-century Christian bishop and martyr, is a historical enigma. Although he is a crucial link between Christians of the first and second centuries, the extant documents surrounding Polycarp give only a few opaque insights into this historical figure. The problem is that scholars no longer see Polycarp as the mystery which the texts present. They have grabbed at any information they can in order to fledge out his biography, without taking into account the possible legendary nature of certain accounts, and without considering the possibility of multiple independent traditions concerning Polycarp. The texts surrounding Polycarp can be broken into two categories. Ignatius’ Letter to the Magnesians, Letter to the Ephesians, Letter to Polycarp, and Letter to Smyrna, Polycarp’s Letter to the Philippians, fragments of Papias, and Irenaeus’ Letter to Victor have reliable information for the historical Polycarp. The remaining texts are historically unreliable for Polycarp’s biography because they represent several independent, non-historical traditions that seek to capture Polycarp’s legacy. These texts include the Martyrdom of Polycarp, Irenaeus’ Adversus Haereses and Letter to Florinus, the Harris Fragments, and the Vita Polycarpi. I analyze the reliable texts and then the unreliable ones in order to demonstrate that the historical Polycarp differs from the legendary Polycarp. The unreliable texts represent two different, independent legendary traditions, namely a Johannine and a non-Johannine Polycarp, with different motives and functions of portraying Polycarp in their own way. While the unreliability of the legendary accounts and their function in using Polycarp to support the authors’ own religious agendas indicate that they should not be used to flesh out Polycarp’s historical biography, these accounts do present significant functions, implications, and historical data for the time periods and communities in which they were written, which I trace in my paper. Several significant conclusions can be drawn from this critical methodology: the historical apostolic link between Polycarp and John the apostle is false, scholars must cease from attempts to date the Martyrdom of Polycarp precisely, and there was at least one tradition among Christians which had no knowledge of a connection between Polycarp and John.
Research Project Title: The consequences of neoliberal globalization on Mapuche women's land rights

Student Presenter: Kirsten Sippola

Faculty Mentor: Ana Del Sarto

Faculty Mentor Department: Spanish

Research Abstract: I. Introduction/Background

In 1973, Chile's socialist government was overthrown by a coup led by the military. Authoritarian and right wing, the new president, Augusto Pinochet, quickly implemented neoliberal reforms to the economy. Intending to make the country a world power, Pinochet began a period of intense globalization, seizing resources to be sold on the international market. This included the seizure of land from the indigenous Mapuche people, which was divided and sold to both private companies and the Mapuche themselves, who suffered immense economic and social losses. Due to this very globalization, however, the Mapuche movement was suddenly visible on an international scale, garnering support from other indigenous movements. Mapuche women were very active in the fight to restore land rights to indigenous communities, even though their own rights to land have long been contested: since the conquest of the Mapuche in the late 1800s, land has traditionally been passed down from father to son or brother to brother.

My research question is: How has the globalization of the Chilean economy, beginning with neoliberal economic reforms under Pinochet and institutionalized during the Concertación (1990s), affected the Mapuche women's land rights movement from 1973 to the current day?

II. Methods

Up to and through Spring 2018, I have used discourse analysis as my primary methodology. By studying both published testimonials of Mapuche women themselves, as well as academic articles produced by Mapuche scholars, non-Mapuche Chilean scholars, and scholars from outside of Chile, I have been exposed to a wide variety of perspectives that have informed my thesis. During the Summer 2018 term, I plan to conduct field research in Santiago, Chile.

III. Results

I am currently working on my analysis, and as such do not have any conclusive results.

IV. Conclusions

This project will demonstrate the importance of looking at any socio-political event, such as globalization, through the perspective of ethnically and sexually marginalized groups – in this case, Mapuche women. It will explore the connection between the indigenous land rights movement of Chile, the Mapuche women’s movement, and international movements to recognize indigenous and gender/women’s rights.
Research Project Title: "The Jewish question" in a Soviet context

Student Presenter: Rebecca Slavik

Faculty Mentor: Jennifer Suchland

Faculty Mentor Department: Slavic and East European Languages and Cultures

Research Abstract: Russia has a long symbolic history with many of its ethnic populations and through this context, the peculiarity of their relationship to the Jewish people is of interesting note. Though bloodied and complicated, Russia, and namely the Soviet Union, is one of the few countries within written history to have entertained the notion of Jewish sovereignty. This nuanced and multi-faceted relationship between two groups of people who have long struggled with defining their identities within the world context is a strangely unique phenomenon. The following seeks to resolve the implications of the internal Jewish question within the Soviet space. With the early 20th century boasting the grand new-age ideas of socialism and zionism, intellectuals across eastern Europe gathered to determine the direction of the new world order. Shedding the yoke of the long-held imperial Russian sphere of power and disrupting the concept of a historic Jewish diaspora, the bridging of both a symbiotic relationship and internal identity discussion led to the creation of the first free Jewish state in the modern era. Through primary sources and personal debates amongst the politically-tied communist and Jewish elite, the core of the eventual failure of Russia’s attempted reconciliation with their Jewish populations is evaluated. Essentially, the lack of a consistent Jewish narrative amongst Russian-Jews in addition to the mixed messages and prerogatives of the early communist party in Soviet Russia, the notion of a free Jewish state was never able to fully manifest into what it hoped to symbolically mean without the direct agency of all Jewish voices being members of its creation.
Research Project Title: Biodistance analysis of north and south american populations

Student Presenter: Julianne Stamer

Faculty Mentor: Mark Hubbe

Faculty Mentor Department: Anthropology

Research Abstract: Archaeological evidence suggests that humans were already present in both North and South America by 12.5-11.5 kyr BP. However, the number of waves and routes from Asia are much debated, and the evidence of early settlements (~12 kya) across South America have been challenging previous ideas about how humans occupied the American continents in the past. Given the debate surrounding this topic, it is important to understand the genetic diversity in North and South American populations in the past. In this project, we used biodistance analysis to explore the cranial morphological variation observed in the New World, and infer how this variation is structured in the two American continents. Human craniometrics data from previous studies (Hanihara, 1996; Herrera, et al., 2017; Hubbe, et al., 2014; Hubbe, et al., 2015; Neves et al., 2013) were used to create a detailed understanding of the biological variation of the region. This data covers populations in North America (USA and Mexico) and South America (Brazil, Colombia, and Peru), as well as comparative series from Asia and Australo-Melanesia. Craniometric data was analyzed using multivariate techniques adapted from population genetics. Results show that Atlantic South America exhibits the highest diversity between groups (Fst = 0.15) of all groups analyzed. Andean (Fst = 0.068), North Americans (Fst = 0.07), and East Asian (Fst = 0.077) populations, on the other hand, have the lowest Fst values. This shows the high genetic diversity of South American groups and calls into question the validity of combining North and South Americans as a single population in genetic studies.
Research Project Title: #themfirst: black female slavery and (t)he legacy of an American rape culture

Student Presenter: Chris Newman

Faculty Mentor: Ousman Kobo

Faculty Mentor Department: History

Research Abstract: This research examines the historical legacy of America's rape culture. Drawing upon sources such as slave narratives and slaveholder memoirs, this research investigates the development of an American culture of sexual violence influenced deeply by the American slave experience. Through viewing the collaborative efforts made by the powerful and influential, this research identifies the establishment of a patriarchal society which was deeply rooted in American idealism. This research further notes a contemporary negligence in correctly acknowledging the problematic history of sexual misconduct in America. Within this process, a concise appraisal of the #metoo Movement is conducted in order to address several questions of significant importance:

What measures were taken to silence Black female slaves from speaking against their offender? Does victim-shaming originate with the raping of Black women? Is there a concerted effort to racialize the #metoo Movement? If so, what negative connotations might befall Black women?

This research asserts that sexual violence against women is indeed nothing new, yet is deeply entrenched in a society which often is concealed, excused, or supported. The social, political and economic consequences of the #metoo Movement should not be ignored, nor should the stories of those victims from the slave experience. Moreover, this paper concludes that without recognition of America's traumatic past, true lessons will not be learned and the American rape culture will, tragically continue.
Research Project Title: From TORCH to Tunisia: the development of allied force headquarters and its general staff officers, from August 1942 - May 1943

Student Presenter: Thomas Wisbith

Faculty Mentor: Peter Mansoor

Faculty Mentor Department: History

Research Abstract: My thesis explores the joint Anglo-American command, Allied Force Headquarters (AFHQ), and a select group of its General Staff officers within the context of the North Africa Campaign in the Mediterranean Theater of Operations from August of 1942 to May of 1943. It was during these months that AFHQ was created, tested, and subsequently altered, while its officers worked side-by-side with one another. My research began with reading the official history of AFHQ in order to understand how the command was structured and changed, and to find the names of the officers in question. It was then necessary to consult archives, both here in the United States and in England, in order to discover how the officers of AFHQ interacted. I was able to locate information on a number of these men, although not all, and what was available has proven to be enlightening. My findings have shown that while the common narrative of intense debate and animosity among allied officers still holds true, it was not wholesale and in fact the relationships of these men were much more complex than commonly believed.

My research has shown that during the North Africa Campaign the officers of AFHQ, by and large, understood the necessity of cooperation within the headquarters. This is not to downplay the animosities that existed. In fact, one American officer was relieved of duty as a result of his inability to work with his British counterpart. His replacement, however, was the exact opposite. Alternatively, the British officer who oversaw all administrative duties appeared to be more at odds with officers in the British 1st Army over supply issues than with any of the American officers at AFHQ. While these disputes doubtlessly kept AFHQ from operating at peak efficiency, it must also be taken into consideration that the command structure itself was not perfect, as seen in the sweeping changes and its expansion in 1943. However, the success of the allied forces under AFHQ in Northwest Africa is a testament to the ability of these officers to work toward a common goal and ensure Allied victory.
Research Project Title: The African slave trade, American slaves, and the migration of black mythology

Student Presenter: Carley Reinhard

Faculty Mentor: Stephanie Shaw

Faculty Mentor Department: History

Research Abstract: During the 1930s, as part of the W.P.A. Federal Writer’s project, over 2,000 interviews of former slaves were completed. These interviews were transcribed and compiled into a grand collection of first-person accounts of all the former slaves who could be located at the time. Within many of these narratives, hundreds of accounts detail folktales the slaves grew up hearing in their communities. The development of these folk stories, which seem unique to African American slaves in their specifics if not in their generalities, reflect aspects of the larger development of African American culture that arose due to forced migration from Africa and, for some, their movement from the upper-South to the Lower South and Southwest as slavery expanded in the United States. Thus, these stories, along with other aspects of African American culture, arose in part as a product of the intersection of traditional African folklore and new circumstance. This research seeks to explore these stories, determining their origin and tracing their development and their dispersal. This will not only contribute to the current studies of the African Diaspora, but it will also contribute greatly to studies of the inter- and intrastate migrations of slaves that never delve into the culture of slaves and to the cultural studies of slavery that don’t pay much attention to the migrations of slaves. It is my hope through the course of this research to arrive at a more complete understanding of both the significance of African American folklore and the factors, including migration, that shaped it.
Research Project Title: Vernacular illusionism in a 16th century book of hours

Student Presenter: Erin Riddiford

Faculty Mentor: Karl Whittington

Faculty Mentor Department: History of Art

Research Abstract: The Ohio State University’s Special Collections Library houses a manuscript Book of Hours (MS.MR.10) that on paper appears conventional. The picture cycle it holds follows the life of Christ and the Virgin, as is common, and it features a calendar and the typical prayers to the Virgin, the Penitential Psalms, and the Office of the Dead. It is not until one has access to MS.MR.10’s imagery and its provenance that one realizes the codex is not wholly standard; while its subject matter is typical, its style is intriguing. Conspicuous shadows back divine figures and some subtly interact with their frames in its miniatures. But these attempts at illusionism are contradicted by the rudimentary nature in which the figures and scenes have been painted. Dated to 1540, MS.MR.10 is quite late for a manuscript Book of Hours, especially one that contains a mixture of medievalizing elements and more modern illusionistic techniques. In this thesis, I argue that the codex’s imagery, particularly a miniature of the Madonna and Child, presents a kind of ‘vernacular illusionism,’ where elite illuminating styles have been imitated by a less-skilled practitioner, creating an interesting mix of ambitious visual strategies with rough execution. After briefly describing the manuscript’s material condition and contents, I will explore this unique blend through an examination of its most interesting image and the visual culture that produced it.
Research Project Title: Nationality before nationalism: ethnic politics, geopolitics, and the sustainability of the medieval Hungarian Kingdom in the east

Student Presenter: George Andrei

Faculty Mentor: Nicholas Breyfogle

Faculty Mentor Department: History

Research Abstract: Introduction:

The medieval kingdom of Hungary, founded by St. Stephan, was a patchwork of many ethnicities—Germans, Hungarians, Vlachs, Szekelys, and many others—sedentary and nomadic, Catholic and Orthodox. It was also situated on the very eastern border of Western Christendom; as such, its defense was of vital importance not solely to the local rulers, but for Rome as well.

One group—its multiethnic in nature—was made up of German colonists to southeastern Transylvania. First arriving in the middle of the XII century, the Saxons, as they were known collectively, settled near several Vlach ëcountries': simple confederations of Vlach villages which held significant sway over their domains. The Vlachs, predecessors of modern Romanians and other populations in the Balkans, had presences in modern Romania and Serbia, and spoke Latin-based dialects.

Methods:

Using a plethora of contemporary medieval sources, mostly decrees and land grants, as well as modern analyses and archaeological findings, I have analyzed the impact of the German migrations of the XII and XIII centuries into Transylvania. All research regarding medieval material was conducted in German, Latin, or Romanian. In addition, German and Romanian secondary (works completed by historians) sources consulted were widely used; however, English languages sources were also thoroughly utilized.

Results/Conclusions:

My research explores how the Vlachs and Saxons would later come to play vital roles in maintaining the Hungarian Kingdom’s domains in the east. I argue that the Saxons were, from the beginning of their colonization, used as a tool by the Hungarian Crown and other authority figures in the region to expand, stabilize, and dominate the area: drawing in, after the Mongol invasions, desperately needed manpower, taxes, and support from the local populations.
Research Project Title: A mask for every occasion: how the face mask connects medicine, fashion, and politics in Chinese narratives

Student Presenter: Harrison Fillmore

Faculty Mentor: Susan Lawrence

Faculty Mentor Department: History

Research Abstract: Introduction:

The habit of mask wearing, which is now recognized internationally as a predominantly East Asian (especially Chinese) practice (although reputedly Chinese in origin), was grounded in Western medical ideology. Nowadays, people who wear masks in East Asia and travelers from East Asia who wear masks abroad wear them for many reasons, including but not limited to: to avoid infecting others with an illness the mask-wearer suffers from, to avoid being infected with an illness from those around them, to protect from smog, sandstorms, or other harmful airborne particulate matter, to avoid breathing in cold air, to cover a breakout of acne, or to be cute or fashionable.

Instead of just reporting a list of the many reasons why people in China choose to wear face masks, this paper seeks to trace how the mask changed throughout several different historical contexts, how it came to be used for several different purposes, and how it became entangled in several different public connotations.

Methods:

By drawing upon facts and figures from history, anthropological theory, and narrative analyses of interviews with Chinese citizens, I explore the use of face masks, their history, and their influence.

Results:

All at once, the mask is a medical device, a fashion statement, a visible narrative, and a cultural symbol. It may have influenced the generally accepted definition of disease, cultural opinions on hygiene and the environment, and the modern state of Traditional Chinese Medicine.

Conclusions:

The history and impact of the mask illustrate the power of cultural narrative, and show how a simple device can facilitate the development and mutual influence of ideas.
Research Project Title: Guatemala, rebuilding a country in the aftermath of violence

Student Presenter: Hannah Tomaszewski

Faculty Mentor: Hollie Nyseth Brehm

Faculty Mentor Department: Sociology

Research Abstract: From the 1960s to 1996, Guatemala endured a violent and conflicting civil war. After an indigenous group of Mayans decided to overthrow the elites that had been ruling Guatemala for over a century, the government worked with the Guatemalan army to exaggerate the threat against the country and start a brutal protest against all indigenous Guatemalans that lasted 40 years. Over these forty years, the army forced indigenous Guatemalans to kill each other in order to save their families, murdered over 200,000 Guatemalans and displaced another 1.5 million Guatemalans.

The Guatemalan government and the indigenous Guatemalans signed a peace agreement in 1996, but true resolution still has not been reached in Guatemala. Even though scholars have studied and deemed the conflict both a civil war and genocide due to the atrocities inflicted by the Guatemalan government and army, the perpetrators of the war have not been brought to justice.

This research project seeks to assess the collective memory of this violence, or how indigenous Guatemalans narrate what happened. In order to study collective memories in Guatemala today, I spent 6 weeks in the Guatemalan highlands. During this time, I engaged in numerous informal conversations as well as 10 in-depth interviews with indigenous Guatemalans. These interviews included questions about their personal experiences, including why the violence occurred and their experiences during and afterward.

While each interview was different, certain themes kept appearing, and this research project will analyze similarities and differences in their collective memories. As I continue to assess how people remember the genocide in Guatemala, I will also analyze how individuals’ experiences in and exposure to the war shape their thoughts about their country and the war in the aftermath of the conflict. After explaining how memory affects people’s perceptions of the present, I will conclude by discussing how individuals and communities in Guatemala are creating social change by trusting one another and becoming social entrepreneurs.
Research Project Title: The battling Buckeyes of the 37th Infantry Division

Student Presenter: Tyler Webb

Faculty Mentor: Peter Mansoor

Faculty Mentor Department: History

Research Abstract: The 37th Infantry Division that was forged during the fires of World War I was again called upon by its nation after December 7th, 1941. These men not only fought for the United States, but also for Ohio. The 37th Infantry Division’s original constituents were Ohio National Guard units, leading to its nickname, “the Buckeye Division.” The soldiers’ bond to Ohio was an integral part of the division spirit, as the division history recalls it was generally assumed that Ohio men belonged to the 37th Division and that the 37th Division belonged to Ohio. The Buckeye soldiers carried their banner across the Pacific for nearly four years, fighting against the Imperial Japanese Army on various islands starting with defense preparations in Fiji, where approximately 40 percent of the division consisted of Ohioans. Their battles included the invasions of New Georgia, Bougainville, and the Philippines. The 37th proved to be an effective fighting force under the leadership of their exceptional commander, Major General Robert S. Beightler, from Marysville, Ohio. His leadership was best exemplified by the fact that he was only one of two National Guard division commanders not relieved of command throughout the war. This thesis investigates the leadership of Beightler, the role of the 37th in its battles, and furthers analysis of the lesser known battles on New Georgia and Bougainville. This study also provides insight into the once tense relationship between the Regular Army and the National Guard. However, perhaps the most important result of this research will be a better appreciation of the heroes who were the Battling Buckeyes.
Research Project Title: The role of visual salience on plural noun production

Student Presenter: Nathan Baker

Faculty Mentor: Nikole Patson

Faculty Mentor Department: Psychology

Research Abstract: There are many factors that influence the perception of distinctive visual groups. Visual salience, the distinctive qualities of an object that distinguish it from its surroundings, is one such factor. To test the impact of visual salience on perceived distinctiveness, participants were asked to complete a photo caption for a series of photographs. Pictures contained either: one individual, a group of individuals, or a group of individuals with one visually salient individual (i.e., the “VIP”). The study examined which visual features will impact when adults view an individual as being separate from a larger group of people. For example, if in a group of people, one individual is visually salient, will that person seem independent from the rest of the group? To test this hypothesis, each photograph was accompanied by a photo caption containing a blank space that could be filled in with either a plural or singular noun. We predict that people will be less likely to use a plural noun in the VIP condition, as that would indicate that the participant viewed the visually salient member as separate from the rest of the group. Preliminary analyses indicate that participants were indeed less likely to use a plural noun in the VIP condition compared to plural condition where there were multiple individuals, but no “VIP”. These data suggest that pictured individuals with greater visual salience were more likely to be viewed as separate from a larger group of people.
Research Project Title: Optimizing spell checking introduction

Student Presenter: Sarah Ewing

Faculty Mentor: Michael White

Faculty Mentor Department: Linguistics

Research Abstract: Introduction

The Department of Linguistics and the Department of Family Medicine are collaborating on a virtual patient dialogue system to help medical students with their patient questioning skills. The system uses a rule-based pattern matching system in combination with a machine-learned classifier to interpret questions. The system currently uses typed interaction leading to significant problems with misspelled words, especially with the rule-based system. This project aims to determine whether automated spelling correction can improve the system's accuracy in question interpretation.

Methods

I have annotated our 94-dialogue data set with over 250 spelling corrections. The machine learned system did no better on the annotated data which was disappointing although expected. I will focus on improvements to the rule-based system, by assessing two spell-checkers: one open-source and one made by Bing. Bing's system uses machine learning and statistical machine translation trained on a corpus of web searches and documents to correct errors. I will observe the accuracy of each system's corrections on the original data. Additionally, I will alter each to consider a domain specific language model and test their improvements. A general purpose spell checker may consider 'dogs' or 'drugs' equally likely corrections for the misspelling 'drogs'. However, for a system with a medical domain specific language model, 'drugs' would be a preferred correction.

Results

At the Denman I will present which of the four systems (open-source, Bing, biased open-source, or biased Bing) performs with the closest accuracy to my annotations, as well as its effect on the rule-based classifier and the virtual patient system overall.

Conclusions

The results have applications in further technology as well. The next step for the virtual patient system is to understand speech. The speech-to-text technology does not require a spell-checker, however a biased language model 'word-checker' will improve the systems translations from sound waves to text by preferring relevant words over acoustically similar irrelevant ones.
Research Project Title: Linguistic, talker, and stimulus factors as predictors of dialect classification accuracy

Student Presenter: Megan Dailey

Faculty Mentor: Cynthia Clopper

Faculty Mentor Department: Linguistics

Research Abstract: Evidence from perceptual dialect classification research suggests that listeners have good intuitions about regional differences between speakers. Less studied is the relationship between dialect classification and speech intelligibility. Regional dialect is known to affect speech intelligibility: in some cases, familiar dialects can facilitate speech processing, but in other cases, less marked dialects facilitate speech processing. Many other linguistic, sociolinguistic, and stimulus factors also affect speech intelligibility, including lexical frequency, phonological similarity, semantic predictability, mention within a passage, speech style, and talker gender. The present study explores predictors of dialect classification accuracy for the Northern and Midland dialects of American English. In previous studies, Midland speech in noise was found to be more intelligible than Northern speech in noise for both Midland and Northern listeners. Given that listeners are sensitive to differences between Northern and Midland speech in terms of intelligibility, we might expect that listeners use differences in intelligibility to identify where talkers are from. To explore this possibility, participants completed a speech intelligibility in noise task followed by a dialect identification task. Stimulus materials were short phrases taken from passages read aloud by eight Northern and eight Midland speakers and were balanced for the relevant linguistic, stimulus, and talker factors that affect speech processing. Participants heard the same phrases in both tasks. Accuracy scores from both tasks were obtained. A linear regression model revealed that token intelligibility did not predict token classification accuracy. The results reveal that easily classifiable tokens are not always the least intelligible, suggesting that dialect-specific forms are encoded for lexical processing, but may not be available to the listener for explicit classification. Ongoing analysis will determine the role of the other predictors of dialect classification accuracy, leading towards a better understanding of the relationship between perceptual and processing mechanisms.
Research Project Title: "Tapping" into the etiology of pediatric communication disorders: spontaneous rhythm tapping predicts auditory working memory

Student Presenter: Katherine Corbeil

Faculty Mentor: Yune Lee

Faculty Mentor Department: Speech and Hearing Science

Research Abstract: A growing body of evidence has shown that auditory working memory (AWM) deficits present in people with speech and language disorders such as specific language impairment (SLI), dyslexia, and ADHD. However, the causal direction between working memory and these disorders remains elusive. This study proposed that innately slow auditory temporal processing pertaining to speech/language deficits adversely affects AWM. A spontaneous tapping task was used to examine the variation in individuals’ temporal processing and provided data on the length of the temporal window (i.e., inter-tapping interval). We hypothesized that a large temporal window (manifesting as slow rhythm tapping) stores more information and, due to heavy storage and retrieval demands on the working memory unit, leads to poorer AWM. A small window, however, facilitates precise processing and better AWM. Prior to recruiting children with speech and language disorders, 21 typically-developing children, aged 7-17 years old, were recruited at the Center of Science and Industry (COSI) Language Pod in Columbus. We proposed that children’s less biased (and fewer number of) life experiences were most appropriate for analyzing what we believe to be innate, perhaps genetic, rhythm skills. Participants first completed computerized visual and auditory working memory assessments and then engaged in two tablet-based rhythm tapping tasks: a beat synchronization measure and the spontaneous tapping measure. A linear mixed effect (LME) regression analysis confirmed our hypothesis, demonstrating that mean inter-tapping interval was the sole predictor (F= 5.01; P = .043) of AWM performance, while other factors (e.g., age, sex, parental education, music training, languages spoken) were not. Perhaps most notably, beat synchronization did not significantly predict AWM (F=4.03; p = .066), supporting the argument for dissociable rhythm skills. No measures predicted visual working memory performance, further arguing for a domain-specific relationship between rhythm and AWM. These results serve as promising evidence for poor rhythm processing underlying AWM deficits in populations with speech and language disorders. Further data collection and analyses are underway to solidify this connection.
Research Project Title: Executive function and psychosocial outcomes in prelingually deafened CI users

Student Presenter: Jillian Harrington

Faculty Mentor: Irina Castellanos

Faculty Mentor Department: Otolaryngology

Research Abstract: A cochlear implant (CI) is a device that provides the sensation of hearing to many individuals with profound hearing loss. Commonly, pediatric CI research revolves around speech-and-language outcomes. While deaf children face obvious obstacles with hearing and language, there is increased concern for their entire neurocognitive development. In fact, CI users are at an increased risk for disturbances in neurocognitive development including delays in executive function: the self-regulation of cognitive and emotional processes. The present study seeks to examine how neurocognitive delays are associated with psychosocial, functional-everyday, outcomes in prelingually deaf, CI preschoolers compared to their normal-hearing (NH) peers. Psychosocial outcomes include social, emotional, and behavioral development and our previous research indicates that these areas of development differ between adolescent CI users and NH controls at clinically significant levels (Castellanos, Kronenberger, & Pisoni, 2017). This makes the early identification and treatment of psychosocial disturbances a pressing, clinical issue. To investigate the impact of executive functioning on psychosocial development, this study utilizes two well-validated parent-completed behavioral checklists: the Learning, Executive, and Attentional Functioning (LEAF) to assess executive functioning and the Behavior Assessment System for Children (BASC) to assess psychosocial development. Additionally, preschool children (CI, n=4; NH, n=9) were administered the Primary Test of Nonverbal Intelligence (PTONI). Parent-reported data indicates that preschool CI users exhibit more externalizing behavioral problems, more social disorders, and less functional communication in comparison to their NH peers. Moreover, nonverbal intelligence scores and executive functioning skills are associated with psychosocial outcomes. Higher nonverbal intelligence is associated with fewer symptoms of anxiety, depression, internalizing problems, withdrawal, and better control of anger and emotions. Similarly, better working memory is associated with fewer symptoms of hyperactivity, attentional problems, social disorders, and more adaptability, resiliency, and emotional self-control in preschool-aged children. These preliminary findings suggest that neurocognitive disturbances, specifically delays in executive functioning, contribute to the early development of psychosocial skills in prelingually deafened CI users.
Research Project Title: Acquisition of Spanish sounds among college students in a Spanish pronunciation course

Student Presenter: Allison Goldman

Faculty Mentor: Rebeka Campos-Astorkiza

Faculty Mentor Department: Spanish and Portuguese

Research Abstract: This project analyzes the acquisition of Spanish sounds among college students learning Spanish as a second language (L2). Differences in pronunciation of a sound depending on context, which are called allophones, are important for the L2 learner to acquire because their production contributes to the perception of accented speech. The distribution of allophones varies according to the presence of allophones in the L2 that do not exist in the L1, or the presence of similar allophones in both L1 and L2 but with a different distribution. This study compares the acquisition of the Spanish voiced ([b, d, g, ð, ɣ]) and voiceless ([p, t, k]) stops allophones by L1 American English learners. Spanish presents an alternation between voiced stops and approximants, while English displays only voiced stops. Additionally, Spanish voiceless stops are unaspirated in all environments, while English alternates aspirated, unaspirated, and weakened allophones. Our project compares the difference in the rate of acquisition of approximant allophones of voiced stops vs. that of unaspirated allophones of voiceless stops for L1 American English learners of Spanish.

This study is part of a bigger project called “See Your Speech,” which analyzes data from a teaching module developed for college-level Spanish Pronunciation courses. Participants received the same Spanish pronunciation curriculum and teaching methodology, and recorded themselves reading English and Spanish words at the beginning and at the end of the course via a web-based interface.

To evaluate the production of voiced and voiceless stops, we measure the VOT of voiceless stops and the intensity of voiced stops. We then compare the rate of change in reducing VOT (less aspiration) and increasing intensity (more approximantization) to elucidate which type of sounds present a higher rate of change, which would mean a higher rate of acquisition. Preliminary results indicate that the change in intensity is greater than the change in VOT, suggesting that learners become better at producing approximants instead of voiced stops than at producing unaspirated vs. aspirated voiceless stops. We interpret this as an indication that the acquisition of approximants is faster or more successful than the acquisition of unaspirated stops.
Abstract: Augmentative Alternative Communication (AAC) devices are considered all forms of communication (other than oral speech) (ASHA, n.d.). Devices may be motor or symbol based systems. Symbol-based systems require learning that a consistent graphic represents a specific referent (e.g., a picture of an apple represents the word apple). Motor-based systems involve learning that a consistent motor pattern represents a specific referent (e.g., when you form a specific set of motor movements with your mouth to say the word apple). The present study investigates whether individual differences (e.g., nonverbal cognition) are correlated with vocabulary learning across two different types of AAC systems (motor and symbol) and whether the number of words being taught (six versus ten) differentially affects learning across the systems. To answer this question 23 college age students were taught novel words on the two AAC systems. In the symbol system, participants were taught symbols that corresponded with a specific referent. In the motor system, participants were taught motor sequences that corresponded with a specific referent. The number of words taught (six versus ten) was randomized across participants. Receptive and expressive vocabulary learning were assessed immediately after teaching. Results revealed that participants demonstrated better expressive vocabulary learning on the symbol system. For receptive vocabulary learning, the interaction between condition and number of words taught was trending towards significance (p=.05). Individual differences were not correlated with learning in either condition. Overall, the findings from this study suggest that adult learners with intact language may benefit more from a symbol system. Further research should explore if such results maintain for adults with aphasia, who at one time had intact language. This study will provide a first step in exploring how the individual differences of children with Autism can be utilized for efficient vocabulary learning.
Research Project Title: A neurolinguistic study of Spanish Agreement

Student Presenter: Katy McFarland

Faculty Mentor: John Grinstead

Faculty Mentor Department: Spanish and Portuguese

Research Abstract:

Background:

In Spanish, there is person, number and gender agreement. The current study focuses on better understanding two specific cases of non-canonical agreement which include a person mismatch, known as Unagreement (e.g. â€œLas cocineras (3rd-pl) cocinamos (1st-pl) en la cocina.â€), which is grammatical in adult Spanish, and a general lack of person agreement found in child Spanish known as the Bare Stem Phenomenon (e.g. â€œHace (3rd-sg.) esto yo (1st-sg).â€, which is ungrammatical in adult Spanish, but produced by children. Though grammatical, the Unagreement cases produce an Event-Related Potentials (ERP) signature consistent with semantic anomaly. However, the grammaticality of Unagreement cases has never been put to a large-scale behavioral test. The Bare Stem phenomenon cases, in contrast, are judged by child Spanish-speakers to be acceptable, but their acceptability by adult speakers has never been tested.

Methods:

The first experiment consists of an adult Spanish language acceptability survey, in which monolingual adult Spanish-speakers in Mexico were asked to provide Likert Scale ratings from 1-5, with 1 being most acceptable, of standard subject-verb agreement, standard subject-verb agreement clashes, as well as Unagreement cases and Bare Stem cases. This survey was administered electronically to 94 monolingual Spanish-speaking participants in Mexico.

Results:

Of these, 55 completed the entire survey. Answers showed that participants judged agreeing sentences (mean acceptance=1.64, SD=.36) and Unagreement cases (mean acceptance=1.74, SD=.63) as equally grammatical (p=.940). Further, the Bare Stem cases (mean acceptance=4.31, SD=.74) were found to be as ungrammatical (p=.940) as the Agreement Clash cases (mean acceptance=4.23, SD=.56). Thus, Unagreement Cases appear to be judged as completely grammatical. Bare stem sentences, in contrast, are judged as completely ungrammatical.

Conclusions:

Based on these results, my second experiment seeks to determine whether we will replicate the semantic anomaly reaction to Unagreement cases, documented in the literature, and find straightforward syntactic ungrammaticality reactions to the Bare Stem cases or perhaps something different. The ERP component of the project will be carried out over spring break in Mexico City with collaborators at the Universidad Nacional AutÃ³noma de MÃ©xico.
Research Project Title: Early math skills as predictors of narrative ability

Student Presenter: Flora Hong

Faculty Mentor: Kiren Khan

Faculty Mentor Department: Psychology

Research Abstract: Despite a growing body of literature establishing the relationship between literacy and math ability in early childhood, very few studies have explored the association between early mathematical and narrative ability, a skill that is separate from, but predictive of early literacy skills. Understanding associations among these developing skills can help inform best practices for instruction so that optimal gains may be made in these skills prior to kindergarten entry. In order to determine the cross-domain association between mathematical and narrative retelling ability, different measures of early math skills (Patterning, Cardinality, Math Language, Counting) and one measure of narrative comprehension (Test of Narrative Language) were administered to 48 children between 4 and 5 years of age. All measures were assessed at one time point as a part of a general Kindergarten Readiness Screener. Simple correlations between measures showed that narrative comprehension was moderately correlated with general math ability (r=0.55), and significantly correlated with three math subtests: Patterning, Cardinality, and Math Language (r = 0.33, 0.54, 0.52). A multiple regression analysis indicated that together, all four math subtests explained 37.9% of variance in narrative comprehension skills (R2 = 0.38, F(3,44) = 6.41, p<0.001), with Cardinality and Math Language each accounting for significant variance (R2 = 0.44, 0.56, p<0.05). Rote counting was neither significantly correlated with narrative, nor accounted for narrative ability in the regression model. We interpret this data to suggest that the mathematical skills most strongly associated with narrative are those that require reasoning about causal relationships—whether they are associations between number sets, operations, and sequences in the case of mathematics, or relationships between characters and sequences of events as in the case of narrative. An implication of this work is that hybrid interventions focusing on teaching patterning, cardinality, and math language in the context of shared book reading sessions may be particularly powerful in supporting cross-domain advances in narrative and math.
Research Project Title: Pragmatic factors influencing existential determiners in child Spanish

Student Presenter: Nicolette Leon

Faculty Mentor: John Grinstead

Faculty Mentor Department: Spanish and Portuguese

Research Abstract: Introduction/ Background

Early work on developmental semantics (e.g. Beilin & Lust 1975) investigated what children knew about logical language, including quantifiers such as some, and concluded that children were not adult-like in their comprehension. However, others (e.g. Chierchia et al. 1998) were able to demonstrate children’s understanding of some, with respect to inferences referred to as pragmatic implicatures, in the terms of Grice (1975) and Horn (1972). Seeking to make certain interpretations easier to grasp by ensuring that experimental contexts follow a discourse structure that answers what is referred to as the Question Under Discussion (e.g. Roberts 1996, 2004), Gualmini et al. (2008) showed that children could demonstrate more adult-like comprehension of ambiguous sentences, if the hard-to-access interpretation was the answer to an implicit Question Under Discussion. An explicit Question Under Discussion design has not yet been used in studies of children’s interpretations of some and its associated some, but not all pragmatically enriched interpretation, which is what I have studied, in monolingual pre-school-aged Spanish-speakers in Mexico City.

Methods

To study this question, our project administered a Truth Value Judgment Task to monolingual Spanish-speakers in Mexico City, including 60 adults (mean age = 305.49 months, SD= 63.0) and 42 children (mean age = 70.65 months, SD = 5.7). To study some in Spanish, we looked at both unos and algunos, which are the Spanish version of some, which previous work has suggested that children understand (Vargas-Tokuda et al. 2009). Because unos and algunos are similar, but subtly different quantifiers (Gutiérrez-Rexach 2001; López-Palma 2007), participants were assigned to either unos or algunos conditions, in a partially between-subjects design, to avoid confusion.

Results & Conclusion

Results showed that adults generated a some, but not all implicature with algunos, but not with unos, which is consistent with, though more categorical than, findings from previous research. In contrast with previous research, the children in our sample did not generate an implicature with either algunos or unos. Future research will investigate predicate type as a potential source for this distinction with previous research. I discuss the significance of the more categorical adult judgments.
Research Project Title: Effects of high-pass filtering on dialect and gender perception

Student Presenter: Magan McClurg

Faculty Mentor: Robert Fox

Faculty Mentor Department: Speech and Hearing Science

Research Abstract: Category: Social and Behavioral Sciences

Title: Effects of high-pass filtering on dialect and gender perception

Student Presenter: Maggie McClurg

Faculty Advisors: Fox, Robert & Jacewicz, Ewa

Abstract: Linguistic (message related) and indexical (related to individual talker characteristics) information are conveyed in spoken language. It has been demonstrated that listeners are sensitive to indexical cues such as regional dialect spoken in their speech community (Clopper et al., 2006; Jacewicz & Fox, 2012). However, we have relatively little information in terms of how listeners form a perceptual representation of speaker identity and how the indexical information is conveyed by the vocal source (related to voice) and filter (related to the changing shape of the vocal tract during speech production). We do not know the necessary and appropriate acoustic cues that listeners use to determine speaker identity. This project analyzes how listeners process information about talker sex (male, female) and dialect (Ohio, North Carolina) with high-pass filtered speech. Research shows that intelligibility remains relatively high even when large portions of the speech spectrum are eliminated by filtering (Stickney & Assmann, 2001), indicating that speech cues are widely distributed. This study explores the contribution of cues at different frequency ranges to the identification of speaker dialect and gender by systematically removing the segmental and semantic content from speech using high-pass filtering. Two types of tests will be given: Identification and Intelligibility. In the Identification (ID) task, listeners will be required to identify each sentence as having been produced by an Ohio speaker or a North Carolina speaker; male or female. In the Intelligibility task participants will be asked to write down (using a Matlab program) the messages (i.e., linguistic content). Intelligibility data will be analyzed using Signal Detection Theory to separate sensitivity to indexical cues from the response bias. Based on previous findings for low-pass filtered speech, I expect to find greater amount of dialect cues than gender cues in high-pass filtered speech. Intelligibility is expected to increase with each decreasing cutoff frequency of the filter.
Research Project Title: Functional activation during reading comprehension in opposite-handed MZ twins

Student Presenter: Nick Mannix

Faculty Mentor: Steve Petrill

Faculty Mentor Department: Psychology

Research Abstract: The purpose of the present study was to examine differences in functional activation during reading comprehension tasks among monozygotic (MZ, or identical) twin pairs. Previous literature suggests left lateralization of language areas associated with working memory in right-handed adults. In addition, prior research has shown that left-handed adults may be more bilateral in their processing of working memory. Finally, our previous research has shown that working memory is bilaterally processed in MZ twins suggesting handedness is not related to working memory processing. MZ twins provide a unique approach for studying the etiology of differences in functional brain activation, as functional differences can be examined while controlling for genetic differences between individuals. Data from four opposite-handed MZ twin pairs (Age range 14 to 18) were analyzed in the current study. Twins were also administered reading comprehension measures by separate examiners. Results examined differences in functional activation if reading comprehension compared to baseline, based on handedness. Because MZ twins are almost completely genetically identical and live in the same environments, these differences are indicative of non-shared environmental and/or epigenetic effects. Since MZ twin pairs are genetically identical, any functional differences in activation, lateralization, or handedness are due to either non-shared environmental factors or an unknown difference which should be studied further.
Research Abstract: This project investigated what effect hand gestures have on the mental conceptualizations listeners construct when hearing a plural noun (e.g., cats) produced in speech. In our study we used punctuated and unpunctuated gestures. Punctuated gestures are discrete from the other surrounding gestures and more accurately convey the number of items compared to unpunctuated gestures, which are not clearly separated from the surrounding gestures and do not give specified information, but rather are currently understood to mean “more than one.” These gestures are produced by homesigners for conveying information about quantity. Homesigners are individuals unable to produce spoken communication but do not have access to conventional sign language and, therefore, create their own gestural system to communicate. We hypothesized that the gestures of homesigners reflect innate processes, thus individuals from the normally-speaking population should interpret these gestures in the same manner.

In the normal-speaking population, different modes of expressing plurality have been shown to influence the conceptualizations of the plural noun created by listeners. Previous research has identified one such difference, wherein the objects in the set are separate and distinct versus a collective group. We predicted that when given a neutral sentence, such as “The books are on the table,” paired with one of the above-mentioned gestures, the punctuated gestures will produce scattered representations due to their emphasis on discreteness and accuracy, while the unpunctuated gestures will produce collective and underspecified representations because of their use for grouping items into a sum. Participants in this study watched videos of an actor performing the gesture while simultaneously saying the target sentence. Following this, participants were given two pictures and instructed to select the picture that best matched the scene described in the video. One picture showed the items spread out and the other showed the items in a pile. Preliminary data analyses do not confirm our hypotheses. Participants’ picture preference was not dependent on the gesture in the video. These data suggest that the homesigners gestures do not reflect innate processes, but future work is necessary.
Research Project Title: Language induced attention optimization in children and adults

Student Presenter: Ted Oyler

Faculty Mentor: Chris Robinson

Faculty Mentor Department: Psychology

Research Abstract: Effects of linguistic labels on category learning are well established; however, developmental research examining possible mechanisms underlying these effects have provided mixed results. For example, while there is some evidence that hearing the same label associated with multiple objects directs visual attention to the category relevant features, other studies have found that infants and young children learn the categories with focusing on the correct information. However, previous studies relied on habituation/familiarization tasks, which may not work on infants and children because of their known novelty preference.

To further examine if labels direct attention to category relevant features, we used a novel paradigm where 8-year-olds and adults were simultaneously trained on three sparse categories (categories that have very little in common) and category members were either presented with a common label (same label associated with all category members), unique labels (different labels associated with all category members), or no labels (silent baseline). The three categories were rule-based groups determined by specific visual components of the stimuli. At the end of the study, there was a recognition task which tested whether increased attention to the category relevant features would spill over to a non-categorization task. Similar to infant paradigms, participants were not instructed about the categories, nor were they asked to make category judgements, and we examined fixations to category relevant features across training as participants passively viewed the novel stimuli.

While it is well established that adults can optimize their attention in forced-choice categorization tasks without linguistic input, the present findings provide support for label induced attention optimization: simply hearing the same label associated with different exemplars pushed children’s and adult’s attention to category relevant features over time. Moreover, children continued to focus on these features on a subsequent recognition task. Participants also viewed images longer and made more fixations when images were paired with unique labels.

The current study provides support for the claim that labels may facilitate category learning by directing attention to category relevant features. Additional data will be presented examining participants' explicit knowledge about category defining features with patterns of looking during training.
Research Project Title: Semantic processing projects

Student Presenter: Peiyuan Tang

Faculty Mentor: William Schuler

Faculty Mentor Department: Linguistics

Research Abstract: Introduction: Research methods for Improving the efficiency and effectiveness of implementations for the semantics processing algorithms

Background: The current semantics processing method used by OSU's Computational Cognitive Modeling Lab currently have around 90% of accuracy in parsing English semantics into computer. However, the modelling of running the deep learning algorithms on experimental data takes very long time, running on the GPU. Our goal is to optimize the time and space used for semantics processing.

Methods:

1. Apply mathematical and statistical ideas and methodology to improve the efficiency of models for data storing.

2. Apply complexity optimization algorithms in improving the speed in parsing the experimental data.

Result: it can be improved, but we are stilling finding better methods. (I will have results later)

Modification of the matrices representation might be useful.

Conclusion: there is some way to improve the semantics processing. (I will get conclusions later, should get before the presentation time).
Research Project Title: Listener tolerance of nasality: A dialectal and comparative perspective

Student Presenter: Karl Velik

Faculty Mentor: Youkyung Bae

Faculty Mentor Department: Speech & Hearing Science

Research Abstract: Nasality in speech is defined differently in speech physiology than in popular belief. Nasality is a perceptual term referring to the degree of nasal resonance perceived in speech. In speech physiology, nasal sounds, such as /m n Å‹/ in English, are produced with the velopharyngeal (VP) port open, resulting in a greater degree of nasal resonance. For non-nasal sounds, the VP port ideally remains closed in order to keep nasal resonance minimal. Nasalization of vowels adjacent to nasal sounds occurs naturally, resulting from partial VP port opening during the articulation of such vowels. There is natural variation in the level of VP port opening between speakers, which may cause the perception of greater nasality from some speakers than others. Greater nasality of certain dialects is also remarked upon by speakers. Some such dialects are affected by a vowel shift affecting the height of the first formant (F1), especially in /Å¦/ (Labov et al 2006). Acoustic correlates of nasalization include modulation of F1 bandwidth and amplitude (Chen 1997), suggesting that listeners perceive these dialects as more nasal than others due to differences in F1. This study investigates the connections between speaker nasal resonance and perception of nasalized vowels while controlling for dialectal variation. The study explores whether a â€˜tolerance effectâ€™ for nasality exists. If speakers with a higher degree of nasal resonance are shown to perceive the same nasalized stimulus as less nasal than speakers with lower degrees of nasal resonance, this would support the notion of tolerance. A recent study (de Boer & Bressmann, 2017) suggests that speakers to some degree perceive nasality in their own speech and make simultaneous articulatory adjustments based on auditory feedback. The projectâ€™s experiment comprises 1) a linguistic background interview, 2) a measurement of speaker nasal resonance using nasometry, 3) and rating of nasality in synthesized speech clips acoustically manipulated to simulate varying degrees of nasalization, rated via direct magnitude estimation with modulus. Preliminary results showed no appreciable overall effect of tolerance of nasality. This study is still in progress, and will be completed in spring 2018. Further findings and implications will be presented.
Research Project Title: Facilitative language techniques and neurocognitive development in preschool children with and without prelingual hearing loss

Student Presenter: Maria Zulliger

Faculty Mentor: Irina Castellanos

Faculty Mentor Department: Otolaryngology

Research Abstract: Prelingual hearing loss and delayed access to spoken language place some deaf children with cochlear implants (CIs) at an elevated risk for delays in specific domains of neurocognitive functioning. The current study investigated the effect of prelingual hearing loss on the relationship between motherâ€™s linguistic input and childrenâ€™s neurocognitive (language and executive functioning, EF) skills. Two groups of preschoolers (aged 3-6 years) with and without prelingual hearing loss and their normal hearing (NH) mothers participated. Mother-child dyads participated in a 5-minute free-play session with age-appropriate toys in a laboratory setting. Maternal linguistic input was categorized as employing lower-level (imitation, closed-ended questions, linguistic mapping, directive, and comments) or higher-level (parallel talk, open-ended questions, expansion, and recast) facilitative language techniques (FLTs).

Additionally, mothers completed the Learning, Executive, and Attention Functioning-Preschool (LEAF-P) scale, which assesses everyday EF and related learning skills in children aged 3 to 6 years. The LEAF-P contains 40 items, divided into two Cognitive-Learning subscales (Comprehension and Conceptual Learning, Factual Memory) and six Cognitive-EF subscales (Attention, Processing Speed, Visual Spatial Organization, Sustained Sequential Processing, Working Memory, and Novel Problem Solving).

Although both groups of children had comparable intelligence and language skills, mothers of CI users provided significantly more linguistic input than mothers of NH children. Mothers of CI users also produced significantly more directives and closed-ended questions (comprising lower-level FLTs) than mothers of NH children. CI users, as compared to NH peers, were rated by their mothers as experiencing greater problems in the EF areas of Comprehension and Conceptual Learning, Sustained Sequential Processing, and Working Memory. Correlational analyses revealed that higher-level FLTs were associated with higher intelligence scores and higher global language skills. Additionally, higher-level FLTs were associated with fewer parent-reported problems with Comprehension and Conceptual Learning, Visual Spatial Organization, and Novel Problem Solving. The findings suggest that mothers who employ higher-level FLTs during play scaffold childrenâ€™s language and EF skills. This is the first study to demonstrate that maternal FLTs are associated with preschool childrenâ€™s EF skills. These findings may provide an avenue for early, individualized clinical intervention for improving EF skills in prelingually deaf CI users.
Research Project Title: Preschoolers' false belief understanding, story comprehension, and inference production

Student Presenter: Michael Blosser

Faculty Mentor: Tompkins No

Faculty Mentor Department: Virginia

Research Abstract: Previous research suggests that theory of mind (i.e., the ability to understand our own and other’s mental states) predicts reading comprehension among children in grade school. Our study investigated the possible connection between theory of mind and narrative comprehension in preschoolers. This relation is important to examine in the preschool years because there is continuity between children’s narrative comprehension and later reading comprehension. Thus, understanding the earlier precursors to reading comprehension is important for understanding the underlying mechanisms of reading development, and also for its potential as an intervention tool. In this study, we examined the relations among false belief understanding and two aspects of narrative comprehension—story comprehension and inference production—across a six-month time period. Participants included 52 3- to 5-year-olds (M = 4.42 years); 83% were Caucasian, 50% were female, and most were middle to middle-upper class. Children were tested twice, six months apart, on false belief understanding and narrative comprehension. False belief understanding assesses the child’s understanding that a belief can differ from reality (e.g., a character will think there are crayons in a box that the child knows to contain ribbons). The story comprehension assessment consisted of ten questions (five implicit, e.g., causal inference and five explicit, e.g., setting). The inference production tasks consisted of children narrating a wordless book; spontaneous inferences made by the child were coded (e.g., emotional states, goals). Children’s receptive vocabulary was also assessed as a control variable. We found that children’s false belief understanding and story comprehension were significantly related controlling for child age and vocabulary within time points and across the six months. We have coded the inference production task and results are soon to be analyzed. We expect that children’s ability to make accurate inferences about a story will also significantly relate to false belief and story comprehension. This study is novel in its focus on pre-readers and on children’s production, not just comprehension, of stories. It suggests that the comprehension-theory of mind link occurs earlier in development than previously studied and suggests possible new avenues for early literacy intervention work.
Research Project Title: Effects of hacking an unmanned aerial vehicle connected to the cloud

Student Presenter: Meghan Booker

Faculty Mentor: Abhishek Gupta

Faculty Mentor Department: Electrical and Computer Engineering

Research Abstract: Control systems with commercial and even military applications are utilizing more networked technologies to perform tasks associated with navigation and communication. Increasingly, these systems are experiencing cyber-attacks due to the interconnections with the internet and interoperability protocols. Current research focuses on improving performance of a control system or improving cryptography methods separately; however, there is a need to understand the joint design of control and cyber-security methods in order to combat the growing cyber-attacks on these systems. Here, we seek to begin bridging this gap by determining how commonly employed cyber-attacks impact the performance criteria of control systems so that future research can aim for strong joint design.

For this work, the control system of choice is the Parrot AR.Drone 2.0, which is a quadrotor unmanned aerial vehicle (UAV). The UAV sends various navigation-related sensor data such as sonar and camera data to the cloud to determine a control command to be executed by the UAV. There, we simulate an attacker and leverage ARP spoofing to create a Man in the Middle (MitM) attack. This allows the attacker to read the data streaming in and out of the cloud and manipulate it. To understand the effects of this attacker, we ran simulation and experimental tests using ROS and Gazebo. These tests manipulated sonar height data and velocities sent back to the UAV, which was tasked with locating and landing on a target tag autonomously. Performance metrics such as linear velocities, location, delays, and end state are analyzed for the tests and compared to a UAV not under attack. The analysis of the results highlights the weaknesses in this networked setup along with degree of damage and disruption this type of cyber-attack can impose on a UAV.
Research Project Title: Mapping fentanyl overdose fatalities in Franklin County, Ohio from 01/01/2016-06/30/2017

Student Presenter: Cristin Day

Faculty Mentor: Julie Field

Faculty Mentor Department: Anthropology

Research Abstract: Synthetic opioids such as fentanyl have significantly increased overdose deaths on a national, state and local scale in recent years. This research project examines the disturbing impact and escalation of synthetic opioid overdoses in Central Ohio. In an effort to spatially and temporally contextualize the US opioid epidemic on a local scale, overdose deaths in Franklin County from 01/01/2016 to 06/30/2017 were spatially mapped using the geographic information systems software ArcGIS. Synthetic opioid deaths increased 579% from the first half of 2016 compared to the first half of 2017 in Franklin County, with south, southeastern and eastern zip codes most heavily affected. By visualizing the synthetic opioid crisis in Columbus, this project hopes to facilitate positive community dialogue to prevent future deaths and reduce stigmatization of people struggling with addiction in our community.
Research Project Title: Video frame interpolation

Student Presenter: Chuhan Feng

Faculty Mentor: James Davis

Faculty Mentor Department: CSE

Research Abstract: For my thesis project, I intend to work on a challenging computer vision problem, video frame interpolation, with a goal of achieving state-of-the-art performance on this task. Video frame interpolation is a classic computer vision problem that aims at increasing the number of frames per second of a video sequence to obtain a smoother higher-framerate video. The interpolation is done by inferring the middle states between each pair of successive video frames.

My research will be built on the top of previous works that are approached with the Convolutional Neural Networks (CNN) and the Adaptive Convolution (AC) technique. The research will be conducted from the perspective of improving the interpolation result by using wider input window. This is inspired by the success of the Long Short-Term Memory (LSTM) networks in the field of sequential data prediction. By taking advantage of the temporal pattern recognition power of the LSTM model, the quality of the interpolation results under large object displacement and complex motion pattern are expected to be improved comparing to the existing models.

This research project is still under its middle stage. There are still some works left to be done before getting expected results. The initial results are expected to come out later this semester.
Research Project Title: Investigation of reciprocity in the millimeter wave channel

Student Presenter: Ahmed Almostafa Gashgash

Faculty Mentor: Can Emre Koksal

Faculty Mentor Department: ECE

Research Abstract: The millimeter wave (mmWave) band of frequencies between 30 and 300 GHz is expected to host the next generation of wireless cellular networks. As the demand for mobile data and cellular capacity increases, current cellular systems, based on microwave frequencies, are running out of available spectrum. It is expected that by the year 2020, some operators would face demand of about 130 x 1018 bits of data per year. A task that is unrealistic for today’s cellular technology. However, bandwidth availability is much wider in the mmWave bands, and the available spectrum can be 200 times larger than all cellular allocations today. For this reason, researchers and engineers have started to believe that mmWave will play a significant role in 5G cellular systems. Despite the potential of mmWave systems, there are a number of key challenges to be overcome. The main challenges of our concern in this project, are due to the characteristics of the mmWave channel. Since these waves operate at a high frequency, their wavelengths are of shorter length, making it susceptible to attenuation, severe shadowing, rapid channel fluctuations, and intermittent connectivity. Based on these aspects, we assume and set to prove that the mmWave channel is non-reciprocal. We model the mmWave channel, test for reciprocity and analyze the collected data.
Research Project Title: Developing a mathematical model for the opioid epidemic in Columbus, Ohio

Student Presenter: Ashley Dundon

Faculty Mentor: Ayaz Hyder

Faculty Mentor Department: Environmental Health Sciences

Research Abstract: The opioid epidemic is pervasive across the United States and, in particular, the state of Ohio. Though the state of Ohio has put forth recovery programs, overdoses continue to occur and increase. In order to combat this epidemic, it is important to understand the dynamics between overdose and recovery efforts put forth by the government and community. A mathematical model was developed to simulate these dynamics using data acquired from City of Columbus Public Health. Using this model, parameters affecting the numbers of susceptible, overdosing, and recovering individuals in Columbus were determined. It is hypothesized that by adjusting these parameters, the epidemic could be shortened and the severity could be lessened. This model could also give emergency personnel information about when overdoses are most likely to occur and how many people are likely to overdose. Because the opioid epidemic is ubiquitous throughout all levels of society and is a widespread issue, adequate resources are not always available. This model could provide information that would allow for a more strategic and effective allocation of resources across communities. Though the opioid epidemic is a continuing problem, steps can be taken to reduce its impact. By identifying and understanding factors that influence the dynamics between overdose and recovery, more effective actions can be taken to mitigate the effects of the epidemic on the community.
Research Project Title: Lithium ion battery data management and analysis

Student Presenter: Frank Ferrato

Faculty Mentor: Jung-Hyun Kim

Faculty Mentor Department: Mechanical Engineering

Research Abstract: There has been growing research and development (R&D) efforts on electrochemical energy storage/conversion devices that are crucial power sources for everyday electronics and transportation (e.g., electric vehicles). To support this energy-related R&D, researchers heavily rely on electrochemical testing cyclers that is capable of measuring electrochemical performances of multiple cells simultaneously following automated schedules. The electrochemical testing cycler produces raw data from the cells, and individual researchers often reduce, process, and analyze the raw data in many different manners to satisfy their specific interests. Although commercial software is provided together with the cycler for the data analysis purpose, it is usually not customizable and has lack of optimization for processing the raw data. Each raw data consists of tens of thousands data points collected over several months, and one research group handles numerous cell data (few hundreds or thousands) simultaneously. Thus, these raw data is considered as Big Data and requires significant efforts to process and analyzing it. In this regard, my research objective is designing and programming the customized software that can significantly improve the efficiency and quality of such electrochemical data analysis. We have purchased the electrochemical testing cycler from Arbin System, which produces data in SQL databases and should allow for faster data processing. An understanding of this data format will allow for ease of access in MATLAB by creating a connection between the database and the MATLAB Graphic User Interface. Therefore, based on understanding the SQL data format, I will create an open-source program that is user friendly and capable of analyzing the data in many different ways to support diverse R&D applications. The beta version of software will be tested throughout the real electrochemical data collected in our Lab, in order to optimize and debug the software. This program should also be customizable for different types of R&D. I will discuss about the testing results and analytical capability of the software through the presentation. In addition, the outcome of this project will be an opensource program available online and shared to many universities at different countries.
Research Project Title: Developing a test bench for NASA's next generation bistatic reflectometry receiver instrument

Student Presenter: Ryan Linnabary

Faculty Mentor: Andrew O'Brien

Faculty Mentor Department: Electrical and Computer Engineering

Research Abstract: Since the early 2000's, scientists have exploited navigational (GNSS) satellite signals for geophysical remote sensing using "reflectometry". An airborne or spaceborne reflectometry receiver observes direct and reflected GNSS satellite signals, enabling scientists to infer properties of Earth’s scattering surface at the reflection point. NASA launched a constellation of eight micro-satellites (called CYGNSS) for this purpose in December of 2016. CYGNSS tracks GPS signals to measure ocean wind-speeds for hurricane forecasting. GPS signals have unique features which allow CYGNSS to out-perform traditional remote-sensing techniques in speed, cost, and spatial coverage. Researchers at Ohio State were involved in the Science Team and testing of first generation CYGNSS receivers and the success of the project so far has motivated a potential follow-on mission, as researchers are identifying opportunities for improvement. An improved receiver should be capable of tracking more than the GPS L1 C/A-coded signal to increase the number of visible reflections. The current test-bench could not simulate other GNSS bands, could not generate long-duration signals, and did not incorporate GNSS meta-data or navigational messages. The purpose of this project is to improve the quality of the test bench hardware and software used to test GNSS-R instruments and add support for the new instrument's enhanced features. In this work we have modified the program for parallel assembly of output files, support for the L1, L5, E1bc, and E5a bands, and incorporation of actual satellite meta-data including navigational messages and realistic timing information. An interface to the software-defined radios was written to facilitate playback. The test signals have been analyzed in MATLAB and each was successfully output from a software-defined radio. As of January, 2018, the following tasks remain incomplete: an upgrade of storage media is needed for a full 24-hour playback; full analysis of space-vehicle dynamics is required; and design and completion of the test procedure will conclude project requirements. This system should enable the development team to characterize through tests how well the improved instrument will process such signals in space. It may allow NASA to address any problems with the new receiver instrument before their future space deployment.
Research Project Title: Canonical height on elliptic curves

Student Presenter: Adrian Neff

Faculty Mentor: Ghaith Hiary

Faculty Mentor Department: Mathematics

Research Abstract: In 1978, Serge Lang conjectured a lower bound for the canonical height of points on elliptic curves defined over the field of rational numbers. He conjectured this bound in terms of the logarithm of the discriminant of the curve. Since then, there has been much work on proving a lower bound for the canonical height, and this conjecture has been generalized to number fields, instead of just the rational numbers. In this project, we computationally test a modern form of Lang’s conjecture on a certain family of curves over the rational numbers with a shared rational point. In our verification, a trend arose in the growth of the height of the rational point in question, which has led to a conjectured formula for the height of this point. This formula depends on the coefficients of the curve and the value of the coefficients modulo 4. A similar trend arose in the growth of the height of a shared point on other families of curves, and how the height of the point grows seems to be related to the prime factorization of a coefficient of the curve. This points to the possibility of a conjectural formula for the height of the shared point on each of these families of curves.
Research Project Title: How practical is the Pollard-Strassen Method?

Student Presenter: Xinyi Zeng

Faculty Mentor: Ghaith Hiary

Faculty Mentor Department: Dept. of Mathematics

Research Abstract: The Pollard-Strassen Method is an integer factorization algorithm. It is a deterministic and proven method that terminates in about $O(n^{1/4}(\ln(\ln n))^2)$ steps, where $n$ is the integer being factored. This method requires high-precision fast Fourier transform for integer multiplication. However, its critics argue that it is less efficient in practice and requires large memory space compared to other integer factorization algorithms. We implemented the Pollard-Strassen Method using C++ programming and GNU MP Library, and tested its running time. It turns out to be the most efficient algorithm among all deterministic algorithms for integer factorization, and took less than 2 hours to factorize a 40-digit number but trial division may take several months.
Research Project Title: Monte Carlo tree search evaluation in imperfect information environments through euchre

Student Presenter: Matias Grioni

Faculty Mentor: Marie-Catherine de Marneffe

Faculty Mentor Department: Linguistics

Research Abstract: Artificial intelligence agents for games such as chess and go have seen tremendous success in the past few years using an algorithm called Monte Carlo tree search (MCTS). MCTS's success in various applications has been seen as a step toward a general form of artificial intelligence; however, a substantial amount of the work for MCTS has been done in perfect information games, where there is no hidden information. In chess, for example, the positions of all pieces are known by both players. Nonetheless, a general form of artificial intelligence must perform well in both perfect and imperfect information domains. This project seeks to evaluate MCTS's performance in an imperfect information environment, the card game Euchre. Euchre is a valuable environment to test MCTS due to its various sources of uncertainty. There is uncertainty in the cards an opponent has and in how one's own partner will play. Success in Euchre would support MCTS's ability to generalize to imperfect knowledge environments, and support its promise as a step toward general artificial intelligence. This research creates a MCTS library modified to support imperfect information environments, and evaluates MCTS's performance against a rule based algorithm and a baseline that randomly selects a valid action from those available. Results show that the modified MCTS algorithm outperforms the rule based algorithm and random baseline, achieving an optimal outcome nearly 10% more often than the rule based approach. The MCTS algorithm was only given the rules of Euchre and no Euchre based heuristics or optimization to guide its search. This supports the fact that even a basic, unoptimized MCTS algorithm is generalizable to both perfect and imperfect information domains.
Research Project Title: Smartphone-based intelligent system: Using AI and motion sensors for real-time intervention during heavy alcohol consumption events

Student Presenter: Jackson Killian

Faculty Mentor: Passino Kevin

Faculty Mentor Department: ECE

Research Abstract: Introduction

Excessive alcohol consumption is an avoidable health risk, yet it causes a significant percentage of yearly deaths and injuries on college campuses. Recent work showed that weekly mobile-based interventions can effectively reduce alcohol consumption in students. However, few studies investigate delivering mobile interventions in real-time during drinking events where interventions could reduce risks like drunk driving, alcohol poisoning, and violence. Such studies require measuring real-time intoxication levels outside of a lab setting at scale. Some technologies exist for this purpose but are impractical or expensive. To address these shortcomings, I built an intelligent system to passively track smartphone accelerometer data to identify heavy drinking events in real time on a mobile device.

Methods

I collected smartphone accelerometer readings and transdermal alcohol content (TAC) readings from 19 subjects participating in an alcohol consumption field study. The TAC readings served as the ground-truth when training the system to make classifications. The TAC sensors and smartphone accelerometers both provided noisy readings which I cleaned with the MATLAB signal processing toolbox. I then mined walking events from the cleaned accelerometer readings by identifying windows of data with frequencies near 2Hz (average human walking frequency). Next, I developed an algorithm to extract from these windows features known to change when humans lose control of their center-of-mass (i.e. become intoxicated). Finally, I built and trained an MLP network to classify each window as a “sober walk” or “intoxicated walk.”

Results

The system currently identifies a subject’s sobriety with 65% accuracy. Promisingly, the result suggests that one aspect of motion data alone (center-of-mass) has significant classification power. I will now improve the system by including techniques from advanced studies analyzing the human gait as well as upgrading the windowing method to account for additional smartphone placements (jacket, purse, etc.).

Conclusions

By introducing a free, reliable, and widely adoptable application that tracks intoxication in real-time, I will enable development of effective real-time mobile-based interventions which can later be delivered via the application to reduce unnecessary alcohol-related injury and death. The results and application will also benefit future studies as new sensor-bearing technologies become widely adopted.
Research Project Title: Chorus: coordinating data across multi-device data visualizations

Student Presenter: Stephen Wu

Faculty Mentor: Arnab Nandi

Faculty Mentor Department: Computer Science Engineering

Research Abstract: Recent proliferation of touch devices and external displays has promoted new methods for exploring and displaying data. Despite this, few open-source generic solutions exist to promote real-time collaboration of this data in a browser environment. Chorus presents a novel method of using web sockets to create chatrooms for data, coordinating data through sockets across multiple devices, indifferent to the type of device utilized. Each device, monitor, or projector serves as a node in this network of chatrooms. Each chatroom allows each node to interact with the Main display, which is dispersed to each node upon a Push. Creating a shared source of Main data, Chorus also allows each user to disconnect and enter an Auxiliary display, disconnecting from the Main server and pushing their updates when desired. Typical multi-device data software uses expensive and specialized queries to a database from each individual client; Chorus improves upon that by re-using shared data and allowing for shared rooms, coordinating individual actions and changes through the network. The use-cases for Chorus include classrooms, workplaces, and essentially anywhere that two devices may desire to have shared data sources and actions. Chorus was demonstrated with the JavaScript libraries D3, Crossfilter, Leaflet, React, and MIDI, demonstrating a wide array of use-cases for real-time data coordination, including data visualization of spatiotemporal fleet data, collaborative musical keyboard notes, and a typical flight data dashboard.
Research Project Title: Invariants for tricolorable knots & links

Student Presenter: Will Hoffer

Faculty Mentor: Chmutov

Faculty Mentor Department: Sergei

Research Abstract: The foundational problem in knot theory here investigated is generating knot and link invariants which identify diagrams that differ by finite sequences of Reidemeister moves. This work establishes a new class of invariants concerning tricolorable knots and links, both classical and virtual.

A knot or link diagram admits a nontrivial tricoloring when exactly three colors are utilized in the tricoloring and every crossing contains either three colors or one color. (Trivial tricolorings would only yield an invariant that behaves the same as the Jones polynomial.) To construct this invariant for a specific diagram, the colors are designated a number (0, 1, or 2), and the diagram is given an orientation. Crossings are designated into six classifications based on the arrangement of colors and orientation. The crossing may be positive or negative in the usual sense, and then there are three possible color configurations concerning the understrand counterclockwise from the outward portion of the overstrand.

Next, a system of Skein relations defines how a crossing of the diagram is split, with coefficients dependent on the crossing types. Similar to the Kaufman bracket, a polynomial is obtained by summing over all the possible states with weight given by the product of the appropriate splitting coefficients. An overall factor multiplied by this sum gives the final polynomial associated to the diagram. The research outlines the specific choices for the variables present in the polynomial which yield invariance under all three Reidemeister moves. The generality in the result permits the choice of multiple different invariants, e.g. the coefficients may take values in a Galois field represented by a polynomial quotient ring. Appropriate choices for the coefficients ease computations and distinguish knots that other invariants cannot tell apart.

One last element is required to make the above process yield a formal knot/link invariant. The ambiguity in choosing an orientation and colors may be subsumed by taking the invariant to be the set of the polynomials obtained from each of the different diagrams after orientation and the tricolor labelling.
Research Project Title: Weierstrass points on tropical curves

Student Presenter: Nik Henderson

Faculty Mentor: Chmutov No

Faculty Mentor Department: Sergei

Research Abstract: Background:

On a tropical curve (a metric graph with unbounded edges), one may introduce the so-called "chip-firing game." Given a configuration of chips on the tropical curve, with possibly negative numbers of chips, one may determine whether it is possible, through a set of approved "moves," to reach a configuration in which every point on the tropical curve has a nonnegative number of chips. More formally, we may determine which divisors on the curve are linearly equivalent to effective divisors. We may restrict our attention to starting configurations which have a large number of chips on a single point and some negative chips placed elsewhere in the tropical curve. It turns out that there is a meaningful way to measure how good a given point is at distributing its chips around the curve; points which have a special affinity for this are called Weierstrass points. We wish to determine the topological properties of the set of Weierstrass points, namely whether there are finitely many connected components, whether the set of all Weierstrass points is closed, and whether non-smooth Weierstrass points on a bridgeless graph are isolated.

Methods:

We employed the notion of reduced divisors as well as placing a cell structure on the linear system for a given divisor (often the canonical divisor) on a tropical curve. Since a map on the linear system known as "Red" is continuous with respect to this topology, we rephrased the problem by creating a metric on the linear system which induced the same topology.

Results:

We used the continuity of the Red map to prove that the set of Weierstrass points is closed. We believe we can also exploit further structure of the Red map to show that the set of Weierstrass points has finitely many connected components.

Conclusions:

The set of Weierstrass points on a tropical curve is likely never as pathological as one may worry. Indeed, these results suggest that it could consist only of finitely many closed intervals.
Research Project Title: Crossroads: spatiotemporal data exploration

Student Presenter: Trey Hakanson

Faculty Mentor: Nandi No

Faculty Mentor Department: Arnab

Research Abstract: As the availability of computing resources increases and the ease of generating spatiotemporal data decreases, the interface a person uses to interact with said data quickly becomes the bottleneck in determining insights. In addition, the barrier to entry for analyzing data via database queries has not improved much since SQL was invented. An interface that supports intuitive gestures to constrain queries and that has real time feedback is necessary to make gathering insights from large data sets accessible to anyone, technical or otherwise.

To solve this problem, we created an interactive visualization tool that is compatible with any movement data set, which we define as having timestamped departure and arrival coordinates. This tool has a multitude of features to facilitate garnering insights from spatiotemporal data sets: the data is displayed in multiple formats and in aggregate, visualizations update real time with changes to constraints, user-uploaded data sets are joined and displayed as overlays, and time-lapses/snapshots can be created to highlight trends.

The visualization tool provides the user with a variety of constraining options, all of which can be used together to effortlessly ask complex questions about the data at hand. After applying the constraints, a heatmap of the results is generated real time. The heatmap shows densities and differences in arrival and departure concentrations. Available constraints include: time of day for departure and arrival, subsetting a range of dates, specifying days of the week, trip distance, trip time, drawing geofences to designate areas of interest for departure and arrival, and more. All constraints are supplied via simple UI widgets, such as sliders, toggles, etc. Animations are also able to be generated, allowing for the visualization of flows across changing query sets. These animations are available for download as well, to facilitate easy sharing of novel results.
Research Project Title: Power optimization of livestock farms

Student Presenter: Logan Morris

Faculty Mentor: Illindala No

Faculty Mentor Department: Mahesh

Research Abstract: My name is Logan Morris, a third year electrical and computer engineering major at Ohio State. I was fortunate enough to participate in research under ECE professor Dr. Mahesh Illindala this last year in his energy optimization project of Ohio agricultural livestock farms. The farmers have many different types of power electronics they use to insure the safety, quality and productivity of their farms. When these power electronics are used simultaneously, the farmer can experience massive spikes in the energy they pull from the grid. If too much energy is pulled at any one point in time, farmers can be unfairly charged at a much higher rate for the energy bill for the entire month. The team combated this issue by attaching sensors to different types of farm equipment, then determine when and where these energy peaks are occuring. When the problem areas were located, the team asked the farmer to make adjustments in their daily routine, add lower cost equipment or modify equipment already present. This in turn results in a much lower cost of operation for the farm. This can then be scaled to many other farms in Ohio, hopefully resulting in much more profitable livestock farms.
Research Project Title: Analysis of persistent colonies of methicillin resistant Staphylococcus aureus biofilm after long term antibiotic treatment

Student Presenter: Jacob Brooks

Faculty Mentor: Paul Stoodley

Faculty Mentor Department: Joint appointments in the Departments of Microbial Infection & Immunity and Orthopaedics

Research Abstract: This project incorporates the comparison and analysis of persistent cells in response to various antibiotics (either single or in dual combination) on Staphylococcus aureus lawn biofilms by examination of zone of inhibition (ZOI). Persistent colonies—slow growing, multi-antibiotic tolerant forms of bacteria, were studied to improve the understanding of chronic biofilm infections. Calcium sulfate hemihydrate beads are often infused with antibiotics in an effort to prevent further infection after revision of an infected arthroplasty. In previous studies, it has been shown that antibiotics such as tobramycin and vancomycin impede metabolic activity of lawn biofilm; yet, after long periods of antibiotic diffusion, even with concentrations well above the minimum inhibitory concentration (MIC), persistent colonies may slowly arise with the ability to grow and form biofilms. A lawn biofilm of methicillin resistant S. aureus SAP231 (MRSA-USA300-NRS384 strain), a pathogen responsible for many surgical site infections, was grown on a plate for 24 hours, followed by the placement of an antibiotic infused calcium sulfate bead, to determine if a zone of complete killing (ZOK) could be obtained. SAP231 is a bio-engineered, bioluminescent strain that was used to track the suppression of metabolic activity through in vivo image analysis technique (IVIS). Various antibiotics (vancomycin, tobramycin, ciprofloxacin, gentamycin, rifampicin), were investigated for persister cell generation through the measurement of ZOI over time. Replica plating after nine days allowed for the quantification of remaining viable bacteria. This system was used to distinguish persistent cultures from resistant mutants. Colonies were tallied and plotted to determine killing of antibiotic on a log scale. Antibiotics in dual combination produced fewer persistent colonies than their respective counterparts. Specifically, the combination of ciprofloxacin and rifampicin formed the largest ZOI and seemed to eradicate all possible bacteria. Conversely, tobramycin and gentamycin, both belonging to the aminoglycoside class of antibiotics, produced rings of persistent colonies, and consequently, a smaller ZOI. This series of experiments targeted possible combination of antibiotics that can lower surgical site infections in total joint arthroplasties, as well as decrease the chances of biofilms, which are associated with significant morbidity and mortality.
Research Project Title: Comparative analysis of Salmonella enterica serovar Typhi isolates from acute and chronic infections

Student Presenter: Bradley Eichar

Faculty Mentor: John Gunn

Faculty Mentor Department: Microbial Infection and Immunity

Research Abstract: Salmonella enterica serovar Typhi (S. Typhi) is the causative agent of typhoid fever—a human-specific disease that results in approximately 200,000 deaths each year. With appropriate treatment, most patients recover from the acute stage of the disease. However, 3-5% of S. Typhi infections lead to a chronic infection and asymptomatic colonization in the host gallbladder allowing carriers to unknowingly infect others despite no outward signs of illness. While it is known that S. Typhi mediates carriage through the formation of biofilms on the surface of cholesterol gallstones in the gallbladder, molecular mechanisms for chronic S. Typhi carriage are not well understood. This project compared genetic, molecular, and functional characteristics of 22 different S. Typhi isolates from confirmed acute and chronic infections, hypothesizing that the components necessary to mediate chronic carriage in the gallbladder may vary and be unique from acute clinical isolates. Biofilms of the isolates were examined utilizing a crystal violet quantification assay, a tetrazolium salt (XTT) reduction assay, and confocal microscopy. The presence and relative abundance of Vi-antigen and lipopolysaccharide (LPS) were confirmed using dot blot assays with specific anti-Vi-antigen and anti-LPS antibodies and subsequent densitometric analysis. Additionally, immunofluorescent microscopy was used to evaluate Vi-antigen and LPS expression. The presence of cellulose was detected quantitatively via a microtiter-based calcofluor binding assay. Finally, the genome-sequence as well as pulsed-field gel electrophoresis (PFGE) patterns of all strains were determined. PFGE and the sequencing data informed phylogenetic relatedness determinations of the strains. Biofilm and extracellular matrix (cellulose, Vi-antigen, and LPS) expression studies revealed unexpected high variability between the S. Typhi strains. Preliminary analyses do not support the uniqueness of the chronic versus acute isolates. Additional analysis will provide a better understanding of how salmonellae enter and persist in the chronic carrier state, which may lead to targeted drug therapies to alleviate the carrier state.
Research Project Title: Mitigation of Pseudomonas aeruginosa virulence factors by novel kinase inhibitors

Student Presenter: Anthony English

Faculty Mentor: Daniel Wozniak

Faculty Mentor Department: Microbial Infection and Immunity

Research Abstract: Psuedomonas aeruginosa (P.a.) is a Gram-negative opportunistic bacterium that causes serious acute and chronic nosocomial infections. The ability to fight bacterial infections, as such, is a growing concern in the world of medicine. With most antibiotics becoming ineffective against a mass of antibiotic resistant variants, controlling bacterial pathogenesis is crucial. We have put focus toward bacteriostatic alternatives that have shown reduction in both attachment and biofilm formation. Mitigation of these virulence factors could lead to a stronger immune response, thus helping to eliminate bacterial infections. A bank of 3000 kinase inhibitors (a type of drug primarily used in cancer treatment) was screened and of those, 5 molecules demonstrated efficacy above 50%. These inhibitors have been screened and have shown no inhibitory effects against bacterial growth. However, two of these candidates have shown reduction in attachment against a lab strain of P.a., as well as three clinical isolates. The other 3 candidates have indicated some degree of biofilm disruption capabilities and will be tested further.
Research Project Title: Identifying genes important for bacterial biofilm formation

Student Presenter: Nikolas Grotewold

Faculty Mentor: Daniel Wozniak

Faculty Mentor Department: Microbiology

Research Abstract: Introduction: Surface-bound bacteria in matrix-coated aggregates, called biofilms, are up to 1,000 times more resistant to antibiotics than planktonic cells (Rasmussen 2006). Rather than attempting to create new antibiotic treatments, disrupting biofilms would allow for a more effective way to use already existing ones. The formation and survival of a biofilm is paramount on having a strong initial cell-surface attachment by way of exo-polysaccharides (Palmer 2017). We hypothesize that interrupting bacterial attachment to surfaces will reduce disease burden.

Methods: Pseudomonas aeruginosa is a model organism in biofilm research due to its proficiency forming biofilms, its mechanisms for antibiotic resistance, and its medical impact in chronic infections. RNA sequence was performed to observe gene regulation upon surface contact within the first hour of biofilm formation. Rapid attachment assays narrowed down the list of regulated genes by seeing the degree of difference of biofilm formation. Clean deletions remove a gene from the organism and ability of biofilm formation can be observed when the gene is not present.

Results: RNA sequence results of cells attached within the first hour showed that 437 genes were regulated upon surface contact in the initial attachment phase of biofilm formation. Transposon mutants of these genes were screened for attachment to polyvinyl chloride. Of the 437 mutants of surface-regulated genes, 36% exhibit enhanced attachment and 15% have an attachment defect compared to the parental strain, PAO1. Mutants will be prioritized by the magnitude of attachment alteration and clean deletion mutants will be generated of the 20 highest priority genes. Future work will test the biofilm formation of clean deletion mutants.

Conclusions: Identification of essential genes for biofilm formation will facilitate the development of treatments specifically preventing biofilms.
Research Project Title: PmrA-regulated sRNAs and their effect on the pathogenicity of Francisella

Student Presenter: Victoria Kocsuta

Faculty Mentor: John Gunn

Faculty Mentor Department: Microbial Infection and Immunity

Research Abstract: Francisella tularensis is a Gram-negative, nonmotile, intracellular pathogen that is the causative agent of tularemia. Because of its virulence properties and ease of dissemination, F. tularensis is classified as a tier 1 (Class A) bioterrorism agent by the CDC. F. tularensis is classified by several subspecies that include tulanensis, holarctica, mediasiatica, and novicida. While most bacterial species contain many regulators including two-component systems (TCS) that regulate gene expression via a sensor kinase and a cytoplasmic response regulator, Francisella encodes a dearth of regulatory elements and lacks any classic TCS. However, PmrA is an orphan response regulator in F. tularensis that directly regulates the Francisella Pathogenicity Island (FPI) and affects intramacrophage growth and survival. Small RNAs (sRNAs) are important regulators of gene expression and protein production in prokaryotes and eukaryotes, and are also believed to play a role in gene expression in Francisella, especially given the lack of protein regulatory factors. The purpose of this study is to explore the role of sRNAs in regulating the virulence of Francisella, focusing on those regulated by PmrA. RNAseq was performed to identify sRNAs in F. novicida and an isogenic pmrA mutant. This data was used in conjunction with IntaRNA software to identify potential targets of the sRNAs. The first prioritized sRNAs were 539 and 543; however, intramacrophage survival and mouse virulence assays with mutants or overexpression strains showed no significant defects. Similar experiments are being performed on additional sRNAs from the IntaRNA-based priority list. This work will lead to a better understanding of how this bioterror agent responds to its environment and could lead to new therapeutic strategies to limit infection by F. tulanensis.
Research Project Title: Defining the physiological changes occurring during biofilm formation in the filamentous fungus Aspergillus nidulans.

Student Presenter: Dale Lingo

Faculty Mentor: Stephen Osmani

Faculty Mentor Department: Molecular Genetics

Research Abstract: Fungi generate multi-layered biofilms resulting in gradients of cell crowding and oxygen concentration. Biofilm formation contributes to fungal persistence and drug resistance during infection. A recent study in our lab using the model filamentous fungus Aspergillus nidulans has revealed that the initiator cells at the base of a forming biofilm disassemble their microtubules (MTs). Notably, in the absence of the transcription factor SrbA that mediates adaptation to hypoxia, cells fail to depolymerize their MTs indicating that MT-disassembly in forming biofilms occurs as part of a regulated response to hypoxia. Additionally, we found that treatment of growing cells with hydrogen sulfide (H2S) mimics biofilm-mediated MT-disassembly. If MT disassembly is the sole cell biological modification occurring in fungal biofilms remains to be addressed.

The focus of my project is to investigate if other physiological changes occur in fungal cells as they form a biofilm beyond MT disassembly. Initial experiments indicate that the dynamics of the Golgi apparatus (GA) is also modified as cells form a biofilm. My goals are therefore to test the hypotheses that the dynamic changes in GA organization occur as a result of adaptation to hypoxia and that these alterations will be mimicked in growing cells by H2S treatment. Using spinning disk confocal microscopy, I will record time-lapse images to capture the dynamic changes in GA in wildtype cells as well as in cells lacking SrbA as they form biofilms. I will also examine the changes in GA organization in growing non-biofilm cells after treating them with H2S and whether the typical organization of GA is restored upon washing out H2S. Using genetic-crossing I have generated strains expressing fluorescently-tagged marker proteins to visualize GA in wildtype and SrbA-deleted backgrounds and I am currently imaging these strains to obtain a more thorough understanding of fungal physiology within biofilms.
Research Project Title: Unlocking a new therapeutic target of NTHI: separation of diverse binding sites is the key

Student Presenter: Nikhil Pramod

Faculty Mentor: Kevin Mason

Faculty Mentor Department: Nationwide Childrens- Center for Microbial Pathogenesis

Research Abstract: Nontypeable Haemophilus influenzae (NTHI) is a gram-negative bacteria that commonly causes respiratory tract infections including otitis media (OM). NTHI persists in the human body by resistance to host-derived antimicrobial peptides (AMPs) and import of essential heme-iron. The Sap Transporter (sensitivity to antimicrobial peptides) is the inner membrane protein complex that confers these activities. SapA, the periplasmic binding protein, binds both AMPs and heme-iron for delivery to the Sap complex and transport of these substrates into the bacterial cell. We are interested in mapping the binding sites for these two diverse substrates in SapA to ultimately design peptide inhibitors to block AMP binding without affecting virulence. Computational modeling of substrate bound SapA, utilizing the recently solved Apo crystal structure, revealed several residues that participate in binding of each substrate. Through genetic recombineering, we created specific point mutations in SapA and assessed the viability of these strains when confronted with AMPs. We found that SapA residues S290 and Y291 contribute, in part, to AMP binding, whereas S169 does not. Importantly, mutation of residue S290 decreases affinity for heme, in contrast to residues S169 and Y291. We have generated a double mutation in S290/Y291 to assess whether removal of both of these residues confers an additive affect in resistance to AMP killing. On-going work has identified an additional residue (R101) that participates in heme-binding but we predict does not recognize AMPs supporting our ability to separate the diverse binding sites. Since SapA is highly conserved across species our ability to design peptide inhibitors of the AMP binding site will support the testing of an advanced therapeutic of NTHI to assess affects on colonization and infection by NTHI.
Research Project Title: The use of traditional medicine in the treatment of malaria in immunocompromised individuals

Student Presenter: Errienna Mckenzie

Faculty Mentor: Jessie Kwiek

Faculty Mentor Department: Microbiology

Research Abstract: The practice of traditional medicine is a vital component of the culture in Tanzania. While the recent governmental regulation of the profession escalated its legitimacy, traditional healers have played a crucial role in the foundation of an integrated healthcare system. The objective of this study is to understand how healers diagnose patients and establish treatment plans, more specifically as it relates to Malaria. Historically, the derivation of chemicals from plants has led to breakthrough discoveries in the pharmaceutical field. While the natural products prescribed by the healers in Tanzania aren't tested for their medicinal qualities and instead monitored to insure they don't cause adverse effects. I hoped to learn whether there was a prevailing treatment used amongst the healers as this could point to legitimate medicinal benefits. Here we show through interviews of traditional healers there is a recurring preferred treatment for Malaria in immunocompromised individuals. During the interviews of three traditional healers from different regions of Tanzania, I learned that they confirmed their diagnosis of Malaria by evaluating the symptoms of their patients and presented a treatment plan considering the patients' demographic information. To combat the common symptoms of vomiting, diarrhea and fever, an herbal tea was prescribed. The remedy consisted of heating water and leaves from the Mvele Vele tree then straining the leaves before oral consumption. Observing the commonalities in treatment for this disease illustrates the possibility this remedy may have an actual medicinal effect since it is widely prescribed by the healers. From a small sample, it can be deduced that the usefulness of traditional healers in the treatment of immunocompromised individuals requires more in-depth research. The chemical structure of the natural products used to treat Malaria could be isolated and analyzed. This information could then be expounded upon dependent on the findings.
Research Project Title: Optimization of the isolation of RNA from antibiotic tolerant Pseudomonas aeruginosa "Phoenix"colonies

Student Presenter: Kelly Moore

Faculty Mentor: Paul Stoodley

Faculty Mentor Department: Department of Microbial Infection and Immunity, Department of Orthopaedics

Research Abstract: Pseudomonas aeruginosa is known to produce variance in isolated colonies, including classically resistant colonies and viable but non culture-able colonies (VBNCS). When an antibiotic loaded cement bead is placed into a lawn biofilm of 5 x 10^9 CFUs per cm^2, 3.23 CFUs per cm^2 of these phenotypes emerge in the zone of clearance. Of these a quarter are antibiotic tolerant but not resistant mutants because they are susceptible to antibiotics when subcultured. Further, they are actively growing, indicating that they are not dormant "persister" cells. We have termed these colonies "Phoenix" colonies. Phoenix colonies are a phenotype of Pseudomonas aeruginosa which grow up within the zone of inhibition of a bone cement bead containing 12mg/ml of tobramycin, but become susceptible after being removed and cultured. The mechanism behind phoenix colony development is unknown. Our approach to elucidate the mechanism was to use a transcriptomic analysis of the colonies. When phoenix colonies were isolated, placed in RNAlater and subsequently cultured, they exhibited the wild-type susceptibility. Due to the large proportion of resistant and VBNCs, the phoenix colonies were difficult to isolate. RNAlater was used to preserve RNA for further examination, but its influence on short term viability of bacteria which was required to retrospectively determine the antibiotic susceptibility of a colony was unknown, leading to the hypothesis that the RNAlater may affect the growth of VBNCs. The effect RNAlater had on the colonies was examined, comparing growth with RNAlater and without RNAlater and we calculated a p-value of 0.986. This suggests the RNAlater had no effect on culturability. VBNCS were produced in the absence of RNAlater. The heritability of the phenotype was also examined, and it was found that there was an increased rate of susceptible colonies in the second generation. The process of removing, culturing and plating the phoenix colonies, was repeated for three generations to examine the heritability of the phenotype, and it was found that there was an increased rate of susceptible colonies. Further study is needed to determine the complete mechanism behind phoenix colony development.
Research Project Title: Patterned electroceutical dressing clears microbial biofilms while inducing wound re-epithelialization

Student Presenter: Aurko Shaw

Faculty Mentor: Sashwati Roy

Faculty Mentor Department: Surgery

Research Abstract: Bacterial infection is a considerable threat when addressing acute and chronic wounds, and commonly aggregate to form microbial biofilms. Biofilms can have adverse effects on wound healing and are difficult to eliminate due to their antibiotic resistance from their self-excreting extra-polymeric substance (EPS) and their quorum sensing abilities. Various therapies have been explored to assist in clearance of biofilms and to restore the skin function. Previous studies in our lab have shown that weak electric fields have been able to disrupt bacterial biofilm in vivo using a FDA approved wireless electroceutical dressing (WED) with no external power supply. This study scales up this dressing by utilizing a battery-powered patterned electroceutical dressing (PED), thus creating stronger electric fields, and increasing the dressing’s ability to eliminate more aggressive biofilms. Each dressing is comprised of a biocompatible silk base with an Ag/AgCl ink pattern powered by a 6 V portable battery. The dressings were tested at three different electrical resistances at 2 kΩ, 10 kΩ, and 60 kΩ to optimize biofilm clearance without affecting the re-epithelialization of the host tissue. In vivo testing with these dressings was performed on two white Duroc pigs, with the control pig receiving no power from the battery. The pigs were subjected to six 2â€ x 2â€ burn wounds and infected with a mixed culture of clinically relevant Pseudomonas aeruginosa, Acinetobacter baumannii, and Staphylococcus aureus 3 days later (d0). Each pig received two dressings at the three different resistance values at d7, d14, and d21 time points, and were powered for 24 hours. Biopsies of the wounds were taken after the dressings were removed at d7, d14, and d21 time points. Histological data has shown that each treatment significantly improved wound closure and reduced bacterial load in comparison to the control dressings. Currently, we are testing to see how inflammatory pathways are affected at the cellular level. Additional experiments will test other biofilm forming bacteria, including antibiotic resistant bacteria.
Research Project Title: The role of oral mucosal natural killer cells (NK)/ Innate lymphoid cells (ILCs) during HIV/SIV pathogenesis and HIV/SIV associated malignancies

Student Presenter: Nicole Reinhold-Larsson

Faculty Mentor: Namal Liyanage

Faculty Mentor Department: Microbial Infection and Immunity

Research Abstract: Although the incidence of HIV has fallen in recent years, it continues to spread globally, and AIDS is the fifth leading cause of death in low-income countries. HIV infects CD4+ T cells via CD4 receptor on the surface of the cell and chemokine receptor CCR5 or CXCR4. Dendritic cells (DCs) and macrophages also play a pivotal role in HIV virus dissemination. Interestingly, we and others have shown the protective role of Natural killer cells (NK) and gut mucosal Innate lymphoid cells (ILCs) in HIV and SIV infection. Vaginal and rectal routes are the most common mode of HIV transmission. However, HIV can spread via oral route in children through breast milk in the HIV untreated mothers. Although very rare, oral-genital HIV transmissions can still occur. Furthermore, studies have shown that 70-90% of individuals infected with HIV (vaginal and rectal routes) develop oral mucosal infections such as oropharyngeal candidiasis or hairy leukoplakia. Interestingly, HIV infected patients are at higher risk of developing Epsteinâ€“Barr virus (EBV)-associated B cell malignancy. However, the potential role of oral innate immunity in pathogenesis of EBV-associated oral lesions in HIV-infected individuals is unknown. Tonsils are considered as oral-pharyngeal mucosal associated lymphoid tissues and play an important role in oral mucosal immunity. Recent studies have shown the important role of NK cell subsets in preventing B cell transformation by EBV in tonsils. Thus, we hypothesize that the loss of protective NK cell subsets in tonsils during HIV infection, could lead to increased EBV mediated B cell transformation. In this study, we explore the role of NK cells and ILCs during HIV/SIV pathogenesis, and EBV related B cell transformation. Due to limited access to the tonsils from HIV infected humans, we use tonsils collected from naïve, acute and chronically SIV infected rhesus macaques to characterize the role of NK cell and ILC subsets during infection utilizing flow cytometry. Furthermore, by using in vitro experiments we will investigate whether loss of NK cell subsets during SIV infection could lead to transformed B cells by EBV-related rhesus lymphocryptovirus (LCV) in rhesus macaquesâ€™ tonsils.
Research Project Title: Characterization of a bifunctional salvage pathway for byproducts of S-adenosylmethionine metabolism

Student Presenter: John Wildenthal

Faculty Mentor: F. Robert Tabita

Faculty Mentor Department: Microbiology

Research Abstract: S-adenosylmethionine (SAM) is a key sulfur-containing metabolite used in multiple biosynthetic processes. SAM serves as a methyl-donor for DNA, RNA, and protein methylation. SAM also functions as a source of 5â€™-deoxyadenosyl radicals for radical SAM enzymes, which catalyze a diverse family of at least 85 different biochemical reactions. This results in the formation of 5â€™-deoxyadenosine (5dAdo) as a byproduct. Lastly, SAM is also used in polyamine synthesis for cellular growth and homoserine lactone production for quorum sensing, resulting in 5â€™-methylthioadenosine (MTA) as a byproduct. These byproducts are potent substrate inhibitors of enzymes utilizing SAM, and can accumulate to toxic levels and result in the loss of valuable organic sulfur and carbon if not recycled. Recently, our lab discovered a novel salvage pathway in the photoautotrophic bacteria Rhodospirillum rubrum and Rhodopseudomonas palustris for the recycling of MTA. Herein MTA phosphorylase (MTAP), methythioribulose-1-phosphate isomerase (MTRI), and a novel class II aldolase (Ald2) sequentially convert MTA into dihydroxyacetone phosphate (DHAP) and methylthioethanol for carbon and sulfur salvage. Given the structural similarity between MTA and 5dAdo, we postulated that the same set of enzymes may also function to recycle 5dAdo into DHAP and ethanol for carbon salvage. To test this, we grew R. rubrum and R. palustris deletion strains in which MTAP, MTRI, and Ald2 were inactivated. Cell cultures were collected and analyzed by high-pressure liquid chromatography (HPLC) for the presence of 5dAdo. In both organisms growing anaerobically, inactivation of the MTAP and MTRI genes led to 5dAdo accumulation, whereas deletion of the Ald2 gene had no effect on 5dAdo levels. This shows that at least MTAP and MTRI function in 5dAdo salvage as well as MTA salvage. The role of Ald2 in 5dAdo metabolism, if any, remains unknown. Further experiments will confirm the chemical intermediates and unknown steps of this novel 5dAdo salvage pathway.
Research Project Title: The role of miR-155 on alveolar type II cellular gene expression during influenza infection

Student Presenter: Adam Bercz

Faculty Mentor: Ian Davis

Faculty Mentor Department: Veterinary Biosciences

Research Abstract: One of the most prevalent diseases in human history is influenza. Pandemics have claimed the lives of millions of people and annual epidemics continue to pose a major public health concern globally. As reported by the CDC, seasonal influenza-related illness around the world results in between 300,000-600,000 deaths every year. Commercially available antiviral compounds are limited in efficacy to treat the symptoms of influenza patients.

Investigations into host-pathogen interactions offer an alternative to current methods of combatting influenza. MicroRNAs (miRs) are non-coding nucleic acids which regulate multiple genes at a post-transcriptional level. We have shown that influenza infection induces higher levels of miR-155 expression in whole-lung cells of mice. This microRNA has been shown to regulate inflammatory processes. Furthermore, the increased abundance correlated with increased inflammatory activity in response to infection. Based on this pro-inflammatory function, we hypothesize that miR-155 plays a role in the physiological changes in the lung during influenza infection.

In healthy lung, alveolar type 2 cells (ATII) are critical in lung homeostasis. In addition to producing surfactant lipids and proteins in the lung, ATII cells are primary target of influenza viruses and express high levels of inflammatory markers upon infection. By isolating both virus-positive and virus-negative ATII cell populations from mice at multiple time points, the role of miR-155 can be observed. We used quantitative real-time PCR to determine expression levels of mir-155 and target genes. Virus-positive ATII cells express higher levels of miR-155 compared to virus-negative cells from the same lung. Angiotensin type II receptor is expressed at lower levels in virus-positive populations of ATII cells, while antiviral factors such as IFNγ receptor and NF-kB regulators are upregulated. The changes in target gene expression were also compared infected mice lacking miR-155 in ATII cells. In contrast to ATII cells from wild-type mice, the absence of miR-155 downregulates numerous target genes in virus-positive populations.

In conclusion, miR-155 influences gene expression of ATII over the course of influenza infection. The information drawn from this project may lead to investigating new targets for therapeutic agents which can mediate the host-response to more effectively treat influenza infections.
Research Project Title:

Student Presenter: John Thomas

Faculty Mentor: Howard-Varona Yes

Faculty Mentor Department: Cristina

Research Abstract: Isolation and characterization of 51 new phages for therapy against pathogenic Escherichia coli
Research Project Title: The role of the zinc finger protein ZAS3 in mammary tumor progression

Student Presenter: Alaa Al-hindi

Faculty Mentor: Lai-Chu Wu

Faculty Mentor Department: Biological Chemistry and Pharmacology

Research Abstract: Breast cancer cures are a continued topic of scientific research. The identification of genes affecting cell proliferation and tumor growth is essential to further understanding the mechanism of tumor progression. The gene ZAS3, a member of the C2H2 zinc finger family that contains an acidic-rich region and a serine-threonine rich sequence, is a candidate for affecting tumor size. ZAS3 is a transcription factor that binds to nuclear factor kappa-light-chain-enhancer motif of activated B cells (NF-κB) that activate inflammatory signal transduction pathways. ZAS3 also binds to other sites to affect production of cytokines, apoptotic proteins, cell adhesion molecules, and transcription factors. To our knowledge, there is no published data correlating ZAS3 to breast cancer. We employed the PyMT breast cancer mouse model to compare tumor size in mice with ZAS3 (wildtype, WT) or without ZAS3 (knockout, KO). Furthermore, we bred ZAS3 WT and KO mice with transgenic mice that harbor the fluorescent luciferase reporter regulated by the NF-kB motif. Mice were genotyped and selected for both PyMT and luciferase containing genes. The double transgenic mice will allow the measurement of NF-κB activity in relation to tumor growth in WT and KO mice using in-vivo imaging. Additional WT and KO mouse tumor weights will be collected at the end point of the study, and we will compare the overall tumor size and expression of specific cancer related genes between ZAS3 WT and ZAS3 KO mice.
Research Project Title: Mapping Rous sarcoma virus Gag-genomic RNA interactions via XL-SHAPE

Student Presenter: Aissatou Bah

Faculty Mentor: Karin Musier-Forsyth

Faculty Mentor Department: Department of Chemistry and Biochemistry, Center for RNA Biology, and Center for Retrovirus Research

Research Abstract: The hallmark of retroviruses such as HIV-1, is reverse transcription of their RNA genome into DNA prior to integration into the host cell genome. Full-length dimeric genomic RNA (gRNA) is packaged by retroviruses via specific interactions between the Gag polyprotein and packaging signal (Psi) located in the 5' UTR of gRNA. Gag contains two nucleic acid binding domains: matrix (MA) and nucleocapsid (NC). Previous research has shown that Rous Sarcoma Virus (RSV) and HIV-1 both require the NC domain to recognize their gRNA Psi elements, but also share a MA-dependent mechanism that allows the discrimination of Psi RNAs from non-Psi RNAs. In contrast to HIV-1, the minimal element of RSV required for efficient gRNA packaging has been well identified. Therefore, the simplicity of RSV makes it an informative model to study the mechanism by which gRNA is selectively packaged in retroviruses. However, little is known about the secondary structure of RSV gRNA or Gag's interaction sites. Here, we used high throughput Selective 2'-Hydroxyl Acylation analyzed by Primer Extension (SHAPE) to probe the secondary structure of the 636-nt RSV 5' leader (RSV-636) for the first time. Cross-linking analysis was also carried out to determine the interaction sites of Gag and to distinguish between Gag-induced RNA conformational changes and direct Gag binding sites. Overall, our results provide new insights into RSV gRNA secondary structure and Gag-gRNA interactions that will be validated by future cell-based assays.
Research Project Title: Whey protein and sphingomyelin but not casein contribute to α-tocopherol bioaccessibility in skim milk

Student Presenter: John Bouranis

Faculty Mentor: Richard Bruno

Faculty Mentor Department: Human Sciences

Research Abstract: Bioaccessibility, or the extent to which nutrients can be taken up by enterocytes, is an important predictor of nutrient bioavailability. Despite being fat-soluble, the relatively high bioaccessibility of Î­±-tocopherol (Î­±-T) is unaffected by the fat content of dairy milk. This suggests that physiochemical properties of dairy milk independent of fat are functionally responsible for promoting Î­±-T bioaccessibility. We therefore hypothesized that the emulsifying properties of whey protein (WP) and micellarized casein (CAS) and an amphiphilic phospholipid, sphingomyelin (SM), are responsible for Î­±-T bioaccessibility. To test this, simulated digestions in vitro were performed to define the independent and additive contributions of WP, CAS, and SM relative to non-fat milk on Î­±-T bioaccessibility. Digestions containing 15 mg Î­±-T were performed in non-fat milk (245 mL) or water (245 mL) containing milk-matched levels of WP (1.6 g), SM (16.1 mg), and CAS (6.6 g), alone or in combination (WP+SM+CAS). Î­±-T recovery was evaluated by HPLC-ECD following the gastric through intestinal phases of digestion. Î­±-T bioaccessibility was expressed as the ratio of Î­±-T recovered in the aqueous fraction relative to that in chyme. a-T bioaccessibility differed in response to treatments as follows (means Â± SEM; P<0.05): WP (82.0 Â± 1.4%) = SM (81.3 Â± 3.9%) &gt; skim milk (57.4 Â± 1.8%) &gt; CAS (35.9 Â± 2.3%) = WP+SM+CAS (33.6 Â± 1.1%). Lower bioaccessibility in WP+SM+CAS treatment compared to skim milk suggests that other components of milk may also contribute to Î­±-T bioaccessibility. Relative to skim milk, isolated SM and WP potentiate Î­±-T bioaccessibility while CAS is inhibitory. These findings suggest that WP and SM partially contribute to Î­±-T bioaccessibility while other factors may also have a potentiating role.
Research Project Title: Role ATF3 and chemotherapy in cancer cell colonization and metastasis

Student Presenter: Jared Fehlman

Faculty Mentor: Tsonwin Hai

Faculty Mentor Department: Biological Chemistry and Pharmacology

Research Abstract: Abstract:

Introduction/Background:

Chemotherapy is used around the world as a major form of cancer treatment. While the benefits of chemotherapy are commonly known, little research/discussion has been done on the pro-metastatic effects of chemotherapy. Examples of this include growth of non-small cell lung cancers in patients treated with chemo and rapid tumor cell proliferation in patients who responded poorly to chemo for their oropharyngeal cancer. While the mechanisms by which this exactly occurs are unclear, the blood of cancer patients treated with chemo contained elevated levels of pro-tumor growth factors, and bone marrow derived progenitor cells. High levels of these cells are known to correlate with higher rates of cancer metastasis and lethality. Based on these findings, and our work on the stress-inducible gene, ATF3, we hypothesized that chemotherapy may exacerbate metastasis through ATF3 in host cells. Our previous work demonstrated that tumor-bearing ATF3 knockout (KO) mice, have much lower rates of metastasis than tumor-bearing wild type (WT) mice.

Methods/Results:

As chemotherapy is a stressor and activator of ATF3 (source), we tested whether it would further enhance metastasis. In order to measure this, GFP labeled cancer cells were injected into both WT and ATF3 KO mice post treatment with either CTX or PBS. Immunohistochemistry was then used to analyze differences in cancer cell colonization between the different groups and the data was statistically analyzed. We found increased cancer colonization in WT mice treated with CTX. We also found that cyclophosphamide (CTX), a common chemo drug, greatly enhanced the attachment of cancer cells to the alveolar blood vessel walls. This was discovered through plasma treatment of HUVEC cells in an in vitro assay. We also found that ATF3 is necessary for early survival and growth of newly metastasized cells, although we do not yet know the mechanism. Additionally, we found increased levels of stem cells in the lungs of CTX-treated mice, and discovered that the bone marrow of ATF3 WT and KO mice respond differently to CTX.

Conclusion:

Overall, we found that ATF3 contributes to chemo-exacerbated cancer cell seeding likely through changes in cancer cell adhesion and immune cell populations.
Research Project Title: Comparative biochemical studies of kinases and deglycases that convert Amadori products to common energy-yielding metabolites

Student Presenter: Daniel Dyszlewski

Faculty Mentor: Venkat Gopalan

Faculty Mentor Department: Chemistry and Biochemistry

Research Abstract: During inflammation, Salmonella enterica serovar Typhimurium, a food-borne pathogen, can utilize fructose-asparagine (F-Asn) as one of its sole carbon and nitrogen sources. F-Asn belongs to the family of Amadori compounds, which are rearrangement products that result from the reaction of a sugar with an amine. Amadori compounds are found in nature as well as in prepared human foods that are consumed widely and regularly. The F-Asn utilization pathway in Salmonella involves the genes encoded in the fra locus, and entails the successive action of asparaginase (FraE), a kinase (FraD), and a deglycase (FraB) to convert F-Asn to aspartate and glucose-6-phosphate, common metabolic intermediates. Inhibiting the last enzyme in the F-Asn metabolic pathway (FraB deglycase) results in toxicity on account of a build-up of the uncleaved 6-phosphofructose-aspartate; this finding identified FraB as a potential drug target and has heightened the prospects for anti-Salmonella therapeutics. In this regard, we have initiated detailed biochemical studies of the FraD and FraB enzymes, focusing on their substrate-recognition determinants and mechanisms of action. Because a similar bacterial pathway involving a kinase (FrlD) and a deglycase (FrlB) also helps convert ε-fructose-lysine (ε-F-Lys) into lysine and glucose-6-phosphate, we seek to understand the similarities and differences in the two enzymes that aid catabolism of F-Asn and ε-F-Lys. Insights from these studies are expected to facilitate future Salmonella FraB-targeted drug discovery efforts and highlight parallels in the evolution of bacterial strategies to catabolize Amadori compounds.
Research Project Title: Identification of protein components of the cytoplasmic capping complex using proximity-dependent biotinylation

Student Presenter: Andrew Giltmier

Faculty Mentor: Daniel Schoenberg

Faculty Mentor Department: Biological Chemistry and Pharmacology

Research Abstract: mRNAs that appear without a 5' cap in the cytoplasm are readily identified and degraded by cytoplasmic enzymes. However, a smaller set of uncapped mRNAs are recapped in the cytoplasm, protecting them from degradation by exonucleases, allowing them to return to a translationally active state. The cytoplasmic capping complex consists of cytoplasmic capping enzyme (cCE), RNA-guanine-7-methyltransferase (RNMT), and a 5' RNA kinase that assemble on adapter protein Nck1. This complex is the set of proteins responsible for replacing the 5' cap, and provides a unique form of mRNA regulation.
Research Project Title: Differential alterations of grey matter myelin in animal models of multiple sclerosis

Student Presenter: Farida Eid

Faculty Mentor: Chen Gu

Faculty Mentor Department: Biochemistry and Pharmacology

Research Abstract: Differential Alterations of Grey Matter Myelin in Animal Models of Multiple Sclerosis

Myelin, a lipid sheath, increases conduction speeds along axons. Demyelinating diseases of the central nervous system, such as multiple sclerosis (MS), burden the quality of life of millions around the world. Historically, studies of demyelinating diseases focused on myelin rich white matter (WM) tissue associated with sensory and motor deficits, however, many patients with MS show signs of depression, anxiety and deficits in social cognition associated with cortical grey matter (GM) regions which contain less myelin. Recent discoveries show that GM tissue can also be demyelinated in humans, and may be associated with long term cognitive impairment. Two common animal models are currently used to study MS, Experimental Autoimmune Encephalomyelitis (EAE) and cuprizone, focusing on WM demyelination. In this project, we have interestingly found that the patterns of GM demyelination markedly differ between these two models. We immunized female C57BL6 mice with a peptide from myelin oligodendrocyte glycoprotein (MOG) to induce chronic T cell mediated EAE. In the cuprizone model, mice were fed a diet containing copper chelator cuprizone for 5 weeks, followed by a normal diet. We collected tissues and perfused at 5 weeks or 7 weeks (recovery), sectioned, and fluorescently labeled by immunohistochemistry. Images were captured by confocal microscopy. We found significant clustered demyelination and recovery in GM cortical regions of the cuprizone model compared to controls, while observing no significant change in the EAE model. No significant axonal degeneration was seen in either model. In the cuprizone model, demyelination was shown to be independent of somatodendritic KV2.1 channel expression, while previous studies showed decreased expression in the EAE model. These results indicate the need to use both models to study different aspects of MS. Understanding and characterizing the myelin pathology of both models in GM and WM lays a solid foundation for identifying the mechanisms governing demyelination and recovery, and could lead to the discovery of new targets for treating the emotional and cognitive deficits that affect patients suffering from debilitating diseases such as MS.
Research Project Title: Highly stable, parallel intramolecular G-quadruplex formed in HIV-1 genomic RNA in vitro

Student Presenter: Chelsea Harpster

Faculty Mentor: Besik Kankia

Faculty Mentor Department: Chemistry and Biochemistry

Research Abstract: Chelsea L. Harpster, Besik Kankia, Karin Musier-Forsyth

Department of Chemistry and Biochemistry, Center for RNA Biology, and Center for Retrovirus Research, The Ohio State University, Columbus, OH 43210

Nucleic acids containing multiple repeats of guanine bases are prone to form higher-ordered structures called G-quadruplexes. G-quadruplexes consist of two or more stacked G-quartets, which contain four guanines held together by Hoogsteen hydrogen bonding. Putative G-quadruplex folding regions are found in telomeres and promoters of genes in eukaryotic organisms, and are proposed to play roles in gene regulation. Like many eukaryotic systems, it is hypothesized that Human Immunodeficiency Virus Type-1 (HIV-1) may use G-quadruplex structures for regulatory purposes. Here we focus on the 5â€™ long terminal repeat (LTR) of HIVâ€™s proviral DNA, which is proposed to act as a transcriptional promoter. It has been previously reported that the U3 region within the LTR may fold into an intermolecular G-quadruplex (1). G-quadruplex structure in this region (U3) may play a significant role in promoter regulation, as well as template switching during reverse transcription of viral RNA1(1-2). In this study, we characterize the possible G-quadruplex structure formed within U3 using thermodynamic and optical studies. UV melting experiments were conducted using a 27-nucleotide (nt) RNA segment containing four GGG runs connected to each other by AGGCUGGCCT, C, and ACU loops. The former is capable of forming a stable stem-loop structure with a 4-bp stem (bold nt). UV-melting experiments at 295 nm and circular dichroism (CD) spectroscopy suggested formation of parallel quadruplexes. Melting curves at 1 ÂµM and 40 ÂµM RNA concentrations displayed the same melting temperature, indicative of a monomolecular G-quadruplex structure. In addition to the 27-nt RNA, a homologous 27-nt DNA also demonstrated formation of a stable quadruplex; however, the DNA oligonucleotide also has characteristics of antiparallel topology, suggesting a possible hybrid G-quadruplex. Superimposable CD images before and after melting were observed for all oligonucleotides, indicating that G-quadruplexes were able to refold to their original structure relatively quickly, providing additional support for a monomolecular G-quadruplex structure. From these studies, we propose the U3 region forms a highly stable, parallel intramolecular G-quadruplex, rather than the previously proposed intermolecular structure (1). Further elucidation of the structure and function of G-quadruplexes within the HIV-1 genome could reveal potential new therapeutic targets.


Research Project Title: Effects of 5' heterogeneity on the structure of the HIV-1 5' untranslated region

Student Presenter: Luke Lamorelle

Faculty Mentor: Karin Musier-Forsyth

Faculty Mentor Department: Chemistry, Biochemistry

Research Abstract: Abstract: The human immunodeficiency virus type-1 5' untranslated region (HIV-1 5' UTR) is critical to many processes throughout the HIV-1 life cycle, such as genome dimerization and packaging, splicing, and reverse transcription. These processes are mediated by conserved secondary structures that, when abolished, drastically reduce HIV-1 viability. It has been proposed that there are at least two distinct populations of full-length HIV-1 RNA due to heterogeneity in the transcriptional start site selection. One population, with three or more 5' guanosines (G3), is enriched within the cytoplasm of HIV-1 infected cells, while another population containing a single 5' guanosine (G1), is selectively packaged into budding virions by Gag, the structural protein responsible for assembly of the virus particle. We hypothesize that the differences in G1 and G3 HIV-1 RNA localization are caused by secondary structure differences between the two populations of RNA, resulting in reduced Gag binding selectivity to the G3 compared to G1 RNA. If this hypothesis is true, we expect to see secondary structures involved in dimerization and packaging to be disrupted in G3 constructs, but be present in G1 constructs. To prepare RNAs with well-defined 5â€² ends (G1 versus G3), we used Site-directed, Ligase Independent Mutagenesis (SLIM) to incorporate 5â€² hammerhead ribozymes into HIV-1 5â€²UTR constructs, which are designed to cleave the RNA during in vitro transcription leaving the desired 5â€² ends. Additionally, dimer incompetent 5â€² UTR mutant controls were created by replacing the HIV-1 dimer initiation sequence with a GAGA tetraloop via site-directed mutagenesis. Using these RNA constructs, we have determined the secondary structure differences between the G1 and G3 HIV-1 5'UTR via Selective 2â€²-Hydroxyl Acylation analyzed by Primer Extension (SHAPE) and dimerization assays. Gag binding affinity and selectivity differences were also assayed. These experiments will help elucidate the structural mechanism of the HIV-1 RNA packaging selectivity by Gag and help guide the creation of new HIV-1 therapeutics.
Research Project Title: Elucidating the structure of human plastins via NMR and protein crystallography

Student Presenter: Julian Lee

Faculty Mentor: Dmitri Kudryashov

Faculty Mentor Department: Biochemistry

Research Abstract: Plastins are a conserved family of actin-bundling proteins that assist in cellular functions such as motility and cell division. There are three human plastin isoforms: I-Plastin expressed primarily in the intestinal, inner ear, and kidney epithelia, L-Plastin expressed in leukocytes, and T-Plastin ubiquitously expressed in solid tissues. L-Plastin and T-Plastin are of particular interest as they are overexpressed in various cancers. In cancer cells, L-Plastin promotes metastasis, while overexpression of T-Plastin has been linked to a poor prognosis. Plastins’ primary function is the non-covalent crosslinking of actin filaments, otherwise known as actin bundling. This bundling is negatively regulated upon binding of Ca2+ to EF-hand motifs located at the N-terminal regulatory headpiece domain. C-terminal to the regulatory headpiece is the actin-binding core consisting of two actin-binding domains, or ABD’s, each capable of binding to actin filaments. Segments of the human plastin isoform structures have been solved, however none of the human isoform structures have been elucidated in their entirety, which hampers understanding of plastin function and regulation. For example, the structure of the L-, but not T-Plastin headpiece is known, complicating cross-examination of the two structures to discern their distinct roles in controlling cytoarchitectural plasticity and role in cancer metastasis. Also, the structure of the actin-binding core of yeast and plant plastins has been solved, but the core structure of human plastins is unknown. The purpose of this study is to characterize by structural and biochemical approaches the calcium-dependent regulation of plastin bundling activity of T and L-Plastins. To this end, both crystallography and NMR techniques are being explored to determine the structure of the T-plastin regulatory domain and the binding core of L-Plastin. A construct of the T-Plastin’s headpiece sufficiently stable for NMR-studies has been obtained and its 15N-labeled version is under preparation. In parallel, we obtained protein crystals of the L-Plastin binding core and are working on optimization of crystallization conditions. We anticipate solving the structure of human plastins will elucidate function and regulation of these proteins and lead to better understanding of plastin’s roles in cancer cell cytoarchitectural plasticity and metastasis.
Research Project Title: Protein-protein surface modeling of yeast cancer models.

Student Presenter: Rachel Hopper

Faculty Mentor: Ryan Yoder

Faculty Mentor Department: Chemistry and Biochemistry

Research Abstract: Protein-Protein surface modeling of yeast cancer models.

Rachel Hopper, Ryan Yoder, and Ruben Petreaca

Department of Chemistry and Biochemistry, The Ohio State University, 100 West 18th Avenue, Columbus, Ohio 43210

Double-strand breaks (DSBs) in DNA are extremely problematic; require intricate, complicated repair; and have an unknown mechanism. Lack of repair results in loss of a region of chromosome, while incorrect repairs result in cancer development. In order to prevent cancer development, the mechanism must be understood. Comparing computational data with experimental results will give better insights as to what is happening among the protein complexes involved with DSB repair. Computational techniques being used include protein-protein docking and homology modeling. Protein-protein docking is a snapshot of two proteins interacting with each other. Homology modeling entails taking a primary protein sequence and deducing possible protein structures. Experimental results that have been obtained are from yeast experimentation. Computational models of yeast proteins may be able to replicate those results and show what is happening among those complexes. Moving on, these computational methods could predict the outcomes of human experimentation. Once the mechanism is well understood, further studies may find a way to ensure DSB are repaired correctly.
Research Project Title: Sequence, structure, and stability in pheromone Er-23: A disulfide rich protein

Student Presenter: Guneet Janda

Faculty Mentor: Thomas Magliery

Faculty Mentor Department: Chemistry and Biochemistry

Research Abstract: This project aims to illustrate the relationship between protein sequence, structure, and stability in the context of a protein Er-23, a pheromone secreted by the protozoan Euplotes raikovi. Er-23 is 51 amino acids long and has 10 cysteine residues in 5 disulfide bonds, whose role in the stability and structure of the protein are of particular interest. The literature suggests that the structure of the protein is driven by the formation of disulfide bonds, and is supported by the currently accepted 3-D structure of the protein. Our working hypothesis is that the folding of the protein is driven primarily by the overall amino acid sequence, while the disulfide bonds play a role in the overall stability of the protein. We have successfully expressed Er-23 in E. coli, a heterologous expression system, and have used solution state NMR spectroscopy, mass spectrometry, X-Ray crystallography and CD spectroscopy to elucidate the precise structure and compare it to that of the homologously expressed protein. Our current data suggest that the protein spontaneously adopts its native conformation from E. coli, and our NMR and mass spectrometry data suggest that the disulfide bonds and overall structure of the protein may differ from that of the reported structure. We will present preliminary results on the replacement of cysteine pairs in order to interrogate the role of disulfide bond formation in the fold adoption and stability of Er-23. This fundamental information about the interplay between protein fold, stability, and sequence can be useful in the future investigation and design of novel proteins, particularly extracellular proteins with large numbers of disulfide bonds.
Research Project Title: Development of binding and stability assays of the anti-tumor Ab fragment 3E8 for high throughput cancer screening

Student Presenter: Callie Moore

Faculty Mentor: Thomas Magliery

Faculty Mentor Department: Biochemistry

Research Abstract: Tragedy falls upon more than 1,500 people a day when they lose their battle with cancer. Surgical resection of the cancerous tumor continues to be one of the most successful methods of cancer treatment. In order to remove cancerous tumors, the surgeon needs to have the ability to differentiate healthy from diseased tissue. Doctors use cancer imaging for this specific reason. In order to see the cancer, a tumor antigen can be used as a marker. One of these tumor antigens is TAG-72 which contains a unique sugar, Sialyl-Tn. The Magliery lab has engineered an antibody fragment, 3E8.scFv, that is able to specifically bind to this disaccharide.

Antibody fragments often suffer from problems with manufacturability and storage due to low stability and aggregation. In some cases, it would be useful to have a highly stable cysteine free variant. In order to solve this issue, we have developed a general assay to screen for a stabilized, cysteine free version of 3E8 or other antibody fragments. This allows us to have a high-throughput way to screen for enhanced binding and stability of our protein. By utilizing the assay, we have been able engineer a biophysically superior construct, termed 3D1, whose binding and stability are similar to wildtype 3E8 and does not contain cysteines in it's variable light domain.
Research Project Title: Synthesis of 5'-chemically-modified RNAs is enhanced by a mutant of T7 RNA polymerase

Student Presenter: Seth Lyon

Faculty Mentor: Venkat Gopalan

Faculty Mentor Department: Chemistry and Biochemistry

Research Abstract: Spectroscopic methods, which are used to establish RNA structure-function relationships, require strategies for post-synthetic, site-specific incorporation of chemical probes into target RNAs.1 For RNAs larger than 50 nt, the enzymatic incorporation of a nucleoside or nucleotide monophosphate guanosine analog (G-analog) at their 5′-end is routinely achieved by T7 RNA polymerase (T7RNAP)-mediated in vitro transcription (IVT) of the appropriate DNA template containing a GTP-initiating class III Φ6.5 promoter. However, when high G-analog:GTP ratios are used to bias G-analog incorporation at the 5′-end, RNA yield is compromised. Here, we show that the use of a T7RNAP Pro266Leu mutant in an IVT with 10:1 thienoguanosine (thG):GTP increased the percent incorporation and yield of 5′-thG-initiated precursor tRNA for a net three-fold gain compared to an IVT with wild-type T7RNAP. We also demonstrate that a one-pot multi-enzyme approach, consisting of transcription by T7RNAP Pro266Leu and post-transcriptional cleanup by a polyphosphatase and an exonuclease, led to essentially near-homogeneous 5′-thG-modified transcripts.2 We also validated the broader utility of our one-pot multi-enzyme approach to initiate RNAs with an azide-bearing G-analog, an undertaking that necessitated the development an RNase P (a tRNA 5′-maturation endonuclease)-based assay to accurately determine the percentage of 5′-azide-initiated RNA. We will present these results and discuss ongoing initiatives that leverage this important technical advance as part of new applications designed to correlate RNA structure and function.


Research Project Title: Kinetic investigation of the bypass and extension vs productivity of dGC8-N-ABA by DNA polymerase kappa as a molecular marker in cancer

Student Presenter: Madison Smith

Faculty Mentor: Zucai Suo

Faculty Mentor Department: Biochemistry

Research Abstract: Genomic DNA is constantly exposed to endogenous and exogenous chemical agents which can damage DNA bases by modifying their molecular structure. Such modifications, termed DNA lesions, cause significant problems during DNA replication including stalling of replicative DNA polymerases and erroneous DNA replication, the latter of which is a major source of DNA mutations that may potentially lead to cancer. 3-Nitrobenzanthrone (3-NBA), a small, polycyclic hydrocarbon produced by the incomplete combustion of diesel fuel, is metabolized in the body and reacts with DNA bases to form bulky DNA lesions such as N-(2â€²-deoxyguanosin-8-yl)-3-aminobenzanthrone (dGC8-N-ABA). Accordingly, this lesion can stall normal replicative DNA polymerases and must be bypassed by specialized Y-Family DNA polymerases to avoid cell death. Y-Family DNA polymerases are uniquely able to accommodate bulky DNA lesions and can perform translesion DNA synthesis by continuing DNA replication in place of stalled replicative DNA polymerases. Our previous studies have shown that two human Y-family DNA polymerases, eta (hPolη) and kappa (hPol), were able to efficiently replicate a small DNA molecule containing a dGC8-N-ABA lesion in vitro. Here, we used pre-steady-state kinetics to investigate the efficiency of hPol during bypass and extension of either matched or mismatched lesion bypass products. We performed single-turnover assays to determine pre-steady-state kinetic parameters for maximum nucleotide incorporation rate constants and nucleotide binding affinities to determine the efficiency of correct and incorrect nucleotide incorporation by hPol. During dGC8-N-ABA bypass and matched base extension, hPol incorporated correct nucleotides, 116- and 786-fold, respectively, less efficiently than with the undamaged DNA substrate. However, the control template (21-dT/26-mer) vs the damaged lesion of the same template shows the 7-fold higher binding affinity when dGC8-N-ABA was present. Our results indicated that indeed hPol likely fulfills a role during the bypass and/or the extension of matched or mismatched base pairs during TLS of dGC8-N-ABA. Furthermore, this leads to the assumption of a non productive complex when bound to healthy DNA, and the ability to measure overexpression of the polymerase as a direct marker for damage in pre-cancerous cells because of the larger productivity when bound to damage.
Research Project Title: Computational simulations of re-alkylation reactions of aged-acetylcholinesterase with quinone methide precursors

Student Presenter: Ian Pelfrey

Faculty Mentor: Ryan Yoder

Faculty Mentor Department: Organic Chemistry

Research Abstract: Organophosphorus compounds (OPs) such as sarin, soman, and tabun are toxic nerve agents used in chemical warfare. These OPs covalently bond with Serine-203 (Ser203), a catalytic residue in the enzyme acetylcholinesterase (AChE), preventing hydrolysis of the neurotransmitter acetylcholine into acetate and choline. Once exposed to an OP compound, the inhibited AChE will undergo an irreversible process known as aging, where the OP-AChE complex will dealkylate and form a stable phosphonate anion on the serine residue, permanently inactivating the enzyme. Without functioning AChE, acetylcholine accumulates in the central nervous system causing seizures vomiting and often death. Currently, there are no known therapeutic methods to reverse this aging process to regain enzymatic activity.

However, inhibited AChE can be restored to the active AChE before the onset of the aging process by treatment with pharmaceuticals containing an oxime functional group. The goal of this project is to discover a compound that will re-alkylate the phosphonate anion on Ser203 in aged-AChE, which can then be restored to the active AChE by oxime treatment. Literature shows that quinone methides (QMs) are capable of alkylating phosphodiesters, which are structurally similar to the phosphorylated Ser203 residue in the aged-AChE active site. Through computational methods, potential docking poses in AChE of a variety of quinone methide precursors (QMPs) were analyzed in silico. These QMPs were chosen as derivatives of a lead compound, a substituted 3-hydroxypyridine. Snapshots of an aged AChE were used for our docking calculations where the QMPs were allowed to interact with the enzyme active site. Molecular dynamics simulations permitted us to determine how the interaction between the ligand and enzyme changed over time. Statistical analysis of the results from these computational studies provided insight into structural characteristics of the most effective QMPs, which our colleagues can then combine and synthesize to make the most promising compounds for in vitro analysis with the goal of eventually creating a therapeutic agent.
Research Project Title: Structural determination of protocadherin 8, a tumor suppressor

Student Presenter: Leah Pastor

Faculty Mentor: Marcos Sotomayor

Faculty Mentor Department: Chemistry and Biochemistry

Research Abstract: The cadherins are a large superfamily of proteins that mediate cell-cell adhesion. Cadherins have extracellular repeats of about 100 amino acids that bind calcium ions and that mediate cell-cell adhesion. The protocadherins are a sub-class of the cadherin superfamily with protocadherin-8 (PCDH8) being a member of the delta-protocadherin subfamily. There is evidence that supports PCDH8’s role as a tumor suppressor in ovarian cancer and its potential use as a diagnostic tool in the detection of prostate and liver cancer. Unfortunately, there is little information about the biochemistry and structural determinants of PCDH8’s function, which could allow for a better understanding of disease causes and for development of therapy. The main goal of my research project is to understand how PCDH8 mediates cell-cell adhesion. To achieve this goal, I cloned fragments of PCDH8’s extracellular domains in the pET21a vector for expression in Escherichia coli. Next, I did protein expression tests and large-scale production of protein for purification using an affinity tag. Size exclusion chromatography experiments revealed that some of the fragments refolded properly, which were further used for crystallization screens. Additional efforts to obtain crystals are under way. Once crystals are obtained, I will use x-ray diffraction to determine the structure of these PCDH8 fragments and determine the binding mechanism.
Research Project Title: Structural determinants in the HIV-1 5'UTR that control genomic RNA packaging specificity

Student Presenter: Joshua-Paolo Reyes

Faculty Mentor: Karin Musier-Forsyth

Faculty Mentor Department: Chemistry and Biochemistry

Research Abstract: The 5\(^\prime\) untranslated region (5\(^\prime\)UTR) of the human immunodeficiency virus type 1 (HIV-1) genomic RNA (gRNA) contains a structured RNA element (termed Psi) that is specifically recognized by the HIV-1 Gag polyprotein, which in turn packages two strands of gRNA into newly assembled virions. However, the mechanism by which Gag recognizes gRNA over other cellular RNAs and spliced viral RNAs is not well understood. A recent study suggested that a negative regulatory element upstream of Psi reduces high-affinity Gag binding, and a positive downstream regulatory element counteracts the upstream element and restores high-affinity binding. These elements are proposed to form a long-range interaction that promotes packaging of only full-length gRNA and excludes packaging of spliced viral mRNAs (which lack the putative positive downstream regulatory element). In this study, we explore how these putative elements affect the specificity and binding mode of Gag in addition to determining how these elements alter the structure of the 5'UTR. Using a fluorescence anisotropy-based salt-titration binding assay, which measures the electrostatic and nonelectrostatic (i.e. specific) components of protein-RNA binding, we have previously shown that Gag interacts with a 109-nt Psi RNA construct with high specificity and relatively few electrostatic interactions. Using a 356-nt gRNA construct that includes the upstream negative regulatory element in addition to Psi, we observed a loss in Gag binding specificity and an increase in electrostatic interactions. However, a 400-nt gRNA construct that additionally contains the positive element, restored more specific binding and reduced the electrostatic interactions, similar to the 109-nt Psi RNA. Interestingly, 400-nt RNA constructs corresponding to the 5\(^\prime\)UTRs of the spliced viral mRNA transcripts encoding Vpr and Tat exhibited a loss in Gag binding specificity and an increase in electrostatic interactions. Using the RNA probing technique, Selective 2'Hydroxyl Acylation analyzed by Primer Extension (SHAPE), we further investigated the structural basis for this difference in our gRNA and viral mRNA constructs.
Research Project Title: Characterization of the 3' to 5' polymerase activities of Thg1-like proteins in A. castellanii

Student Presenter: Surabhi Tewari

Faculty Mentor: Jane Jackman

Faculty Mentor Department: Chemistry and Biochemistry

Research Abstract: The polymerization of DNA and RNA is canonically catalyzed in the 5' to 3' direction. However, the discovery of tRNAHis guanylyltransferase (Thg1) in Saccharomyces cerevisiae was the first example of an enzyme to catalyze the polymerization of RNA in the 3' to 5' direction. Thg1 post-transcriptionally adds a guanosine across from a non-Watson Crick discriminator nucleotide to the -1 position (G-1) of tRNAHis. This modification is required for the aminoacylation of tRNAHis and is therefore essential in yeast and most other eukaryotes with highly conserved Thg1 homologs. Another similar class of proteins, Thg1-like proteins (TLPs), is found in all domains of life. However, the diversity in functions, mechanisms, and structures of TLPs are less understood. Thg1 and TLPs are evolutionarily divergent, differing by at least two known parameters. Unlike Thg1, TLPs preferably add Watson-Crick base pairs during polymerization. Secondly, TLPs are not limited to G-1 addition and can act on truncated RNA substrates. Thus, it has been hypothesized that some TLPs are involved in mitochondrial tRNA 5'-end editing, an activity that has been noted in several eukaryotic protists. In this study, we are examining two TLP enzymes from the amoeboza Acanthamoeba castellanii, AcaTLP1 and AcaTLP2. A. castellanii does not encode a canonical Thg1 and does not require G-1 addition to aminoacylate tRNAHis. Certain mitochondrial tRNA substrates in A. castellanii have been identified to require post-transcriptional editing to correct mismatched base-pairs. We hypothesize that either or both AcaTLP1 and AcaTLP2 are responsible for this editing. If either TLP is involved in 5'-end editing of mitochondrial tRNA, we expect it to exhibit this activity in vitro. Based upon this assumption, we have designed two different 5'-end truncated tRNA substrates to test for template dependent nucleotide addition by AcaTLP1 and/or AcaTLP2. Both the kinetic efficiency and the fidelity of nucleotide addition will be compared between the two enzymes, potentially highlighting differences between their functions and activities. By understanding if and how AcaTLP1 and AcaTLP2 are involved in mitochondrial tRNA 5'-editing, we can better characterize TLPs in A. castellanii, furthering our knowledge about the biological basis for such enzymes in all domains of life.
Research Project Title: Spectroscopic resolution of metal binding affinity during cofactor assembly in the novel Mn/Fe ligand oxidases

Student Presenter: Zachary Smith

Faculty Mentor: Hannah Shafaat

Faculty Mentor Department: Chemistry and Biochemistry

Research Abstract: The R2-like ligand-binding oxidase (R2lox) proteins utilize a binuclear, metal-containing active site to execute multi-electron oxidative chemistry. The active site is capable of incorporating both manganese and iron cofactors to achieve two distinct arrangements, one adopting a heterobinuclear manganese-iron configuration and the other utilizing a homobinuclear diiron assembly. In addition to employing this rare heterobinuclear cofactor, R2lox is found in many pathogens and extremophiles, making it a prime candidate for investigation. In this work, UV-visible (UV/vis) and Stopped-Flow (SF) spectroscopies were used to monitor cofactor assembly and maturation over time in wild-type (WT) R2lox, providing optical signatures for potential reaction intermediates, as well as kinetic information on their formation and/or decay. In addition, metal titration experiments coupled with kinetic modeling indicate an order of magnitude greater binding affinity for Mn(II) over Fe(II), as demonstrated by increased inhibition of product formation and slower cofactor assembly with excess Mn(II) ions. To explore secondary sphere contributions to metal binding affinity the Y175F mutant, which perturbs the hydrogen bonding network to a primary sphere water ligand, was investigated. Compared to the WT protein, the Y175F variant assembles with markedly different rates but similar intermediate features, and effects on cofactor assembly and maturation from excess Mn(II) are more pronounced relative to WT R2lox. Taken together, these results suggest the overall mechanism remains the same, but the Y175F mutation has a significant influence on metal binding affinities. Further analysis of WT, Y175F, and other variants of R2lox will help to characterize the residues that mediate metal binding, an especially important consideration in the context of a heterobinuclear active site. Additionally, the knowledge obtained from these experiments will provide further insight into the relationship between protein structure and metal specificity in metalloproteins as a whole.
Research Project Title: Toward a more robust gene expression signature for Alzheimer's disease neurodegeneration

Student Presenter: Connor Wagner

Faculty Mentor: Jeff Kuret

Faculty Mentor Department: Biological Chemistry and Pharmacology

Research Abstract: Late Onset Alzheimer’s Disease (LOAD) is a neurodegenerative disorder characterized by accumulation of extracellular plaques composed of Aβ peptides and intracellular neurofibrillary tangles composed of aggregated tau protein. With the failure of extensive drug discovery efforts, there continues to be a need for basic science insight into the molecular mechanisms associated with LOAD pathogenesis. One approach to characterizing LOAD involves analysis of gene expression. Previous studies have focused on degenerating regions of interest to identify a broad range of biological processes altered in disease. We propose a complementary approach, in which gene expression data from an affected region, pre frontal cortex (PFC), is normalized to a relatively spared region, cerebellum (CR), to capture changes associated with disease invulnerability in parallel with disease vulnerability. Here we demonstrate the utility of the approach using a publically available microarray-based data set derived from &gt;200 human tissue specimens. The results identified ~350 transcripts uniquely changed with disease vulnerability, including those involved with Aβ clearance, intracellular chaperone activity, and neuroinflammation. Most importantly, the results also identified neuroprotective gene expression changes associated with established genetic risk factors of disease. We conclude that the approach of characterizing selective vulnerability has the potential to identify mechanisms associated with successful neuroprotection in vivo.
Research Project Title: Green fluorescent protein (GFP) and GFP binding protein (GBP) tagging in Aspergillus nidulans

Student Presenter: Leymaan Abdurehman

Faculty Mentor: Stephen Osmani

Faculty Mentor Department: Molecular Genetics

Research Abstract: Green Fluorescent Protein (GFP) tagging is commonly used to identify locations of proteins and is an important step towards understanding a protein’s function. Live cell microscopy after GFP-tagging is as an excellent way to study proteins of interest and has been widely used in the model filamentous fungus Aspergillus nidulans. To further enhance experimental approaches after GFP-tagging, we have adapted the GFP-Binding protein (GBP), a protein that binds GFP with high affinity, for A. nidulans (Suresh et al., 2017). Tagging anchor proteins with GBP causes GFP-tagged proteins to be re-targeted to the location of the GBP-tagged anchor protein. Four DNA-cassettes were generated that, through fusion PCR, can be used to generate specific GBP-tagging constructs. Using the cassettes, two strains were generated expressing either SPA10-GBP or Tom20-GBP. SPA10 locates to the septa and Tom20 locates to the surface of mitochondria. Using live cell-microscopy, I was able to determine that SPA10-GBP successfully relocates GFP-tagged proteins to forming and mature septa. In the Tom20-GBP strain, GFP-tagged proteins located to the surface of the mitochondria. Notably the higher abundance Tom20-GBP anchor was able to attract more GFP-tagged protein than the SPA10-GBP anchor. Both the SPA10-GBP and Tom20-GBP strains generated can be used to further investigate the consequences of re-targeting other GFP-tagged proteins to ectopic locations in A. nidulans.

Research Project Title: Activation of 3-hydroxypropionate by addition of coenzyme A in Rhodobacter sphaeroides

Student Presenter: Sydney Alibeckoff

Faculty Mentor: Birgit Alber

Faculty Mentor Department: Microbiology

Research Abstract: Rhodobacter sphaeroides is a metabolically diverse bacterium that can grow with a variety of carbon sources, including the organic acid 3-hydroxypropionate. This molecule is used in the synthesis of industrial chemicals and polymers, and understanding how it is metabolized may have important applications. To be fully assimilated by R. sphaeroides, we hypothesize that 3-hydroxypropionate is activated via addition of a coenzyme A (CoA) thiol. The purpose of this study is to determine the enzyme responsible for converting 3-hydroxypropionate into 3-hydroxypropionyl-CoA. One class of enzymes that we hypothesize to be responsible for catalyzing this reaction is AMP-forming synthetases, which hydrolyze ATP to add a free CoA to the target molecule. 3-hydroxypropionate and CoA dependent hydrolysis of ATP was readily detectable in cell extract of cells grown with 3-hydroxypropionate as the sole carbon source. To test if synthetases are responsible for the conversion of 3-hydroxypropionate to 3-hydroxypropionyl-CoA, mutant analysis was performed. Two synthetase genes were bioinformatically identified in the genome of R. sphaeroides encoding a putative acetyl-CoA synthetase (acs) and propionyl-CoA synthetase (pcst). Both genes were inactivated by homologous recombination, exchanging the wild type gene with an in frame deleted copy. The resulting mutant strains were RsΔacs and RsΔpcst; RsΔacs was then used to generate the double mutant RsΔacsΔpcst. Cell extracts of RsΔpcst and RsΔacsΔpcst mutants have reduced synthetase activity on 3-hydroxypropionate when compared to wild type, which supports the hypothesis that pcst encodes a synthetase that can act on 3-hydroxypropionate. Initial growth experiments of the mutant strains with 3-hydroxypropionate indicate that while Pcst may play a role in 3-hydroxypropionate assimilation, the loss of Pcst still allows growth on 3-hydroxypropionate. We can conclude from mutant analysis that the loss of the pcst gene correlates to a decrease of synthetase activity with 3-hydroxypropionate. However, the preliminary data from growth experiments and enzyme assays lead us to believe that synthetases are not solely responsible for the conversion of 3-hydroxypropionate to 3-hydroxypropionyl-CoA. Other classes of enzymes that may catalyze this reaction include transferases and kinases-transacetylases.
Research Project Title: Determining binding specificities of cell adhesion molecules from Drosophila and other related Dipterans

Student Presenter: Leah Anderson

Faculty Mentor: Mark Seeger

Faculty Mentor Department: Molecular Genetics

Research Abstract: Neurons of both vertebrates and invertebrates exhibit a complex set of cell-to-cell interactions during successful development of the nervous system. Cell adhesion molecules (CAMs) play an important role in mediating many of these specific and stereotyped cell-cell interactions. I am investigating the binding specificities of two CAMs of the immunoglobulin superfamily from Dipteran insects: Lachesin (Lac) and Amalgam (Ama). Ama arose as a duplication of Lac early in Dipteran evolution, and both proteins still share extensive sequence similarity. In Drosophila melanogaster, Lac is membrane-linked and homophilically binds itself. Ama, which is a secreted molecule, has both a homophilic binding property as well as the ability to heterophilically bind another CAM, the transmembrane protein Neurotactin (Nrt). Despite the high level of amino acid sequence similarity between Ama and Lac, the two proteins are unable to bind each other, and Lac does not display any interaction with Nrt. The goal of this project is to identify the precise domain(s) of Lac and Ama that produce these differences in binding specificity. To accomplish this, chimeric constructs of the three immunoglobulin-like domains of Ama and Lac from D. melanogaster have been created and cloned into a vector for regulated expression in Schneider 2 (S2) cell lines. The S2 cells are then to be used for aggregation assays, which will reveal binding patterns of the chimeric proteins. Preliminary aggregation assays have revealed that the first immunoglobulin domain is responsible for the homophilic binding specificity of both Lac and Ama. Further experiments to test the secreted version of the Ama/Lac chimeras will allow identification of the domains that contribute to Nrt binding and Nrt-mediated cell adhesion. Using this approach, a thorough model can be devised for the specific interactions of Lac, Ama, and Nrt in D. melanogaster. In addition to studying these protein interactions, I am utilizing bioinformatic databases to locate and subsequently clone out orthologs of Ama and Lac in other Dipteran species. Testing these clones in further aggregation assays will help develop a better understanding of how the unique binding properties of Ama and Lac have changed over evolutionary time.
Research Project Title: The structural fate of spliced tRNA introns: linear or circular

Student Presenter: Alicia Bao

Faculty Mentor: Anita Hopper

Faculty Mentor Department: Molecular Genetics

Research Abstract: Transfer ribonucleic acids (tRNAs) are abundant molecules, comprising ~15% of cellular RNAs. Although the major biological role for tRNAs is to bring amino acids to the ribosome during protein synthesis, they also play many secondary roles. Defects in pre-tRNA biogenesis and processing cause numerous disorders, from neurodegenerative diseases to cancer. In eukaryotes, a subset of tRNA-encoding genes contains non-coding introns that must be removed in post-transcriptional tRNA processing; in S. cerevisiae, these account for 20% of pre-tRNAs. Through an unbiased screen of the yeast genome, we identified two proteins required for tRNA intron turnover of tRNAileUAU, the tRNA employed in our screen. We showed that the free tRNAileUAU intron is first phosphorylated on the 5â€™ end by the tRNA ligase/kinase Rlg1, then degraded by the 5â€™ to 3â€™ exonuclease Xrn1. By expanding my analysis to the other intron-containing pre-tRNAs, I identified the possibility for three more mechanisms for intron degradation, as well as circularization of the tRNATrp intron in vivo. The circular form is seen on Northern blots as an aberrant band running below the linear intron. The aberrant form is resistant to digestion by Terminator Exonuclease (TEX), a 5â€™ â†’ 3â€™ exonuclease, suggesting it has no available 5â€™ end. Additionally, when reverse transcription polymerase chain reaction (RT-PCR) is performed on the tRNATrp intron, reverse transcriptase loops around the template sequence over and over, transcribing a long cDNA strand containing multiple repeats of the intron sequence. During the PCR step, primers hybridize to multiple sites on the cDNA transcript, creating concatemeric DNA, which can be visualized on an agarose gel as a series of bands that are multiples of the length of the original intron. This data is novel, as it was previously believed that introns in S. cerevisiae only existed in linear forms. Interestingly, only the tRNATrp intron circularizes in wild type cells; however, circular introns can be formed in other tRNA families if Rlg1 is replaced with the bacterial ligase, RtCB. Together, these findings indicate the multiplicity and specificity of tRNA intron degradation pathways, and suggest additional novel pathways exist for the turnover of novel intron forms.
Research Project Title: Inhibition of micro-RNA 126 to prevent Kasabach-Merritt Phenomenon in endothelial cell tumors

Student Presenter: Emma Clark

Faculty Mentor: Gayle Gordillo

Faculty Mentor Department: Plastic Surgery

Research Abstract: Hemangioendothelioma (HE) is a type of endothelial cell tumor. Kasabach-Merritt Phenomenon (KMP) can develop in infants with HEs and has a mortality rate of 20%. Infants with KMP die from consumptive coagulopathy with sequestration of blood and platelets in the tumor. Treatments for HE include chemotherapy agents, such as vincristine, that have high risk side effects. The purpose of this work was to test whether microRNA-126 (miR126) prevents KMP through repression of mammalian Target of Rapamycin (mTOR). mTOR is a protein kinase that promotes angiogenesis, which increases susceptibility to KMP. p85ß/PIK3R2 is a protein that represses mTOR. Hemangioendothelioma endothelial (EOMA) cells, a validated HE model in 126P/3 mice, have high levels of expression for miR126 and mTOR, which were measured using qPCR and western blots. EOMA cells were transfected with miR126 inhibitors or control inhibitors to measure, using qPCR and western blots, expression of p-85ß and mTOR. Results indicated that inhibition of miR126 increased p85ß expression, which decreased mTOR expression. To analyze miR126 inhibition in vivo, 126P/3 mice will be injected subcutaneously with EOMA cells and treated with either miR126 inhibitors or control inhibitors. Blood testing should indicate decreasing levels of hemoglobin, hematocrit, and platelets in the control inhibitor group, indicative of KMP, compared to the miR126 inhibitor. Overall, activation of mTOR is miR126 dependent because miR126 silences p-85ß, resulting in mTOR activation. Inhibition of miR126 resulted in mTOR repression by p-85ß, which should prevent KMP. By determining the effects of miR126, we will be closer to discovering a safe and effective treatment for KMP. This will improve lives and decrease the death rate due to KMP.
Research Project Title: Characterization of multiple novel aperture proteins in Arabidopsis thaliana

Student Presenter: Ayla Edwards

Faculty Mentor: Anna Dobritsa

Faculty Mentor Department: Molecular Genetics

Research Abstract: In many species, exine, the outer wall of pollen grains, is deposited non-uniformly on the pollen surface. The gaps left on the pollen surface by the absence of exine deposition are known as apertures. These apertures facilitate emergence of the pollen tubes, making them important for male fertility in some plants. The positioning of the apertures is highly conserved within species, yet it varies widely between species, making apertures an ideal model for studying how cells control formation of distinct extracellular domains. Very little is known about how the locations of apertures are specified and how apertures are formed. Dobritsa Lab’s current work involves identification and characterization of novel proteins in Arabidopsis required for aperture formation. My project focuses on two of the mutants recently found during a mutagenesis screen, both of which completely lack apertures. The candidate genes responsible for these mutations, called Strubbelig-Receptor Family 2 (SRF2) and Inaperturate Pollen 2 (INP2) were isolated, fused with YFP, and introduced into their respective mutants in Arabidopsis using Agrobacterium. I created the constructs and confirmed the identity of these genes by phenotypic rescue, and their expression and localization are currently being characterized using YFP. In addition, I am also testing the effects of inactivation of ELMOD-A, a close paralog of a third gene involved in aperture formation called Macaroon, by mutating ELMOD-A using CRISPR. Mutant plants have been obtained and are being crossed with macaroon, inp2, srf2, and other aperture protein mutants to create double mutants and further characterize how the proteins interact. Characterizing these new aperture proteins will help elucidate the molecular mechanisms involved in the formation of distinct cellular domains.
Research Project Title: Reb1 is a pioneer factor that dynamically regulates nucleosomal DNA accessibility

Student Presenter: Caroline Jipa

Faculty Mentor: Michael Poirier

Faculty Mentor Department: Physics

Research Abstract: For efficient storage and protection, DNA in cells is packaged into chromatin. Chromatin’s basic unit is the nucleosome, 147bp of DNA wrapped around the histone octamer. Nucleosomes play important roles in regulating gene expression; the DNA in a nucleosome is inaccessible to most transcription factors (TFs) and other DNA binding proteins. Additional suppression of transcription stems from higher-order nucleosome compaction. So how does transcription begin in these highly compacted regions of the genome? A class of TFs called pioneer factors possess the unique ability to access binding sites within heterochromatin to initiate transcription and affect cell differentiation. However how this is achieved remains unknown. In this study, we develop a model for how pioneer TFs target their sites in individual nucleosomes.

Reb1 is an essential TF from S. Cerevisiae that establishes correct nucleosome positioning at the 5’ ends of genes. Gel shift experiments show that, unlike other TFs, Reb1 has a similar affinity to DNA and to nucleosomes. Ensemble FRET experiments indicate Reb1 targets its binding site on unwrapped nucleosomes without evicting the octamer. Additionally, single-molecule fluorescence experiments show that despite similar affinities, Reb1 displays dramatically slower exchange kinetics to nucleosomes than to DNA. From these results, we propose that Reb1 can function as a pioneer factor because it has high affinity for nucleosomes. Together this data could suggest that long dwell times from entry-exit sites allows for recruitment of chromatin remodelers leading to correct nucleosome positioning. Future experiments to characterize binding include EM structural studies, footprinting and mutagenesis studies. This may provide models for other pioneer factors, opening the door to bioengineering of molecules to control gene expression and regenerative medicine.
Research Project Title: The role of Rho5 in the apoptotic response of budding yeast

Student Presenter: Jack Fioretti

Faculty Mentor: Hay-Oak Park

Faculty Mentor Department: Molecular Genetics

Research Abstract: Apoptosis is a process of programmed cell death to remove cells that are no longer needed during development or damaged cells from stressful conditions. I am interested in understanding how cells of budding yeast Saccharomyces cerevisiae respond to harmful levels of reactive oxygen species (ROS), a byproduct of the metabolism of oxygen, and activate the apoptotic response. This response is a defense mechanism to remove those cells with excessive damages in the genome, which could potentially lead to a host of subsequent genetic errors in organelles. I am in the process of corroborating previous findings in the lab that the Rho5 GTPase is necessary for cell death upon damage by oxidants or heat stress in budding yeast. By subjecting wild type (WT) and rho5 deletion mutant strains to identical heat shock treatments, I will use a spot test assay to quantify cell survival in response to these stresses. I expect to observe that the WT cells exposed to the heat treatment will undergo a greater rate of apoptosis, as if they had been subjected to hydrogen peroxide, while the rho5 deletion mutant will be more resistant to the stress. After confirming the lab’s previous findings regarding these strains, I will seek to gain a deeper understanding of Rho5 GTPase’s molecular role in apoptotic response by identifying potential targets of Rho5. Specifically, I will test Cwp1/2 (cell wall proteins that contribute to propionic acid and low pH resistance), which were identified from previous genome-wide studies in the lab, by a BiFC (bimolecular fluorescence complementation) assay. The results of this analysis should provide insight into how Rho5 might interact with these proteins and contribute to apoptotic cell death. These findings may help us to understand how small GTPases might regulate apoptosis in animal or plant cells in response to stress or during fungal pathogenic infection.
Research Project Title: Functional analysis of the telomere (TLO) expanded gene family in Candida albicans

Student Presenter: Griffin Kinney

Faculty Mentor: Matthew Anderson

Faculty Mentor Department: Microbiology

Research Abstract: Candida albicans is a common commensal of the human gastrointestinal (GI) tract, however it is the cause of 50% of fungal infections, and the 4th most common hospital acquired bloodstream infection. Significantly, bloodstream infections result in mortality rates approaching 50%. C. albicans virulence is due, in part, to its ability to adapt to altered environments and the host immune system. Genes that confer a selective advantage to these unique environmental challenges faced by the organism are often found at the ends of the chromosome. Expansion of gene families through increases in gene copy numbers have been associated with virulence in C. albicans. The telomere associated (TLO) genes represent the most dramatic expanded gene family. The TLO gene family consists of 14 genes separated into 3 clades (α, β, and γ). TLOs share approximately 97% sequence similarity, all encode a Med2 domain which has been shown to interact with transcription regulation. To analyze individual TLO gene functions, a drug-ON misexpression system was used where doxycycline activated expression. Misexpression strains for 12 of the 14 genes were constructed by replacing the promoter of one allele of a TLO gene with this inducible promoter. Strain phenotypes were assessed between induced and uninduced states, in both the parental strain and strains with specific TLO genes under misexpression. These misexpression strains were assayed to test the role of the TLOs in a diverse range of environmental pressures. All TLO genes showed involvement in multiple phenotypes, as well phenotypes were shown to be controlled by multiple TLOs. However, no phenotype was controlled by all TLO genes, indicating the development of either novel or delegated functions in relationship to the ancestral gene from which expansion acted on. TLO genes were shown to be involved in both simple phenotypes such as cell aggregation and complex phenotypes such as Galleria mellonella virulence. Sequence analysis of the TLOs showed multiple sequence locations that correlated with specific observed phenotypes. These results suggest evolutionary pressures have acted on the TLO gene family to cause regulatory diversification. We purpose this diversification of phenotypic regulation advances the pathogenic and commensal success of Candida albicans.
Research Project Title: Using molecular dynamics to characterize mutants in the connector region of Rho

Student Presenter: Max Gilliland

Faculty Mentor: Irina Artsimovitch

Faculty Mentor Department: Microbiology

Research Abstract: Transcription termination factors are necessary to silence synthesis of aberrant RNAs. Bacterial Rho protein is an archetype of factor-dependent termination. In Escherichia coli, Rho inhibits expression of anti-sense, corrupted, and horizontally-acquired RNA messages. E. coli Rho is a hexamer made up of 419 amino acids per subunit. Rho is an ATP-dependent, RecA-family hexameric helicase composed of an N-terminal RNA-binding and a C-terminal ATPase/helicase domains separated by a flexible 30-residue long connector region. A key step in the Rho mechanism is a switch from an open, RNA-loading state into a closed, translocation-competent state in which the RNA is captured inside the inner pore; this switch is activated by Rho binding to canonical RNA sequences yet Rho also has to act on non-canonical sites. Our genetic data suggest that the flexible connector region may modulate the transition between Rho’s inactive open and active closed states. We have identified substitutions that confer defects in Rho-dependent termination and are predicted to reduce connector flexibility (e.g., Gly→Asp). We hypothesize that the connector region is involved allosterically in binding to of divergent RNA sequences and is a potential target for factors that control Rho activity. Using molecular dynamic simulation software NAMD, we can develop a model of the connector region by mutating residues in silico. By modeling the closure of Rho mutants, we can assess the contributions of individual amino acid residues to Rho function. Quantitative analysis of root-mean-square deviation of atomic positions and inner pore diameter along with viewing the mechanism with VMD modeling software can give insights to how the selected substitutions affect ring closure. Additionally, elucidating the molecular details of Rho action will lead to understanding of other motor proteins that couple ATP hydrolysis to translocation on polymer substrates.
Research Project Title: Phenylalanyl-tRNA synthetase regulated quality control is linked to stress responses in Saccharomyces cerevisiae

Student Presenter: Amanda Kyle

Faculty Mentor: Michael Ibba

Faculty Mentor Department: Microbiology

Research Abstract: Compared to other essential cellular processes, translation is more error-prone, with an error rate of approximately 1 in $10^4$ codons. In translation, aminoacyl-tRNA synthetases (aaRSs) are enzymes which bind amino acids to cognate tRNAs. Some aaRSs have editing processes to prevent the misincorporation of structurally similar amino acids into proteins. Recently, it has been shown that phenylalanyl-tRNA synthetase (PheRS) quality control is important in the regulation of the general amino acid control (GAAC) pathway in Saccharomyces cerevisiae. To further explore how quality control affects S. cerevisiae, the growth of a PheRS editing deficient strain was compared to a wild-type (WT) strain in many conditions using phenotypic microarrays. Conditions where a difference in growth was observed were assigned to genes using previously established relationships between genes and chemicals. Many of these genes were associated with the target of rapamycin (TOR) and GAAC pathways. When grown in caffeine supplemented media, the PheRS editing deficient strain was more tolerant to caffeine than the WT strain. There is evidence linking mutations in the TOR pathway to differential growth in caffeine. To explore the relationship between PheRS quality control and the TOR pathway, growth of âˆ’âTOR WT and âˆ’âTOR PheRS editing deficient strains were compared in a chronological lifespan assay. Previously, prolonged chronological lifespans have been observed in âˆ’âTOR yeast mutants. However, we observed that the âˆ’âTOR mutation in the PheRS editing deficient strain had a decreased effect on chronological lifespan compared to the âˆ’âTOR WT strain. This evidence suggests a relationship between PheRS regulated quality control and stress responses in S. cerevisiae. Since translation is a comparatively error-prone cellular process and there is evidence that mistranslation may be advantageous, it is important to understand how lacking quality control affects the cell.
Research Project Title: In vivo characterization of FACT complex proteins in C. elegans

Student Presenter: Aislinn Latham

Faculty Mentor: Helen Chamberlin

Faculty Mentor Department: Molecular Genetics

Research Abstract: FACT is a protein complex involved in transcriptional regulation, DNA replication, and DNA repair processes in all eukaryotic organisms. FACT allows transcriptional enzymes to access the DNA for transcription and eventual translation into proteins and it is highly conserved across species. However, there is limited knowledge about the FACT complex in multicellular organisms. The objective of this study is to discover more information about the composition and expression of the FACT complex and its role in multicellular organisms by tagging the genes that code for the FACT subunits in order to view the subsequent proteins in the nematode Caenorhabditis elegans. The complex is composed of two proteins: SSRP1 and SPT16. In C. elegans, two genes (hmg-3 and hmg-4) encode SSRP1 proteins, and one gene (spt-16) encodes SPT16. In order to determine the presence of the target subunits in C. elegans, sequences encoding a fluorescent tag were inserted into each gene using CRISPR-mediated genome editing. Using fluorescent microscopy conditions, the target proteins were visible in vivo, revealing the specific areas of the organism where the subunits were present. The location of the product in the cells of C. elegans differed between the HMG-3 and HMG-4 proteins. HMG-3 had somatic presence during the embryonic stage, but in later larval stages the product was confined to the germline. In contrast, HMG-4 and SPT-16 were present in the somatic and germ cells throughout the entire developmental process of the organisms. The FACT complex’s functions in DNA regulation and repair make it a potential target for future cancer and HIV research. Gaining information about the expression of the FACT complex’s proteins at different life stages in a multicellular eukaryote creates a base from which future research can draw. Future research may include interactions between subunits, and determining the number of each subunit protein in the FACT complex.
Research Project Title: Characterization and mapping of the required to maintain repression10 locus affecting paramutation in Zea mays

Student Presenter: Emily McCormic

Faculty Mentor: Jay Hollick

Faculty Mentor Department: Molecular Genetics

Research Abstract: Paramutation is a genetic phenomenon describing heritable changes caused by the interaction of a allele at a specific locus. Such behavior is observed at multiple loci in different organisms, and defines patterns of inheritance that appear to defy the first law of Mendelian genetics. Paramutation at the Pl1-Rhoades (Pl1-Rh) allele of the purple plant1 (pl1) locus in the organism Zea mays results in meiotically heritable changes in gene regulation that are influenced by trans-homolog interactions. Plants with a fully-expressed Pl1-Rh allele exhibit dark anther coloration, while plants with a repressed paramutant derivative (denoted Plâ€™ ) lack anther coloration. The transcriptional and post-transcriptional repression of Pl1-Rh is facilitated by required to maintain repression (rmr) factors. We previously reported on eight different rmr factors identified by mutations induced with ethyl methanesulfonate (EMS) pollen treatment. At least six of these factors are required for the biogenesis of 24-nucleotide sRNAs that may direct de novo cytosine methylation.

Genetic complementation tests and molecular mapping were used to determine that two recessive mutations, ems062986 and ems073240, define a novel locus provisionally designated rmr10. Results of genetic tests with the ems062986 mutation indicate that normal rmr10 function is required for the meiotic maintenance of Plâ€™ states but not for facilitating paramutations at the booster1 locus.

RNA-seq data and a bioinformatics pipeline are currently being used to identify likely candidate genes, and the effects of rmr10 function on pl1 RNA levels is being determined using qRT-PCR. Bulk low molecular weight RNA profiles will also be evaluated to characterize possible effects on small RNA accumulations. Results of these efforts expand our understanding of basic mechanisms controlling meiotically-heritable changes in gene regulation.
Research Project Title: Membrane localization of the F-BAR protein Rga7 depends on its F-BAR domain

Student Presenter: Shelby Naegele

Faculty Mentor: Jian-Qiu Wu

Faculty Mentor Department: Molecular Genetics

Research Abstract: F-BAR family proteins bind to phospholipids in the plasma membrane and are vital players in various cellular processes. However, the regulation and molecular mechanisms of their localization within the cell are not well understood. The purpose of this project is to study the localization of the F-BAR protein Rga7 in fission yeast cytokinesis. Rga7 contains an F-BAR domain at the N-terminus, and a Rho-GAP domain at the C-terminus. Normally, Rga7 localizes to the plasma membrane at the division site and the cell tips. The minimal region required for localization is Rga7 F-BAR domain. Recent studies from Wu lab have shown that proper cellular localization of Rga7 depends on its interaction with the coiled-coil protein Rng10. Rga7 cannot localize properly in the absence of Rng10. We also found that Rga7 F-BAR domain and Rng10 C-terminus interact directly and are able to bind phospholipids in vitro, with Rga7 binding preferentially to PI(4,5)P2. In this study, we created three lipid-binding mutants (PIP2, PIP2+Core, PIP2+Core+Tips) in Rga7 F-BAR domain using PCR-based gene targeting and examined the importance of membrane binding in Rga7 localization by confocal microscopy. Our data showed that PIP2+Core and PIP2+Core+Tips mutations abolished Rga7 localization on the plasma membrane at both the division site and the cell tips, whereas PIP2 mutants retained some localization at the division site. Overexpression of three Rga7 F-BAR mutants failed to rescue their localization on the plasma membrane. Surprisingly, loss of the membrane localization in Rga7 F-BAR mutants did not result in significantly more cell lysis compared to rga7Δ cells. Consistent with the important roles of PI(4,5)P2 on the plasma membrane, reducing the levels of PI(4,5)P2 significantly decreased Rga7 localization at the division site, but Rng10 localization was unaffected. Collectively, our data show that proper localization of the F-BAR protein Rga7 to the plasma membrane requires its F-BAR domain to bind the phospholipids and coiled-coil protein Rng10 simultaneously.
Research Project Title: Global analysis of cystic fibrosis and epigallocatechin gallate on CF mouse methylomes

Student Presenter: Alex Pan

Faculty Mentor: Pearlly Yan

Faculty Mentor Department: Internal Medicine

Research Abstract: Introduction

Cystic fibrosis (CF) is a genetic disorder that perturbs respiration that leads to pulmonary infections. Previous studies have suggested that changes in DNA methylation, an epigenetic modification involving the addition of a 5-methyl group to the cytosine residue followed by guanine residue (CpG site), is associated with the development of CF. In a published study, the treatment of CF patients with the demethylating agent epigallocatechin gallate (EGCG) and cysteamine were shown to alleviate CF symptoms. However, the specific epigenetic effects of CF and EGCG treatment on the disease methylome are largely unknown.

Methods

Reduced representation bisulfite sequencing (RRBS) was used to quantify DNA methylation at single-base resolution in wild-type (WT), CF-, and EGCG-treated CF mice. The RRBS data were aligned to the bisulfite converted murine genome, and methylation signals were analyzed using the statistical tools in methylKit R-package to yield analyzed data such as PCA and differentially methylated cytosines (DMCs) between treatment groups. In addition, we utilized custom scripts to visualize RRBS data and to assist in the analysis of methylKit output.

Results

Of particular interest were DMCs localized in distal promoters. There were 5241 DMCs in WT vs CF and 3060 DMCs. These data revealed that CF mice had increased levels of DNA methylation in the proximal promoter regions in comparison to WT mice, and EGCG treatment on CF reduced the methylation levels to those found in the WT mice.

Conclusions

The CF and EGCG-treated CF methylomes showed a distinct pattern with global hypermethylation in CF samples and EGCG treatment was able to reverse this trend. Moving forward, we will focus on a gene-by-gene analysis of DMCs and CpGs to identify regions and genes that are preferentially perturbed by CF and EGCG-treatment.
Research Project Title: Yin and Yang mutants to study pre-synaptic Cre-loxP complex

Student Presenter: Devante Potter

Faculty Mentor: Mark Foster

Faculty Mentor Department: Chemistry and Biochemistry

Research Abstract:

Cre recombinase is a site-specific DNA recombinase derived from bacteriophage P1, that is commonly used in biomedical research to recombine DNA molecules in a highly controlled manner, without the use of other cellular cofactors. To recombine its specific loxP DNA sequences, two pairs of Cre molecules assemble as a dimer of homodimers onto two loxP sites. Which are then brought together via protein-protein interactions to form a tetrameric pre-synapse [(Cre2-loxP)2]. X-ray crystallographic studies have shown that the recombination pathway follows through this tetrameric synapse and a DNA four-way Holliday junction intermediate. However, little is understood about the intermediates leading to assembly of the recombination complex.

I seek to engineer two Cre mutants (termed "Yin" and "Yang"), totaling ten point mutations, that are incapable of forming the synaptic tetramer, but can assemble as a heterodimer on loxP, allowing formation of the assembly intermediate Cre2-loxP. Structural studies of these pre-synaptic complexes will lend insight to the study of dimer formation, DNA bending, and the thermodynamic contribution of each protomer to the binding of the asymmetric binding element between loxP sites.

To engineer Yin and Yang, I am using site directed mutagenesis by performing polymerase chain reactions (PCR) with complementary mutagenic DNA primers and a plasmid encoding the Cre gene as the starting template; at each step, the resulting mutagenized plasmid serves as the template for the next PCR reaction. Following completion of the construction of the genes encoding the Yin-Yang pair, the proteins will be expressed recombinantly in E. coli, purified and their complex on loxP will be characterized by electrophoretic mobility shift assays (EMSA). Thus far, I have succeeded in engineering Yin through site directed mutagenesis and the protein has been purified and expressed. Site directed mutagenesis to construct Yang is in progress.
Research Project Title: Characterization of DNA methylation in CHH contexts

Student Presenter: Whitney Powers

Faculty Mentor: Pearly Yan

Faculty Mentor Department: Internal Medicine

Research Abstract: Introduction

DNA methylation is an epigenetic modification which can repress transcription. Methylation in the human genome occurs at Cytosines (Cs) predominantly in CpG contexts (a Cytosine followed by a Guanine (G)), however, methylation can also occur in CHG and CHH contexts, where an H represents any base except for G. Single-base resolution methylation analysis can be achieved with reduced representation bisulfite sequencing (RRBS). Bisulfite conversion changes unmethylated Cs into Thymines (Ts). Methylated Cs are unaffected by this process. Since methylation primarily occurs at CpG sites, the amount of methylation in CHG and CHH contexts is traditionally used as an indicator for incomplete bisulfite conversion. Interestingly, we noted that RRBS data can sometimes harbor a non-significant amount of CHH methylation (~5%) and our analysis reveals that they tend to contain a sequence motif often found in centromeric regions.

Methods

RRBS data from OSU and from public data sets were analyzed. Regions containing methylated CHHs were investigated. Several samples were processed at the original 150 bp length, as well as trimmed to 75 bp. This allowed for the analysis of read length dependencies. Additionally, samples were filtered for high levels of methylated CHHs, as well as the presence of repetitive motifs. This allowed for the characterization of the locations of methylated CHHs.

Results

In RRBS data, CHH methylation appears to be distributed primarily in reads with multiple methylated CHHs. We found that much of CHH methylation is in reads with repetitive characteristics and shared a common motif often found in human centromeres. Interestingly, the alignment rate of these reads is highly dependent on the read length.

Conclusion

Our findings suggest that the alignment of these reads to the annotated portion of the human genome may be misleading, and the source of these reads may likely be the poorly annotated centromeric region. Furthermore, we show that the centromere contributes significant non-CpG methylation to RRBS data and by removing centromeric DNA prior to processing by library generation or by removing centromeric reads prior to alignment will increase the usability of CHH methylation as a surrogate of incomplete bisulfite conversion.
Research Project Title: A chemical crosslinking approach to elucidate the sub-unit arrangement of the essential tRNA deaminase from Trypanosoma brucei

Student Presenter: Amelia Staats

Faculty Mentor: Juan Alfonzo

Faculty Mentor Department: Microbiology

Research Abstract: The eukaryotic parasite, Trypanosoma brucei, is the causative agent of African Sleeping Sickness (Trypanosomiasis). According to the CDC, this disease threatens the lives of thousands of people in sub-Saharan Africa with a 100% mortality rate in untreated cases. Our laboratory studies transfer RNA (tRNA), an adaptor molecule which links the information encoded in the genome to protein synthesis. tRNAs receive a number of naturally occurring nucleotide chemical modifications, which are critical for translation; and therefore, are often essential to the viability of the parasite. Modifications may result in the change of one nucleotide to another; these belong to a sub-group of modifications collectively known as RNA editing. In T. brucei, certain tRNAs undergo editing events from A to I (adenosine to inosine) essential for viability, catalyzed by a heterodimeric enzyme called ADAT2/3 (adenosine deaminase acting on tRNA). This enzyme is made up of two distinct subunits, ADAT2 and ADAT3. Given their essentiality, it is important to understand the enzyme structures and function. The structure of ADAT2/3 has been difficult to elucidate partly due to the predictably highly dynamic nature of the N-terminal region of the ADAT3 subunit. In this study, we use chemical crosslinking to covalently bind the two subunits of ADAT2/3 together. Crosslinking dilutions will be made to determine the optimal concentration of chemical cross-linker to be used, ensuring that only one molecule of ADAT2 gets crosslinked to one molecule of ADAT3. This step is important to avoid crosslinks due to non-specific interactions that do not normally occur in the native enzyme and are therefore non-physiological. The properly crosslinked subunits will be analyzed by mass spectrometry to reveal key interactions between subunits, establishing their natural orientation. This analysis will allow us to determine the subunit conformation for this essential enzyme, which in turn will provide us with a better understanding of its function. In addition, to validate the results above, we will generate deletions to the N-terminal region of ADAT3 and determine how such deletions impact the ability of the enzyme to bind to the tRNA and catalyze the A to I reaction. Binding and activity assays will be conducted to assess how the cross-linked structure, as well as various mutants, affect enzyme function. Ultimately, elucidation of the deaminase structure is important to understand this unique modification pathway. In the long term, this information could potentially be exploited for the design of new anti-trypanosomal drugs and help combat this medically important parasite.
Research Project Title: Use of CRISPR to determine ligand effects on EGFR signaling

Student Presenter: Dan-Ho Tran

Faculty Mentor: Amanda Simcox

Faculty Mentor Department: Molecular Genetics

Research Abstract: Abstract

The Epidermal Growth Factor Receptor (EGFR) pathway is a complex and intensely studied signaling pathway that controls cell growth, proliferation, survival, and differentiation. The EGFR pathway is highly conserved in animals and altered pathway function can result in diseases like cancer. The signaling pathway is initiated by ligands (growth factors) that bind to the membranebound EGFR receptor and cause a signaling cascade into the nucleus through a common set of cellular proteins. However different ligands can result in different signaling outputs even though they use the same intracellular pathway. How these growth factors lead to different outcomes is an important question to study. In mammals, the EGFR pathway has many ligands (derived from eleven genes including EGF, TGF-alpha, epigen, and the neuregulins) and four receptors, whereas, in Drosophila there are only four ligands and one receptor. Due the relative simplicity of Drosophila it is easier to design an experiment to analyze downstream signaling triggered by a single ligand. In mammals this would be difficult because there are numerous ligands and these interact with multiple receptors generating great complexity. I will be focusing on the Drosophila ligands called Spitz (Spi) and Vein (Vn), which are members of different ligand families. Vn has a similar domain combination to the neuregulins and Spi is structurally similar to TGF-alpha ligands. Recent studies have led me to hypothesize that Spi will induce cell differentiation and Vn will cause cell proliferation. To test this hypothesis, cell lines expressing only Vn or only Spi will be generated using gene editing (CRISPR-Cas9). The other two Drosophila ligands share functional overlap with Spi and thus both can be deleted using CRISPR-Cas9. The cells will be used to evaluate differences in cellular phenotype and molecular signature (RNA-seq) following signaling initiated by single ligands (Vn or Spi). These results will be important for understanding how different responses are induced by distinct ligands using a common intracellular pathway.
Research Project Title: Identification of new players involved in creation of specific membrane domains in pollen of Arabidopsis thaliana

Student Presenter: Zachary Weber

Faculty Mentor: Anna Dobritsa

Faculty Mentor Department: Molecular Genetics

Research Abstract: Most pollen grains have, on their external surface, a complex arrangement of deposited materials. These deposits, known as exine, show species specific patterns and are often interrupted by distinct regions without deposits called apertures. Arabidopsis thaliana has three longitudinal apertures spaced equidistantly at the equator of the grain. The mechanisms by which sites for pollen apertures are selected and aperture formation occurs are still largely unknown. To identify potential members of the underlying pathway, we conducted a large screen of A. thaliana accessions to identify naturally occurring exine and aperture defects. From the screen, we found one accession with incompletely formed apertures. This defect was mapped using bulk segregate analysis and next generation sequencing to the gene encoding a kinase D6PKL3 and was confirmed via complementation and T-DNA insertion lines. We hypothesized that proteins affecting aperture development would localize to the positions of future apertures in developing pollen grains. We found that fluorescently-tagged D6PKL3 localized to the sites of future apertures on the interior of the plasma membrane during early pollen development. The structures of the D6 protein kinase-like family (D6PK) members predict conserved regions including phosphatidyl inositol phosphate (PIP) variant binding sites. PIP variants have previously been described to play a role in polarization of distinct membrane domains, and we suspected they may also play a role in specifying aperture domains on the plasma membrane. Lipid binding assays of D6PKL3 showed binding affinity for several PIP variants. To assay whether these PIP variants corresponded to developing apertures, we created fluorescently-tagged marker proteins known to interact with these PIP variants and tested their localization in developing pollen of A. thaliana. Two PIP variants, PI(4)P and PI(4,5)P2, were shown to localize to future aperture sites. D6PKL3 is only the second gene known to affect aperture formation in Arabidopsis. Its discovery and characterization are important to the formation of potential pathways in exine patterning and aperture formation. It’s structure and affinity for modified lipids also gives important direction for the identification of downstream and upstream interacting members.
Research Project Title: MetaPop: a metagenomic data analysis pipeline for investigating microbial population genetics

Student Presenter: Kenji Gerhardt

Faculty Mentor: Matthew Sullivan

Faculty Mentor Department: Microbiology

Research Abstract: Metagenomics, the study of genetic information in natural microbial populations, has revolutionized microbiology by elucidating the diversity of microbes and their interactions in complex communities. Although initially limited in such applications, recent improvements in genetic sequencing and computing technologies have made it possible to not only assess which populations are in a community, but also to study the diversity within these populations. Currently such efforts are largely manual. Here we sought to establish an analytical pipeline that enabled researchers to better study variation within populations from single nucleotide polymorphisms to population haplotypes in a way that could be applied to multiple samples capturing spatial and temporal variation in response to changes in their environment. This pipeline, which we call MetaPop, cleans and processes data to quantify population genetic metrics (codon bias, Tajima’s D, Pi and Theta, FST, and pN/pS) and identify haplotypes for abundant populations in deeply sequenced metagenomes, and provide metadata about each sample’s quality and breadth. MetaPop is mostly written in R, co-opts several popular metagenomic tools, and improves upon prior pipelines by (i) increasing the speed, breadth, and rigor of the metagenomic analyses being performed, (ii) empowering the user to process data locally or using a supercomputer, (iii) provides output in both tabular and figure formats to better enable exploration of patterns and trends, and (iv) scales linearly with data, so that the time taken to process larger datasets only increases linearly, instead of exponentially, so that MetaPop can handle datasets of any scale. By making population genetics more accessible and robustly applied to metagenomic datasets, we anticipate significant advances in establishing meaningful biological species definitions for microbial populations, as well as identifying and linking microbial microdiversity to ecological drivers and evolutionary processes.
Research Project Title: Identifying defects in midline axon guidance using fruit fly natural population lines

Student Presenter: Maya Gosztyla

Faculty Mentor: Mark Seeger

Faculty Mentor Department: Molecular Genetics

Research Abstract: The central nervous system (CNS) midline is an important choice point for many pathfinding axons during neural development. Previous studies have searched for novel regulators using mutagenesis experiments involving a few inbred laboratory strains of the fruit fly, Drosophila melanogaster. However, no studies thus far have attempted to utilize the polymorphic variation that exists in natural populations to study embryonic axon guidance at the CNS midline. This approach was recently enhanced by the creation of the D. melanogaster Genetic Reference Panel (DGRP), which consists of more than 200 isogenic, sequenced strains derived from an outbred population. In the present study, embryos from 142 DGRP strains were stained using one of two antibodies: BP102, which labels all axon pathways, or 1D4, which labels a subset of longitudinal axons that normally do not cross the CNS midline. We then selected a minimum of $n = 5$ embryos per strain for each antibody and scored for the presence of missing commissures or ectopic midline crossovers. We identified 39 strains where at least one embryo showed one or more defects in axon guidance. Of these, 18 showed only missing commissures, 16 showed only ectopic crossovers, and 5 showed both types of defects. Between these 39 strains, we observed considerable variation in the penetrance of the observed phenotypes, ranging from 5% to 65% of embryos showing a defect within a strain. These observations demonstrate that natural variation exists among genes influencing midline axon guidance in D. melanogaster. We are now repeating these experiments using the remaining DGRP strains. In addition, we are utilizing a sensitized genetic background to screen for additional strains with axon guidance defects. In the long-term, this research may provide insight into the complex network of ligands, receptors, and signaling molecules that regulate axon guidance.
Research Project Title: A genetic model of common, complex disease hints at genomic architecture

Student Presenter: Elizabeth McNamara

Faculty Mentor: Jennie Rowell

Faculty Mentor Department: College of Nursing

Research Abstract: Background: One of the greatest challenges facing scientists today is an understanding of genetic factors associated with the development of common, complex diseases such as diabetes, depression, and cancer. In addition to symptom burden (affecting quality of life), premature death, and disability caused by such diseases, the economic burden to society is vastly overwhelming. Last year, Major Depression alone cost nearly $211 Billion [USD] to US taxpayers. Yet, these diseases have been incredibly arduous to study due to the hundreds of genes that contribute very small effects that lead disease development. We suggest that an alternative model of complex diseases is needed to elucidate the causative genetic mechanisms. We exploit a naturally occurring clear phenotype (brindle color) present on a simplified genetic background (pet dogs) and analyze large-scale genomic variation (CNVs) effecting gene expression (epigenetics – DNA methylation).

Significance: Common, complex disease is a tremendous burden for patients, families, and clinicians alike. Elucidation of the genetic mechanisms leading to disease development would result in personalized therapies and improved patient outcomes.

Purpose: To identify large-scale genomic variations present in Brindle color dogs and determine if epigenetic regulation is leading to phenotype development.

Methods: Using a custom-designed aCGH to interrogate genomic structural variation, we analyzed 12 dogs of 3 different coat colors (Black, yellow, and brindle). Then, we performed genomewide DNA methylation analysis on a subset of 8 dogs to determine the effect genomic variation has on epigenetic silencing of gene expression.

Results: We identified a 67 Kb complex genetic variation (10 probes, p=0.001) that disrupts gene expression and is epigenetically silenced in certain skin cells producing pigment differences (p=0.04).

Conclusion: Brindle coat color in canines is a complex genetic mechanism involving structural changes leading to epigenetic effects. Identifying this mechanism provides the first tractability for understanding complex diseases and is particularly exciting as a model for identifying such features in human diseases.
Research Project Title: Exon skipping using an AAV-U7snRNA approach and its therapeutic implication for Duchenne Muscular Dystrophy.

Student Presenter: Daniel Lesman

Faculty Mentor: Nicolas Wein

Faculty Mentor Department: Center for Gene Therapy

Research Abstract: Duchenne Muscular Dystrophy (DMD) is a recessive X-linked degenerative muscle disorder affecting 1 / 5,200 males. DMD usually occurs due to mutations in the DMD gene that disrupt the reading frame. DMD encodes for dystrophin, a protein that links the F-actin cytoskeleton to the plasma membrane through its actin binding domains (ABD). Because of this, such domains were thought to be crucial for dystrophin function. However, recent evidence is challenging this dogma as proteins missing part of ABD1 were demonstrated to be highly functional. We have in the past developed a therapeutic vector inducing such protein lacking part of ABD1. Under this project we intend to develop another exon skipping vector inducing such proteins in order to potentially treat a sub population of DMD patients (~4% of patients). We developed a complex of proteins and antisense sequences (U7snRNA) mediating exon skipping. The advantage of our approach is that the antisense sequence is embedded, thereby protecting it from degradation and causing accumulation in the nucleus where splicing occurs. Moreover, when embedded into an Adeno-Associated Virus (AAV), these U7snRNAs can be permanently expressed. We transfected myotubes with a variety of plasmids to determine the best way to skip DMD exons. Our preliminary results support the ability of U7snRNA to mediate exon skipping. We are currently screening additional U7snRNA that mediates exon skipping. Cloning of the best candidates into a single AAV plasmid will then be performed to produce AAV. This AAV will be used in patient cell lines harboring mutation within exon encoding for the ABD1 domain. These results suggest that this U7snRNA vector offers a therapeutic approach for patient harboring mutations within exons encoding for ABD1 (~4% of patients), an area of the gene largely ignored by the current therapeutic approaches.
Research Project Title: Global local folding of the human transcriptome

Student Presenter: James Li

Faculty Mentor: Peter White

Faculty Mentor Department: Pediatrics

Research Abstract: Currently, disease-associated variants in humans are largely procured via their predicted functional impacts on proteins. Past in silico studies propose that selection in humans and mammals may have been shaped by mRNA secondary structure, but the direct impact of RNA folding on genetic diseases is not fully understood. Hence, a systematic whole transcriptome study of SNP (single nucleotide polymorphism) impacts on local RNA folding has yet to be undertaken. We aimed to (1) develop a cloud-based big data pipeline to generate RNA folding statistics for every possible polymorphism in the known human transcriptome (~0.5 billion variants), and (2) use population allele frequencies from 138,632 individuals, as well as mammalian conservation scores to see if SNPs causing large RNA disruptions were constrained, thus supporting our hypothesis that RNA stability and structure influence disease. First, all known RefSeq mRNA transcript sequences were retrieved and processed to generate 101 nucleotide flanking sequences for every position in each transcript. For every position, flanking sequences corresponding to each of the three possible alternate alleles were also generated and analyzed using our implementation of the ViennaRNA Package to obtain 10 RNA folding disruption metrics. SNPs were then joined with data from the Genome Aggregation Database, and ultimately annotated with SnpEff. Following this data compilation, we sorted the SNPs for each of their ten RNA folding metrics and binned these SNPs based on the percentiles of each of their metric values. Metric bins corresponding to higher RNA disruption values had a smaller fraction of SNPs with non-zero allele frequencies than metric bins corresponding to lower RNA disruption values. Analysis of mean and median GERP++ scores for each metric bin illustrated that positions of SNPs that were predicted to cause large RNA disruptions tended to have a deficit of mutations compared to a neutral substitution rate. The relationship of both constrained allele frequencies and GERP++ scores with increased RNA disruption metrics suggests that RNA folding disruptions may play a significant role in human health and disease.
Research Project Title: Psychosocial effects of frequent social media use on adolescent males

Student Presenter: Traci Blue

Faculty Mentor: Amy Ferketich

Faculty Mentor Department: Public Health

Research Abstract: Intro

As the percentage of adolescents using social media continues to increase worldwide, it is important to understand its relation to psychosocial disorders. Many studies in the past have focused on females and social media use. This study evaluates the amount of time spent on social media by male adolescents and its association with symptoms of psychosocial disorders.

Methods

Adolescent males (n=1220, age 11-16 years) from one urban and nine rural Appalachian counties in Ohio, completed a self-administered baseline questionnaire. Youth reported how often they used social media and their last incident with feelings of depression, anxiety, loss of attention, and trouble sleeping. We categorized social media frequencies as use more than once a day vs. less frequently. We also dichotomized the psychosocial symptoms as occurring within the past year vs. not within the past year. Survey-weighted Chi-squared tests were used to test the association between social media use and reported disorders.

Results

The average age of the adolescents was 13.9 years, 68.2% were non-Hispanic white, and 16.2% were non-Hispanic black. Overall, within the participants, it was found that 33.1% use social media more than once/day, 36.5% felt depressed in past year, 55.4% had trouble sleeping, 56.1% felt anxious, and 59.8% had a hard time paying attention. Among adolescents who used social media more than once a day, 37.5% expressed depression symptoms (vs. 35.9% among less frequent users), 61.4% expressed anxiety (vs. 53.2% among less frequent users, p = 0.05), 61.6% expressed trouble sleeping (vs. 52.5% among less frequent users, p = 0.03), and 65.8% expressed trouble paying attention (vs. 57.1% among less frequent users, p = 0.03).

Conclusions

Adolescent males who used social media more than once a day were at a higher risk for anxiety, trouble sleeping, and trouble paying attention. This study contributes additional knowledge on the topic of social media's effects on male adolescents' mental health. In future studies, it may be beneficial to give a test that is more sensitive in evaluating such disorders, instead of having participants self-report a few common symptoms of a disorder.
Research Project Title: Prenatal substance exposure: family functioning, strengths, and needs

Student Presenter: Rebecca Bradley

Faculty Mentor: Linda Helm

Faculty Mentor Department: Social Work

Research Abstract: When a woman uses drugs or alcohol during pregnancy, the fetus is exposed to the substances in utero. This causes extended hospital stays for infants, risks of complications, and extra challenges for new mothers. According to the National Center on Substance Abuse and Child Welfare, an estimated 15% of infants are affected by prenatal alcohol or illicit drug exposure. Prenatal substance exposure complicates pregnancies and possibly the ability for a mother to parent her infant. This warrants a report to Child Protective Services to ensure the child’s safety. This study is an analysis of The National Child Abuse and Neglect Data System (NCANDS) Child File from the National Data Archive on Child Abuse and Neglect at Cornell University. Data from the years 2002-2015 will be analyzed. The population of interest is families that have a child who has been prenatally exposed to substances. This population is identified using two variables, Drug Abuse Child marked yes, alongside of Child Age at Report marked less than one. The research question asks what risk contributors, disabilities, and referrals are significant with families with a drug dependent child under the age of one? Has there been a change in common risk contributors, disabilities, and referrals associated with these families over time? Risk contributors include history of maltreatment, inadequate housing, domestic violence, and substance use. Disabilities include mental illness, learning disability, physical disability, and visually or hearing impaired. These variables refer to any member of the family. What referrals are given to these families could include case management services, counseling services, employment services, housing services, and legal services. Father involvement and family support is also a variable of interest. An analysis of these variables will provide a well-rounded view of the functioning, strengths, and needs of these families. This information will be beneficial for Child Protective Service workers as well as Nurses and other professionals working in Neonatal Intensive Care Units where prenatal substance exposure is identified as well as identifying the social services that can be of help to families.
Research Project Title: Discrimination and depression in lesbian, gay, and bisexual adults: the role of emotion regulation

Student Presenter: Ashley Brancamp

Faculty Mentor: Michael Vasey

Faculty Mentor Department: Psychology

Research Abstract: Background: Lesbian, gay, and bisexual (LGB) individuals consistently demonstrate higher rates of mental illness compared to heterosexual peers (Cochran, 2001). One explanation for this might involve experiences with discrimination (Bostwick et al., 2010). Indeed, Meyer’s (2003) minority stress theory proposes that others’ negative evaluations might induce poor psychological outcomes. The mechanisms behind this phenomenon are less clear. One possibility might involve their approaches to emotion regulation (ER), the processes by which individuals modulate how, when, and which emotions they experience (Gross, 1998). The present study examined the effect of discrimination on state-level ER in an LGB sample. We expected that individuals high in depressive symptoms would be more likely to use maladaptive ER strategies in response to a discriminatory stimulus, compared to those low in depressive symptoms.

Method: LGB adults (N=169) completed an online study in which they watched an affirming or discriminatory video and reflected on this experience in a writing task. Responses were coded for three ER strategies (rumination, worry, reappraisal). We ran regressions predicting state ER strategy use during the reflection task using depression symptoms (measured by the CES-D) and video (discriminatory, affirming).

Results: The model was a marginal predictor of state rumination (F(2, 168) = 2.77, p =.066, R2=.032), and state reappraisal (F(2, 167) = 2.71, p =.07, R2=.020), but it did not predict state worry (F(2, 168) = 0.37, p =.70, R2=.004). Specifically, participants made on average 3.95% more ruminative statements and 2.52% more reappraisal statements in the discriminatory condition relative to the affirming condition. Depression scores were not significant predictors of state ER (ps > .18).

Conclusions: These findings suggest that LGB individuals utilize both adaptive and maladaptive ER strategies to cope with experiences of discrimination. Interestingly, we found that depression was unrelated to state ER use. Most research examining depression and ER has used trait measures, more research is needed to understand how state and trait ER strategy use converge. Prevention and intervention efforts with this population should focus on increasing the ratio of adaptive to maladaptive strategy use in discriminatory contexts, to reduce the immense mental health burden within the LGB community.
Research Project Title: Impact of sharing economy engagement on environmental efficiency of well-being scores of Clintonville and Olde Towne East residents in Columbus, Ohio

Student Presenter: Sophie Chang

Faculty Mentor: Jeremy Brooks

Faculty Mentor Department: School of Environment and Natural Resources

Research Abstract: The “sharing economy” describes collaborative forms of consumption that may improve efficiency and increase well-being by enhancing a sense of community. Despite expectations that the sharing economy can contribute to more sustainable forms of consumption, it is unclear whether engagement actually improves well-being and reduces environmental impact. To investigate whether the sharing economy has these intended effects, we used the environmental efficiency of well-being (EWEB). A high EWEB score is indicative of individuals who have high well-being and relatively low ecological footprint. Using a survey of 271 residents in two Columbus neighborhoods, we collected data on well-being, consumption, and behaviors that are components of the sharing economy. We calculated individual EWEB scores and fit linear regression models to examine whether engagement in the sharing economy is associated with a more sustainable lifestyle. Preliminary results suggest that, after taking into consideration age and income, individuals who participate in a larger number of sharing economy behaviors have significantly higher EWEB scores. In addition, car-sharing, car-pooling, childcare-sharing, gardening, borrowing library books, sharing books with family, and purchasing clothing from second-hand stores are all associated with higher EWEB scores. Results also suggest that higher EWEB scores are driven by increases in well-being that come from sharing rather than from a lower ecological footprint. Future research is needed to understand whether and how engagement in the sharing economy may also reduce environmental impacts and to examine whether the relationship between the sharing economy and EWEB is shaped by neighborhood-level socio-economic conditions in Columbus and beyond.
Research Project Title: Variables for predicting successful completion of a treatment program for juvenile males who have committed sex offenses

Student Presenter: Morgan Brenner

Faculty Mentor: Audrey Begun

Faculty Mentor Department: Department of Social Work

Research Abstract: According to the most recent data from the U.S. Department of Justice (2007), adolescents (all genders) perpetrate about 22% of all sex offenses and 15% of all rapes. The importance of rehabilitation in these formative years is significant, especially considering that about half of adults who committed sex offenses have disclosed that their first offenses were committed during adolescence (Fritz, 2003). The purpose of this research was to ask, “Which variables can best predict successful completion of a residential treatment program for juvenile males who have committed sex offenses?”

The data used in this study were collected at Hittle House, a residential treatment facility in Columbus specializing in programming for adolescent males who have been identified as being “sexually reactive.” Based on review of the literature, we included information from record review for all 94 discharged cases on the categorical variables of victim type (sibling, friend, or stranger), adoption/foster care history (yes or no), and levels of parental/guardian involvement (low, moderate, high), as well as the continuous variable of Juvenile Sex Offender Assessment Protocol (J-SOAP) scores. Logistic regression analysis for the J-SOAP scores predicted successful program completion versus other outcomes (p<.001) 67% of the time, where lower problem scores were associated with successful completion. Chi-square analysis was significant for successful outcome by parent involvement (p<.05), but not by victim type or adoption/foster care history; parent involvement was not significantly related to victim type but was related to adoption/foster care history (p<.05). Analysis of variance showed parental involvement was lowest when J-SOAP problem scores were high (p<.05) and J-SOAP scores were unrelated to victim type. With these results, this study offers insight for clinicians at Hittle House and other similar programs, as well as a starting point for future analyses.
Research Project Title: Utilizing a city brand to inform investment and economic development

Student Presenter: Maria de Caris

Faculty Mentor: Kyle Ezell

Faculty Mentor Department: City and Regional Planning

Research Abstract: This thesis will explore the attributes of a city brand, who the stakeholders are, and which city assets commonly influence a positive brand image. A case study will compare how Columbus’s brand positioning is set to meet target outcomes versus how another city is using their own brand positioning to reach specific outcomes (ex. tourism, firm attraction and retention, etc.). This comparison will help define strong versus weak brand identity. Success indicators in cities such as rising housing prices and population growth will be acknowledged as it correlates with positive or negative brand image. The purpose of this research is to prompt urban leaders to have a basic understanding of city brand strategy as an economic development tool. Exploring why cities undertake a branding process and what they hope to achieve from it is an important way to understanding the correlation between investment and outside perception.
Research Project Title: Community perceptions of toxic stress

Student Presenter: Caroline Buck

Faculty Mentor: Barbara Warren

Faculty Mentor Department: Nursing

Research Abstract: Introduction: Toxic stress involves life course exposure to adversity without adequate support or protective factors. This adversity begins in childhood and continues through adolescence and adulthood, and may occur in form of abuse, neglect, exposure to violence or prolonged economic hardship that results in protracted biological and psychological alterations in the lives of affected persons. These alterations have negative consequences for persons’ overall health, well-being, and positive life course progression. Research indicates that the presence of toxic stress may be more detrimental across the life course for persons from African American populations living in poor, stress-filled communities. The purpose of this study was to ascertain the perceptions of African American adults regarding stress and traumatic events occurring in their environment.

Methods: A phenomenological approach was used to gather information on African American participants’ interpretations of their lived experiences regarding stress and traumatic events within their lives. Participants aged 18-70 years were recruited from a near eastside community in Columbus, Ohio because this community has a large number of African American adults and experience a high incidence of stressful and traumatic events that occur. A business owner in the community was a gatekeeper who helped to recruit participants for the study. Participants were randomly split into two groups. Focus groups were conducted with participants by two advanced practice mental health nurses and two senior nursing students. A neighbor provided the location where the groups were conducted. Sessions were videotaped, transcribed, and analyzed for emerging themes.

Results: Themes emerged regarding participants’ health. These included the high amounts of violence and lack of resources in their community have led to constant high levels of stress and anxiety, concern about how this affected children as well as themselves, and providing help to children and adolescents to prevent harm.

Conclusion: Results from this phenomenological study supports literature that toxic stress can lead to poor overall health. Additional studies need to be conducted within similar communities in order to further understand the effect that toxic stress has on African Americans within community settings.
Research Project Title: Exploration of cultural discipline as a contributing factor to communal stress in African American adults in The Near East Side of Columbus, Ohio

Student Presenter: Morgan Ciehanski

Faculty Mentor: Elizabeth Fitzgerald

Faculty Mentor Department: Graduate Studies, Nursing

Research Abstract: Introduction/Background: Discipline of children varies, and is multifactorial in its intent and impact. Exposure to discipline begins in childhood and continues through adolescence and adulthood. Physical or verbal discipline may come from parents and family, the community, or society. A lack of discipline, as well as parental permissiveness, positively predicts developmental changes and deviant behaviors in children (Harris et al., 2017). Community stressors may include abuse, neglect, and exposure to violence or prolonged economic hardship that results in protracted biological and psychological alterations in individuals. These alterations may have negative consequences for overall health, well-being, and positive life course progression. Exposure to violence in communities can desensitize children and they can violent acts if parents do not aim to mitigate them (Tyler, 2013). The purpose of this study was to ascertain the perceptions of African American adults regarding stress and traumatic events occurring in their environment.

Methods: A phenomenological approach was used to gather information on African American participants’ interpretations of their lived experiences regarding stress and traumatic events within their lives. Participants aged 18-70 years were recruited from a near eastside community in Columbus, Ohio. A community leader and business owner in the community hosted space for the groups. Three focus groups were conducted and led by an advanced practice mental health nurse and two senior nursing students assisted. The focus groups were audiotaped, transcribed, and analyzed for emerging themes.

Results: Various themes emerged but my focus was the cyclic nature of violence in the community, a concern that parents were not able to effectively discipline their children, and a lack of communal discipline and support in the current environment that existed when the participants’ were growing up in the community.

Conclusions: Results from this phenomenological study support findings in the literature regarding a lack of discipline in children can lead to poor overall health of the community residents. Additional studies need to be conducted within similar communities.
Research Project Title: Social capital among those experiencing housing hardship

Student Presenter: Brooke Epstein

Faculty Mentor: Katie Maguire-Jack

Faculty Mentor Department: Social Work

Research Abstract: Housing hardship is a common trend experienced by many individuals across the United States. Housing hardship includes struggling to pay rent or mortgage bills, moving in with family and friends, living in a car, or living with government support through subsidized housing or vouchers. The instability that comes with housing hardships can be greatly impacted- both positively and negatively by social capital. Social capital is the networks that individuals build around themselves through their community and their peers to create their own support system. In this study, I examined the difference in social capital for individuals who are experiencing housing hardships compared to those who are not experiencing housing hardships. I also examined correlates of social capital for those with housing hardships. Using the Fragile Families and Child Wellbeing Study, a longitudinal birth cohort study of approximately 5,000 families, I conducted a series of linear regressions to analyze these relationships. Among the individuals who participated in the study, 14.4% receive subsidized housing from the government but many more participants have other housing hardships. There is a shortage of information regarding social capital and how it can be utilized by individuals to better their current situations. This study will continue to push for more research in social capital, how it can come about, and the benefits or disadvantages it can have on some of the nations most vulnerable individuals.
Research Project Title: Project SWEAT: a nutrition and physical activity assessment of USDA summer food service program sites in low-income urban zip codes

Student Presenter: Leah May

Faculty Mentor: Carolyn Gunther

Faculty Mentor Department: Human Sciences, Nutrition

Research Abstract: Background: Over 1/3 of U.S. children are overweight or obese. The summer months are a window of risk for unhealthy child weight gain. Unfortunately, little is known about the food and physical activity environments to which kids are exposed during the summer.

Objective: Project SWEAT is a prospective, observational study that aims to evaluate the multiple food and physical activity environments to which children are exposed during the summer. The objective of this sub-study of Project SWEAT was to examine the food/nutrition and physical activity[PA] environments away from the home “specifically, USDA Summer Food Service Program (SFSP) sites.

Methods: Two Columbus City Schools located in neighboring low-income urban zip codes were recruited, including 43205, 43206, and 43207. The summer structured programming occurring at USDA SFSP sites in the surrounding neighborhoods of the selected schools was identified. Sites were assessed using the Project SWEAT Site Environmental Assessment Form.

Results: 20 USDA SFSP sites were identified. 70%(n=14) of sites were open USDA Summer Food Service Program feeding sites, and the other 30%(n=6) were closed feeding sites. 90%(n=18) of sites had accessible water fountains. 25%(n=5) and 40%(n=8) of sites had snack and beverage vending machines with 100%(n=5) of snack vending machines having mixed healthy and unhealthy options. 88%(n=7) of sites had beverage vending machines having mixed healthy and unhealthy options and 12%(n=1) having only unhealthy options. Indoor and outdoor PA environments were present at 75%(n=15) and 85%(n=17) of sites, respectively. Specifically, 35%(n=7), 5%(n=1), 60%(n=12), and 85%(n=17) had swimming pool, trampoline, playground equipment, and a basketball hoop, respectively. 70%(n=14) had screen time devices present, specifically children had access to 55%(n=11), 50%(n=10), and 15%(n=3) had televisions, computers, and video game consoles respectively. Planned sites activities were 90%(n=18), 95%(n=19), and 90%(n=18) sedentary, light PA, and moderate/vigorous PA, respectively.

Conclusions: Overall, the food and PA environments of the sites were favorable due to the availability of PA environments at most sites and the health of available snack and beverage sources which were mixed. Information from this study can be used to reform policy to ensure child accessibility to positive environments to promote health during the summer months.
Research Project Title: Can child support help mothers be self-sufficient?

Student Presenter: Brian McClure

Faculty Mentor: David Blau

Faculty Mentor Department: Economics

Research Abstract: Introduction:

I am studying a policy regarding child support pass-through and disregard and this policy change's effect on self-sufficiency outcomes for families receiving TANF. I will measure self-sufficiency with enrollment in other government programs, labor force participation, and the number of hours worked per week. Child support is an important source of income for single mothers, so consistent payments may be one pathway to reaching long-term self-sufficiency outside of government assistance.

Methods:

I utilize CPS March data and the CPS Child Support Supplement to analyze a 2008 policy change in seven states (New York, New Mexico, New Jersey, Virginia, Oregon, Washington, and Pennsylvania) using a difference in difference model with state and time fixed effects. This will provide evidence for whether self-sufficiency outcomes change in response to the policy change.

Results:

I have not yet run regressions on the data, but I expect there to be a causal effect of the policy change on lower enrollment in government programs, greater labor force participation, and more hours worked per week.

Conclusion:

From the expected results, we can conclude that an increase in pass through and disregard amounts are associated with a greater ability for a single mother who receives TANF to achieve self-sufficiency (enroll in less government programs, work more hours per week, have higher labor force participation).
Research Project Title: The influence of population density on the inputs and outputs of innovation

Student Presenter: Samuel Horen

Faculty Mentor: Roger Bailey

Faculty Mentor Department: Marketing and Logistics

Research Abstract: From a macro perspective, cities across the world are constantly competing to become “sticky places” by attracting and retaining the best available people and businesses. To remain competitive in this era of rapid technological change and development, city officials and planners have placed a large emphasis on creating innovative environments. This paper hypothesizes that cities with higher density are more successful in such attempts, and evaluates whether or not a relationship exists between population density and innovation. To examine this relationship, USPTO patent data from the years 2000-2015 and R&D spending data from the year 2013 are compared against the population density of 26 unique Combined Statistical Areas (CSAs) or Metropolitan Statistical Areas (MSAs). Ultimately this study finds that both patent data and R&D data are weakly positively related to population density. When removing the San Jose-San Francisco-Oakland CSA, a highly innovative outlier, from the dataset the correlation becomes slightly stronger. Finally, this study indicates that population density by CSA may not be the most important population factor to consider when measuring innovation, as total population by CSA provided a stronger correlation to innovation.
Research Project Title: Dancing pathways to healing: Combatting social injustice through dance education

Student Presenter: Danielle Kfoury

Faculty Mentor: David Covey

Faculty Mentor Department: Dance

Research Abstract: Within the OSU Department of Dance, I have chosen to research dance pedagogy and community outreach, specifically working with a population of sexual violence survivors. Through a close partnership with OSU’s Office of Sexual Civility and Empowerment, I have explored the ways in which dance can be used as a means of healing for those who have experienced trauma. Additionally, I have investigated the ways in which dance as an art form can be embedded within communities to combat social injustices. The main component of my research involved teaching a weekly creative dance class to sexual assault survivors at OSU. Within my teaching and research, I aimed to question body autonomy and the ways in which one’s autonomy is lost and then re-gained. Upon teaching the classes, I crafted lesson plans with themes that related the students’ bodies to their lives and inner emotions. The themes I focused on included safety, taking up space, power, breath, initiation, and livelihood. Throughout my pedagogy, I have aimed to give the survivors a holistic experience of their humanity in which movement explorations involved their body, mind, and inner emotions, as these sensations often become separated after experiencing sexual trauma. My research also included involvement as a Sexual Civility and Empowerment Ambassador on campus, in which I became well versed on sexual consent education, sexual violence intervention techniques, and effectively engaging with survivors. My results have been multi-faceted, as I can evaluate my research from a pedagogical point of view, as well as from a community outreach and social engagement standpoint. Pedagogically, I have developed an incredible vocabulary for teaching dance from a trauma-informed perspective. I have observed my students move through class and transform their bodies move, whether it be across multiple classes or within the 1-hour period. This project is significant both in the field of dance as well as the overarching progress of justice within society and humanity. By creating an environment for survivors that is specifically centered around personal healing, I have empowered individuals and disrupted low levels of rape culture that are present in our society.
Research Project Title: Motivation in stereotyping in domestic violence cases

Student Presenter: Brooke Marston

Faculty Mentor: Steven Spencer

Faculty Mentor Department: Psychology

Research Abstract: The role of motivation in stereotyping has been studied extensively (Kunda & Spencer, 2003), but not in domestic violence situations. In this study, participants completed a threatening task known as cyberball and then shown a video in which they can hear a neighboring couple arguing through the wall. They then went through two separate trials where they were asked to pick between two racially ambiguous faces, based on which they believed to be closest to the male and females faces of the neighbors briefly shown in the video. We expect that when people are threatened they will be more likely to imagine that the violent male is Black.
Research Project Title: The role of state environmental justice actions on reducing environmental inequality from 1994 to 2004

Student Presenter: Grace Saalman

Faculty Mentor: Kerry Ard

Faculty Mentor Department: School of Environment and Natural Resources

Research Abstract: In 1994 President Bill Clinton signed Executive Order 12898 requiring state environmental protection agencies to consider how decisions differentially impacted poor and minority communities. Since this time, states have enacted a diverse set of actions to achieve environmental justice (EJ) in their states. Despite this on-going effort to minimize the racial and economic gaps in exposure, there is still evidence of disparities. For example from 1995 to 2004 national-level research indicates that African Americans were consistently exposed to twice the amount of toxic air pollutants as whites (Ard 2015). Moreover, African Americans of greater socioeconomic status were more exposed to toxins than whites of lower socioeconomic status (Ard 2015). The following paper breaks down these findings by state in order to determine if state-level variation in environmental inequality can be partly explained by state actions (laws, policies, efforts and movements) implemented to reduce environmental inequality. We use Hasting College of Law’s comprehensive survey of EJ Legislation enacted by states from 1994 to 2004 to evaluate if those states with more actions, and/or stronger actions are associated with smaller disparities between racial and socioeconomic groups over this decade. We found that states with the highest number of strong EJ actions do not necessarily have the greatest reductions in exposure inequality. Thus, there is evidence that some state environmental justice actions may not be effective.
Research Project Title: Selfish or selfless? How threatening diversity models affect interpersonal goals

Student Presenter: Ariana Munoz-Salgado

Faculty Mentor: Taylor Ballinger

Faculty Mentor Department: Psychology

Research Abstract: Introduction/Background: Previous research shows Whites are more threatened by diversity models emphasizing group differences (multiculturalism) where non-Whites are threatened by diversity models minimizing group differences (colorblindness; Plaut, Thomas, & Matt, 2009; Rattan & Ambady, 2013). While both diversity models seek to promote positive interracial relations, past studies have demonstrated the effects of a threatening diversity model (e.g., multiculturalism for Whites, colorblindness for non-Whites) on an individual’s emotions and cognitions. However, our research goes beyond by examining how it affects intergroup relations: the way individuals intend to relate to in-group and out-group members.

Hypothesis: We examine how a threatening diversity model affects individuals’ self-image goals (intentions to focus on themselves and how they appear to others) and compassionate goals (intentions to be caring toward others and form supportive relationships). We hypothesize that when non-Whites adopt the colorblind (vs multicultural) perspective, they experience social identity threat, adopting self-image goals and prioritizing their own needs and desires.

Methods: In a 2 (diversity model: colorblind or multicultural) x 2 (coworker race: ingroup or outgroup) factorial design, Black, Hispanic, and Latino/a participants (N=120) completed a survey ostensibly about workplace environments where they read a mission statement of a fictitious company. Within this mission statement, we manipulated whether the company had a colorblind or multicultural diversity model. Participants were then asked to imagine they were paired with a coworker that was the same race as them or White, and to report their self-image and compassionate goals toward that individual.

Analytical Strategy: A series of between-subject ANOVA’s, hierarchical linear regression, and moderation analyses will be used to analyze the results when data collection completes in late February.

Conclusions: This research is the first to examine how a threatening diversity model can affect non-Whites’ self-image and compassionate goals. We aim to provide evidence that the colorblind model produces negative feelings for non-Whites, encouraging self-image goals and a selfish mentality. By understanding how colorblind diversity models negatively impact non-Whites, making them feel isolated and disengaged, future work can focus on developing diversity models that promote positive interracial interactions between Whites and non-Whites.
Research Project Title: Echoes of discrimination: The lasting impact of redlining in Columbus

Student Presenter: Nick Spence

Faculty Mentor: Julie Field

Faculty Mentor Department: Anthropology

Research Abstract: Throughout the early 20th century the home loan process was dominated by the practice of Redlining. The drawing of artificial, arbitrary divisions through a city and then designating the homes in those areas only be owned by individuals of a certain ethnic or economic background. This process was done under the guise of ensuring that the loans would be "safe" for the banks but ultimately Redlining was in place to serve the prejudiced ideals of the day and ensure that newly minted "white" suburbs and schools would remain whites only. In this project I explored the degree to which Redlining practices are still visible in the city of Columbus by examining connections between the Redlining maps of Columbus and maps of food centers, health care centers, polling places, school districts, and modern day demographic data. I used the features available in arcGIS to cross reference the data sets with the original Redlining map that I digitized by hand for this project. I then compared the analysis results between each of the four grades on the Redlining map (A, B, C, and D). My results concluded that noticeable connections were found in the aspects of racial population density, school district boundaries, and food service locations with noticeable disparities between. The significance of the connections in these three areas warrant further investigation.
Research Project Title: Project SWEAT - Healthy Eating Active Living Mapping Attributes using Participatory Photographic Surveys (HEAL MAPPS): A qualitative approach to combating unhealthy weight gain in summer months in underserved school age children

Student Presenter: Amy Sharn

Faculty Mentor: Carolyn Gunther

Faculty Mentor Department: Human Sciences

Research Abstract: Introduction/Background: During the summer months, children from underserved homes are at risk for unhealthy weight gain. Little is known about the contributing food and physical activity environment factors. The objective of this study was to determine the environmental barriers and facilitators to healthy food and active living during summer break among children living in low-income, urban, neighborhoods.

Methods: Students in grades pre-k to 5th attending two Columbus City elementary schools located in low-income urban neighborhoods were invited to participate in the study. The Healthy Eating Active Living Mapping Attributes Participatory Photographic Surveys (HEAL MAPPS) protocol, which engages participants by using their smartphone-like device to identify facilitators and barriers to healthy living through images and mapping software, was utilized. HEAL MAPPS involves four contacts: 1) orientation to project and equipment training; 2) individual interview discussing images and routes taken; 3) focus group per school site discussing common experiences with neighbors/fellow MAPPers; and 4) local community stakeholder meeting to present images/findings and develop community action plan for each respective community.

Results: Nine families enrolled and mapped routes within their neighborhoods; five of these families participated in focus groups. Preliminary analysis of themes include: 1) poorly maintained walkways; 2) scarce accessibility to healthy, affordable foods; 3) multiple abandoned properties; and 4) unsafe activity near common neighborhood routes.

Conclusions: This information may be be used by local- and state-level stakeholders to improve low-income Ohio neighborhood environments to promote healthy eating and active living during summer months.
Research Project Title: Institutional actors and state death penalty laws: an analysis of Nebraska and Washington

Student Presenter: Derek Whidden

Faculty Mentor: Jack Wright

Faculty Mentor Department: Political Science

Research Abstract: My project analyzes changes in state death penalty laws since the Supreme Court’s 1972 Furman v. Georgia decision that struck down death penalty laws in the American states. My primary focus is on Nebraska and Washington, where voters used referenda to override decisions of the state legislatures. The Washington legislature decided in 1975 not to reinstate the death penalty after Furman, but voters in Washington passed a ballot initiative reinstating it. The Nebraska legislature voted in 2015 to abolish the state’s death penalty and then voted again to override the governor’s veto. However, Nebraska voters chose to repeal the statute and reinstate the death penalty in a November 2016 referendum. My research question is, “Why were some institutional actors-legislators, governors, or voters-more influential than others in determining death penalty laws in Nebraska and Washington?” My analysis draws from daily legislative journals, newspapers, recorded legislative votes, and county and district-level voting returns.
Research Project Title: Resource discrepancies for survivors of intimate partner violence: the effects of different policies and programs within Ohio counties

Student Presenter: Alyssa Wischmann

Faculty Mentor: Bridget Freisthler

Faculty Mentor Department: Social Work

Research Abstract: Introduction/Background: Intimate partner violence accounts for 15% of all violent crime with 33% of women and 25% of men who are survivors. Survivors shy from formal resources; 55% of male survivors and 49% of female survivors opt not to report. However, there is a lack of information on the impacts policies have on the availability of resources and programs offered to survivors throughout communities. The current political landscape of the U.S. is unprecedented with increasing dispute on globalism and multiculturalism within the country. This specific study seeks to depict the impacts policies at the state-level have on the availability of resources and services for IPV survivors and their communities.

Methods: A thirty-minute phone interview was administered with fifteen randomly selected shelter directors from across Ohio. Geographic information systems (GIS) was used to determine if the resources provided in Ohio counties match the need and risk, as indicated through mapping. Additionally, demographics of each county was considered to see if there may be any link between racial, ethnic, or other minority groups and the amount of services provided and whether those populations utilize them at different rates from majority populations. Information collected through GIS and these phone interviews can be used to inform research and policy in Ohio and other states to ensure that legislation is positively assisting survivors and families of intimate partner violence.

Results: We see differences across the state with how policies are implemented, the resources available to domestic violence shelters, and populations who utilize the services.

Conclusion: One practice recommendation that may come from this study is for shelters to focus on outreach and collaboration with other community organizations that work with these populations. Although the Ohio state legislature has made efforts to expand its definition of domestic violence to be more inclusive, there is still progress to be made in policy such as including other populations who may need special protections (documentation status, LGBTQ, language, trafficked persons).
Research Project Title: Become, the holistic beauty shop

Student Presenter: Remaile Ferrell

Faculty Mentor: Susan Melsop

Faculty Mentor Department: Design

Research Abstract: Undergoing an arts initiative, the neighborhood of Franklinton is still a place most known for its crime and drug use. Although, most may only see the negative in downtrodden neighborhoods, I see beauty and opportunity. There has been an established sense of “community” among its residents due to long term relationships and diversity. Something as pure as this, no city should negate with gentrification. But instead, should embrace and celebrate through revitalization efforts. In addition to the challenges Franklinton already faces, results in gentrification can cause increased violence and crime, and mental health issues. In respect to demographics, approximately 61% of households in Franklinton are single mothers. With this, many families are living below the poverty level and have high mental health issues. My question is: Is there a way to combat the issues that Franklinton’s single mothers are already facing and with the new addition of gentrification? My project will target just that.

By using the psychological principles of Abraham Maslow's Hierarchy of Needs Pyramid, of basic, physiological and self fulfillment needs. I will be able to help guide the single mothers into self-actualization, which will create self-celebration, leadership and self-acceptance. I have identified the gaps that Franklinton is messing within Maslow’s framework and have made informed decisions on what my programing should be to complete the the pyramid.

With this theory and also with the respect of my demographics, I have made a informed decision to appeal to my demographic through beauty. It has been proven that beauty (inside and out) has been one of the biggest notions that correlates to many women’s issues and it can also correlate to helping the issues that Franklinton mothers are facing and will be facing. So by creating a Beauty Shop that, promotes inner and outer beauty, help women gain professional skills and create a stronger single mother community, I will be filling in that gap and promoting a stronger single mother community.

My overall project is to translate the theoretical framework of Maslow into a poetic experience though interior design, to empower the women in Franklinton.
Research Project Title: Moms makin' moves: an exploration of the needs of single mothers in Franklinton, Ohio

Student Presenter: Libby Riddell

Faculty Mentor: Susan Melsop

Faculty Mentor Department: Design

Research Abstract:

Franklinton is a neighborhood right on the outskirts of downtown Columbus. Here, one will find fun, artsy spaces like 400 West Rich, and Strongwater Food and Spirits, juxtaposed against vacant houses, and families who cannot afford to live in their homes much longer. While the area is an up and coming arts district, it is facing issues of extreme gentrification, infant mortality, and food insecurity. Single mothers make up approximately 64% of households in Franklinton. Two main questions drive the research for this project: Is there enough support for single mothers in Franklinton? And how can we support the rise of Franklinton without displacing the current residents? This leads to the exploration of an integrated, systems-thinking interior design proposal that addresses employment, community, and security needs for mothers in Franklinton. By researching social enterprises, micro-housing and innovative child care initiatives, this design asks the question, how can interior design create an intervention to solve these problems?

Primary research methodologies such as site visits and informal interviews led to continuous visits to Franklinton. This encouraged an analysis and understanding of the deeper needs of these residents, rather than just addressing surface level problems. These activities provided an understanding of the needs of this demographic of Franklinton and supported secondary research findings. For example, 81.8% of single mothers living in the Franklinton neighborhood are on food stamps, and 30% of single mothers seeking parenting help are homeless. By proposing a design that includes a bakery, child care, and transitional living units the Moms Makinâ€™ Moves framework provides essential resources and support for these women. By employing single mothers, the bakery will subsidize living costs to mothers living upstairs, provide job training, sustainable wages, and flexible hours. A well designed environment will provide single mother families with community support, security, and the amenities needed to support their families. Overall, this project can support an aspect of community to Franklinton that can help break the cycle of struggling single mothers.
Research Project Title: Stemming the flow on opioid circulation

Student Presenter: Cecelia Glackin-Hunt

Faculty Mentor: Curtis Haugtvedt

Faculty Mentor Department: FCOB Marketing & Logistics

Research Abstract: Opioid overdoses have been a leading cause of death in recent years. Overprescribing opiates leads many people to keep unused, or expired drugs in their cabinets, leaving them vulnerable for misuse. In an effort to mitigate drug abuse, efforts for proper, safe, and anonymous drug disposal have been made to educate the Summit County community through Drug Take Back Days and D.U.M.P boxes in high-traffic areas. Summit County suffers from a high rate of opioid overdoses, leaving a need for convenient and safe ways for the community to clean out their cabinets. Our research will deliver drug deactivation packets that will instruct targeted participants on proper use and disposal methods that are safe for the environment. The pouches will be free of charge, and mailed directly to houses, as well as, readily available in local high-traffic areas for convenience. With three different targeted audiences (urban, suburban, and rural), marketing campaigns will be developed with language that appeals to each population. To develop appropriate messages and techniques for each community, theory-based persuasion and compliance techniques developed with the guidance of Petty and Cacioppo’s Elaboration Likelihood Model of Persuasion and Robert Cialdini’s principles of compliance will be used. Each marketing campaign will include a social media element, pouch instructions, and endorsements by local influential figures and partnerships to promote a grassroots ownership over the drug take back efforts. Data collection is ongoing and will be evaluated using marketing research and social and consumer psychology tools to gauge effectiveness. Conclusions will be presented at the Denman Forum, as well as, next steps and predictions to grow the program.
Research Project Title: An exploration on interior designs ability to supplement existing opiate addition recovery

Student Presenter: Jonathan Wallace

Faculty Mentor: Susan Melsop

Faculty Mentor Department: Design

Research Abstract: Category: Art/Architecture

Title: The influence an interior space can have on wellbeing and addiction recovery

Student Presenter: Jonathan Wallace

Faculty Advisor: Melsop, Susan

Abstract:

The opioid crisis has recently been a very common topic in the Columbus news, and the city government including Mayor Ginther and Attorney General Mike Dewine, are taking extraordinary measures to combat the crisis. Ohio has greatly been affected by the Opioid Crisis and the number of deaths from heroin overdoses continues to grow at an alarming rate. In Columbus, the areas with the highest mortality rates are synonymous with low income neighborhoods. The area of focus for this research is Franklinton. This research seeks to understand the community of Franklinton along with its needs, and potential. Many houses in Franklinton are vacant, and the drug activity is becoming a problem for the community businesses and safety of residents (Steve Levine, abc6). With the current investment in East Franklinton, the condition of the existing population of West Franklinton and the challenges it faces are being brought into light providing an opportune time for the support of this this community. The existing facilities are bleak and lack emotional placemaking due to the utilitarian and clinical design of them. Through case studies and precedent studies, and the combination of primary and secondary sources, this research is exploring interior designs ability to heal and rehabilitate. In the heart of Franklinton is Mount Carmel Hospital, which will soon be leaving. How will this impact the community? Would an adaptive reuse to one of the vacant properties in Franklinton, designed through evidence based research create a positive disruption of the status quo? How can an interior design encourage both community and unity amongst those in Franklinton that are trying to overcome their dependency on opioids? Answering these questions will help to develop an interior space to promote the congregation of addicts in a safe place, which offers physical and emotional services to improve the wellbeing of those individuals, while striving towards a common goal of a living a sober life.
Research Project Title: The Responsibility to Protect: UNSC’s Restrained Attitude Towards the Rohingya Refugee Crisis

Student Presenter: Xuan Yang

Faculty Mentor: Erin Lin

Faculty Mentor Department: Political Science

Research Abstract: The Rohingya refugee crisis is one of the biggest human rights violation cases in recent years; more than half a million people have been forced to flee from Myanmar since 2017, and the number of refugees fleeing to the neighboring countries is still increasing. In other similar cases, such as Kosovo Muslims, the United Nations Security Council (UNSC) has issued resolutions, and even used military action. However, in the Rohingya refugee crisis case, even though there has been short-term humanitarian aid from the international community, UNSC has done nothing. The world wonders why there is no UNSC action towards Rohingya refugee crisis. In this paper, I will show how complicated it is to get UNSC action in this case, I would like to look two levels: 1) How UNSC define the Rohingya crisis by collecting data of framing language used in UNSC official statement and reports, and in comparison to other UN agencies, mainstream media and INGOs’ related documents; 2) How great power clashed within permanent members of UNSC, especially look at China, Russia and United States. The results show us the the simple definition of the Rohingya refugee crisis by UNSC and lack of cooperation among great powers are the main reasons why there has been no further actions by UNSC towards the Rohingya refugee crisis.
Research Project Title: Application of the public health exposome framework to vulnerable southern Gateway communities in Columbus, Ohio

Student Presenter: Jahara Wakeel
Faculty Mentor: Darryl Hood
Faculty Mentor Department: Neuroscience

Research Abstract: ABSTRACT

A public participatory geographical information systems (PPGIS) demographic, environmental, socioeconomic, health status portal was refined for the Milo Grogan community in Columbus, OH. We hypothesized that noise pollution is occurring through the Republic Waste Transfer Station located in the middle of the community. Aims were developed that will allow us to test this hypothesis. Aim 1 will focus on establishing partnerships between academia, state agencies and communities to assist in the conduct of a hazard assessment which came after the neighborhood association developed a community principle/collective efficacy. Results of the hazard assessment will be conveyed to residents via an enhanced PPGIS portal.

METHOD

Refinement of PPGIS Community Mapping Tools

The refinement and customization of our PPGIS portal by the Division of Environmental Health Sciences, College of Public Health will continue using MapplerX [49] This will occur as previously described. Like MapplerX, we will link EJSCREEN (from USEPA) to Milo Grogan environmental factor and variables as was done for Southern Gateway communities in Columbus, OH. This will allow residents of Milo Grogan to access a variety of data relevant to their plight. Due to the fact that the EJSCREEN maps can provide data at the local level, they serve to provide the much-needed attention to vulnerable communities that may be in need of further scientific review, analysis or policy changes [50,51].

RESULTS

Refinement of our customized PPGIS portal www.mappler.info/ohio for residents of the Milo Grogan community will be used to:

1) post ongoing environmental related issues;
2) administer an environmental exposure survey
3) assess impacts on resiliency
4) assess indicators of health-related well being; and
5) assist in the design and delivery of an environmental health literacy curriculum to Milo Grogan residents

REFERENCES

The Ohio State University, College of Public Health, Mappler: Interactive Map Stambaugh-Elwood Community. Available online: http://mappler.info/ohio/ (accessed on 11 August 2015).

Research Project Title: Blackened tradition: A performance study of black bodies and classical music genres

Student Presenter: Cyrah Ward

Faculty Mentor: Daneil Roberts

Faculty Mentor Department: Dance

Research Abstract: Within the world of dance, traditional balletic technique is seen as prized currency: big stage ballets with classical music are the most recognized form of concert stage dance. Through my research, I am challenging the idea that classical music is best paired with Eurocentric bodies of sameness. I am interested in how modern/contemporary movement on a black body paired with classical music will change not only the stereotypes associated with classical music but also the choreographic/artistic possibilities of African-American performers.

My artistic process consists of a self-exploration through movement improvisation to different genres of music. I documented my own exploratory process in conjunction with my dancers in order to track our movement tendencies, create a movement bank to draw from, as well as observe growth within our improvisational studies. I researched various Baroque artists from Domenic Scarlatti to Johann Bach. Additionally, I studied the history of blacks in concert dance by reading Brenda Dixon Gottschild's 'Digging the Africanist Aesthetic'. In the midst of my research I attended the International Association of Blacks in dance and participated in a workshop facilitated by Urban Bush Women professional dance company in Brooklyn, New York. Urban Bush Women is a company that uses dance as a platform to address current political issues. Within their workshop I researched black radicals within history as well as discovered ways to further my solo improvisational practice.

My research challenges the physical aesthetic expectations associated with concert stage performances. The three solos I have crafted break the stereotypes of what blacks in dance are capable of, through a presentation of black women as equally capable bodies, in a very unique rhythmic artistic light. I am really looking to address the political barriers within dance by presenting more than just the beauty of black bodies; rather, the idea that classical music genres should be colorless in their ability to be paired with performers with many racial ethnicities without it being a visual taboo.
Research Project Title: Remembering political events together: experimental evidence from the collaborative remembering paradigm

Student Presenter: Ryan Moore

Faculty Mentor: Jason Coronel

Faculty Mentor Department: Communication

Research Abstract: People often remember facts and events related to politics with the help of others. Surprisingly, despite the prevalence of collaborative remembering in political life, existing research has primarily examined how people remember political facts without the aid of others. In the research reported here, we use the collaborative remembering paradigm from psychology to examine, for the first time, the effects of collaboration on the retrieval of political information from memory. We do this in the context of two types of political information: 1) issue positions of political candidates and 2) numerical facts relevant to public policies (e.g., immigration statistics). We find that collaborative groups were more likely to remember accurate political information when compared to individuals remembering alone, but these gains from collaboration were unlikely to stay with individuals when they went back to remembering alone. Our study highlights attention to a prevalent resource to which individuals often have access to when they attempt to retrieve political information from memory - other individuals.
Research Project Title: Role model effect and girls of color- Building the next generation of leaders

Student Presenter: Allison Susor

Faculty Mentor: Wendy Smooth

Faculty Mentor Department: Women's Gender and Sexuality Studies

Research Abstract: In this research project, I examine the significance of diversity in role models for girls of color. This research looks at role models for girls of color. The phrase girls of color refers to any girl who identifies racially beyond the category of white. Existing research chronicling young girls’ experiences focuses largely on girls who are white, middle class, and suburban. This is not always explicitly mentioned, but a lack of intersectionality in the data about young girls and role model behaviors suggest that all girls share similar experiences and share similar reactions to role models regardless of race and gender. In my research I explore the messages girls of color receive regarding role models. I argue that the presence of role models that align closely with girls’ own identities matters for creating possibilities for leadership in their own lives. “You can’t be what you can’t see” is a common phrase used when talking about role models and young girls. Several after school programs push this narrative relating solely to gender, but I argue that it has implications for race as well. In working with Dr. Wendy Smooth on her Girls of Color as Social Change Agents leadership project, I am able to draw upon data from focus groups with girls of color ages 8-14 years of age from across the city of Columbus. I utilize the words of girls of color to build an understanding of their attitudes on role models in developing their leadership behaviors. Focusing on the next generation of leaders has always been a priority, but I intend to find ways to make it so that young women of color will have those same leadership foundations that set them up for a successful future.
Research Project Title: Tobacco advertising and ID-checking based on store type in Franklin County, Ohio

Student Presenter: Nirupama Muralidharan

Faculty Mentor: Megan Roberts

Faculty Mentor Department: Health Behavior and Health Promotion, College of Public Health

Research Abstract: Background

Around 90% of adults start using tobacco before they turn 18 years old. Convenience stores have the highest rates of tobacco advertising and selling tobacco to minors when compared to other tobacco retailers (supermarkets, drugstores, etc.). Prior to the widespread implementation of Tobacco 21, a policy which increases the legal purchasing age of tobacco products from 18 to 21, it is important to establish a baseline for ID checks and tobacco advertising in Franklin County.

Methods

During summer 2017, undergraduate fieldworkers (aged 20-21) visited a random sample of 125 tobacco retailers across Franklin County, Ohio. Stores were selected through proportional sampling, stratified by location in the county. Fieldworkers collected data on store features including store type (e.g., convenience store, mass merchandiser) and external tobacco advertising (measured as overall impressions such as discreet, moderate, etc.). At the end of each visit, one 21-year-old attempted to purchase a pack of cigarettes and recorded whether they were asked for identification (ID; federal law requires ID checks for anyone who looks under age 27). ANOVA and Chi-square tests analyzed the relationships between store type and (1) tobacco advertising and (2) ID checks.

Results

Overall, 68% of stores were categorized as convenience stores/tobacco shops, 16.8% as grocery stores/mass merchandisers, 9.6% as hookah/vape shops, and 5.6% as “other.” Most (60.8%) stores had some external advertising for tobacco products, and advertising was greatest among convenience stores/tobacco shops (p<.001). Among the stores where cigarettes were purchased, 60.7% did not conduct an ID check. ID checks did not occur at 65.5% of the convenience stores/tobacco shops nor at 40.0% of the grocery stores/mass merchandisers (p=0.04).

Conclusions

Grocery stores and mass merchandisers are more likely than convenience stores and tobacco shops to check the IDs of young people attempting to purchase tobacco. To ensure Tobacco 21 legislation is effective, it will be important for stakeholders to invest more resources into policy enforcement. Furthermore, training and outreach to convenience store and tobacco shop employees will be critical to the policy’s success.
Research Project Title: The racialized juvenile justice system: a governmentality analysis of youth incarceration and resistance in Ohio

Student Presenter: Madeline Marshall

Faculty Mentor: Nancy Ettlinger

Faculty Mentor Department: Geography

Research Abstract: This project examines an aspect of the "hot button issue" of mass incarceration that is often overlooked in academic works: youth incarceration, specifically in Ohio. There is little scholarship on youth incarceration, and the focus of that work lacks attention to race, which crucial to understanding the unequal incarceration of youth of color and larger mentalities involved. Further, analyses tend to focus on large scale theories, to the exclusion of individual experience and action. This project will examine the racialization of youth incarceration and identify productive methods by which the problems of dehumanization of incarcerated youth, unfair treatment/protocol in courts, and unequal resource allocation can be resolved.

Method:
In addition to a critical review of scholarly literature, I interviewed members of two different organizations, Ohio's Juvenile Justice Coalition (JJC) and OSU's BuckeyeREACH, dedicated to resolving problems of youth incarceration. My aim was to discover the ways in which these organizations strategized to target specific, problematic practices of youth incarceration. I received approval from the IRB.

Results:
I found that BuckeyeREACH focused on individuals already trapped in the cycle of youth incarceration and how to "break them out" through education and art, whereas JJC was able to interact with the judicial system in Ohio by using new data collection to counter the problematic nature of the data currently being collected by the state of Ohio. BuckeyeREACH used strategies to humanize the youth already incarcerated to themselves and others, focusing on education on social issues and using art as a way to re-access and share emotions that were often stifled. JJC, however, noticed that the judicial system's budget and practices were extremely reliant on data for their underlying reasoning, and sought to alter the amount and types of data being collected in order to tell a more complete story of youth incarceration in Ohio. These interviews paired with a critical review of scholarly literature, which allowed for further understanding of the use of art as resistance (against, for instance, hypermasculinity) and multi-scalar analysis allowed for realization of the effectiveness and reasons behind JJC and BuckeyeREACH's actions.

Conclusion:
Although members of both groups shared concerns that their successes with individual youths were “small” victories, both nonetheless effectively identified and acted on specific aspects of the larger problem of racialized youth incarceration. Both projects sought, among other things, to rehumanize youth of color in the eyes of both themselves and others so as to create paths for victories against racialized youth incarceration. BuckeyeREACH evidenced that even individual success stories can be a part of breaking a larger stigma, and JJC showed just how powerful changing of data and language can be to altering larger understandings of specific populations.
Research Project Title: You are playing with people's lives - how city-building videogames represent the public

Student Presenter: William Plumley

Faculty Mentor: Tijs van Maasakkers

Faculty Mentor Department: City & Regional Planning

Research Abstract: This project explores how city-building videogames represent the public across four different themes: visual presentation, biography and demography, their need for and use of the city's amenities and services, and how the people can express their approval and dissent. City-building videogames, having drawn inspiration from urban planning, are quickly becoming a part of the planning profession itself. University instructors build lessons around playtime, and cities are using these games as practical tools for visualization and public engagement. The genre is not without critics, though, and many call out how these games portray their cities' inhabitants as a persistent problem. By looking at a broader sample of games than typically seen in published literature, this project aims to present a more complete picture of how the genre approaches this frequent concern. To accomplish this, the four games—Cities: Skylines, SimCity, Tropico 5, and Urban Empire—are evaluated in the four themes according to a rubric which clearly expands upon each one. This model focuses on variables, systems, and mechanics that are explicitly present or missing in the game, in order to collect relatively objective data in what can be a subjective experience. The analysis of the four games takes the form of cross-comparison according to the rubric, incorporating principles and literature from planning and related fields where appropriate, and the discussion following focuses on how these findings can be applied to planning instructors and game designers.
Research Project Title: Improving accessibility, audience, and appreciation with Andean and Amazonian artifact collection

Student Presenter: Diego Arellano

Faculty Mentor: Michelle Wibbelsman

Faculty Mentor Department: Department of Spanish and Portuguese

Research Abstract: OSU’s Andean and Amazonian Cultural Artifact Collection was acquired by the Center for Latin American Studies (CLAS) in Autumn of 2015 through a series of donations and purchases supported by Title VI Federal Funds. The collection supports curriculum and programming on the Andes and Amazonia connected to the Quechua Language Program and the Andean and Amazonian Studies Minor at OSU. The collection revolves around the ways indigenous communities maintain storytelling, cultural production and oral traditions. As student curator, I focused my research interests on three major points: 1). How to understand the interests and attention of the general audience, 2). how to identify and effectively use interactive technology that engages a new generation of students while 3). also providing depth and insight into the collection developing an overall sense of audience appreciation.

Specifically, I look at how everyday digital technology that is accessible and familiar to students, such as smartphones, can be an entry point into cultural appreciation. In collaboration with various departments on campus, I developed SoundCloud recordings, 3D digital models, and a digital storytelling map that allow students to access information that communicates key concepts and/or aesthetics of Andean and Amazonian culture. Ease of accessibility is ensured by way of QR codes that students can scan with their smartphones using popular apps like Snapchat. The familiar technology and frequent access have the potential to bring Andean and Amazonian culture into the realm of the familiar as well. Beyond audience engagement, these digital mediums are conducive to learning in a different way. Preliminary results indicate that use of this interactive tech resulted in longer and more focused attention to items in the collection. These observations provide a foothold for conceiving of and creating dynamic new learning environments for audiences of all ages and levels of expertise.
Research Project Title: Women’s adaptation to climate change in Melghat, India

Student Presenter: Rachel Beery

Faculty Mentor: Elisabeth Root

Faculty Mentor Department: Geography

Research Abstract: Introduction/Background

The effects of climate change are felt everywhere today in our globalized society. Overall in the study of demographic trends we understand that women who are more educated with better access to health care, and contraceptives on average have less children over their lifetime. However, little research has been done to understand how women are affected by climate change. This project investigates attitudes to climate change, how women in the area of Melghat, India have adapted to effects climate change, and how those decisions affect their choices in family planning.

Methods

Fifty in-depth interviews were conducted using stratified random sampling in 31 villages within the area of Melghat, India. The interview included questions on demographics, agriculture, family planning, and health translated in the local language.

Results

A concern for the effects of the weather changing was reported by 76% of the women saying they believe the weather will become worse over time with increasing temperature, decrease in precipitation, and unpredictability of weather patterns. Monsoon season rain are of most concern in subsistence agriculture societies in India as this dictates crop season. A true disconnect exists between those who rely on the natural environment as 32% of the women said they didn’t know what climate change is or what effects it has. There are clear concerns about the changing climate with 48% of women stating that climate change has influenced their decisions in limiting family size. Education level and age is found to have the strongest correlation to women knowing of climate change and in turn limit or will limit the amount of children they will have.

Conclusions

Women in these areas of rural India and other subsistence agriculture communities will have a difficult time adapting to climate change. These findings are the start of understanding how this area can adapt to climate change as the next generation of women make the best decisions for their families. With education the younger generation of women are receiving they know and understand these effects and making decisions to have less children so they can provide for all in their family.
Research Project Title: Changing climate change belief through source matching and simple statements

Student Presenter: Gillian Davis

Faculty Mentor: Ellen Peters

Faculty Mentor Department: Social Psychology

Research Abstract: Climate change is a highly politicized, polarizing topic. Despite the scientific consensus that climate change is occurring and is human caused, 21% of Americans do not believe climate change is occurring (Pew Research Center, 2016). To combat this, researchers have been investigating effective ways to increase belief in climate change by presenting scientific consensus information, for example (van der Linden et al. 2015). However, other research has suggested that this approach could backfire, especially for Republicans (e.g., Bolsen & Druckman, 2016; Hamilton, 2015; Kahan, 2013). Little research has explored how source affects the acceptance of simple statements about climate change. The purpose of this study is to explore effective methods for increasing belief in climate change through source matching. It has been shown that opinionated leaders may be an effective means of communicating science and overcoming political bias (Nesbit and Kotcher, 2009).

I will manipulate source information in a pretest/posttest design in order to understand how political affiliation and knowledge influences climate change persuasion. In the pre-test, participants will provide their political affiliation, climate change belief, and scientific/political knowledge. Source information will include a brief biography of the source (e.g., military leaders, scientists, religious leaders, celebrities) and a quote on climate change. In the posttest participants will answering questions regarding their belief in climate change, and willingness to take action (sign a petition, donate).

I expect that Republicans will be more persuaded by sources like military and religious leaders. More importantly, I expect an interaction of knowledge and source: high knowledge Republicans should increase in climate change beliefs when presented with military/religious sources and decrease in climate change beliefs when presented with scientists/celebrities. Low knowledge Democrats and Republicans and high knowledge Democrats will be equally persuaded by both because the information will not challenge their political ideology.

This study may reveal an important way to increase climate change belief, and possibly action, in those who are difficult to persuade. In this case, those people are high knowledge Republicans, but this approach could be adapted for other domains.
Research Project Title: Meningococcal disease and its importance at university institutions

Student Presenter: Mikafui Dzotsi

Faculty Mentor: Randall Harris

Faculty Mentor Department: Division of Epidemiology, College of Public Health

Research Abstract: Meningococcal disease, or a disease which can result in the inflammation of the meninges or septicemia, is known to be spread through droplets. While many individuals are carriers, individuals not vaccinated become more susceptible to the disease, given the right environment. Even though meningococcal disease is rather rare and on the decline, college students who often live in dormitories or close quarters, remain one of the most susceptible populations. The purpose of this study was to compare US university meningitis prevention and awareness efforts for their students, so state health departments and universities can better decrease the annual number of students that become victims of the disease.

For this study, US university meningitis cases reported by the National Meningitis Association between 2013-2017, were utilized as case studies. In addition to gathering specific case data and state immunization requirement data, university health center directors or staff and various national meningitis and immunization organizations were also interviewed. The main areas compared and analyzed in this study were university and state immunization requirements, trends in the types of strains that occurred, and the existence of university meningitis active or passive prevention efforts and awareness campaigns.

Through analyses of state health department protocols, it was found that not all state departments require Men ACWY vaccination for adolescents entering college. Even though serotype Men B is more virulent, no universities require Men B vaccination, given its fairly recent FDA licensure. While all US universities are required to follow state health regulations and ACIP guidelines, some universities have gone above and beyond in awareness and vaccination education.
Research Project Title: Where there's smoke, there's fire: examining associated press coverage of wildfires in the US

Student Presenter: Brianna Gwirtz

Faculty Mentor: Annie Specht

Faculty Mentor Department: CFAES ACEL

Research Abstract: This research project examined newspaper articles surrounding wildfires that were published by the Associated Press. Following the Starbuck Fires in the western United States, which devastated many farms and ranches in 2017, I wanted to investigate if and how print media focused on agricultural and environmental issues related to wildfire tragedies. Using the framing theory, this study examined how news surrounding wildfires is framed and whether or not agricultural and environmental topics are discussed. Using Lexis Nexis, I searched for articles published by the Associated Press between November 1, 2012, and November 1, 2017. I then examined a sample set of 5 percent of the 2,990 articles (n=150), some of which contained several newswire stories. In articles that classified as newswires, I assigned a frame and actor to each timestamp. In total, I assigned a primary frame to 243 stories within the 150 articles and then assigned actors to each story. I created 35 different options of frames based on the work by Terracina-Hartman (2017). Nearly a quarter (22%) of the stories were unrelated to wildfires upon reading, and 10 percent of the stories were not related to American wildfires. The most common frame was a fire update, which included a status report on the fire and fire damage (27.6%). Only one story had a primary frame related to agriculture (.04 %). Two stories discussed threats to wildlife (.08%). Further analysis may uncover secondary frames that address agricultural, environmental or natural resources issues.

This research is important because it shows that agricultural and environmental factors are often not covered by mainstream press during periods of tragedy, such as a wildfire, despite large losses of farmland, forests, and other natural resources (USDA, 2017).
Research Project Title: Double whammy?: how (dis)confirming a negative STEM stereotype affects women in subsequent STEM domains

Student Presenter: Morgan Morrison

Faculty Mentor: Steven Spencer

Faculty Mentor Department: Psychology

Research Abstract: Introduction: Women are often stereotyped as less proficient in math and science than men (Spencer, Steele, & Quinn, 1999). Women are also gravely underrepresented within the STEM field, making up only 29% of the workforce (NSF, 2016). Stereotype threat theorizes that negative stereotypes surrounding one’s identity create extra pressure that causes individuals to underperform (Steele, Logel, Davies, 2016). Stereotype spillover occurs when confirming a negative stereotype depletes mental resources, leaving individuals at subsequent risk of self-control failure (Inzlicht & Kang, 2010). However, it remains unclear whether stereotype spillover transfers to other negatively-stereotyped domains. We examined whether confirming a negative stereotype in one STEM domain (e.g., math) affects women’s performance in a subsequent STEM domain (e.g., computer science).

Methods: Participants were female college students (N = 90) majoring in STEM fields who viewed STEM abilities as central to their identity. In a study ostensibly examining how math abilities transfer to other domains, participants took a difficult math exam where they received false feedback (either positive, negative or no feedback). After self-reporting emotions and self-esteem, participants completed a coding task for however long they felt they were making meaningful progress. The primary variable of interest was how long they persisted in the coding task.

Hypotheses: According to the spillover hypothesis, we believe that when women receive negative feedback on the math exam, they’ll believe they’ve confirmed a negative stereotype about their group. As a result, this spillover effect will cause them to spend less time on the coding task, experience lower self-esteem and more negative emotions.

Analytical Strategy: When data collection completes in late February, the data will be analyzed using a combination of between-subject ANOVAs, hierarchical linear regression, and moderation analyses using SPSS.

Implications: Understanding the consequences of this spillover effect can shed light on the viewpoint of women in STEM. If one’s abilities to perform tasks are negatively affected by previous failures in STEM domains, this could give insight on how women could be deterred from STEM. Ultimately, this knowledge can be applied to improve conditions and encourage more women to be in the STEM field.
Research Project Title: Aid for an ageing nation: a geographic perspective on migration policies in Berlin, Germany

Student Presenter: Rebecca Martin

Faculty Mentor: Carmen Taleghani-Nikazm

Faculty Mentor Department: Germanic Languages and Literatures

Research Abstract: Since 2015, Europe has struggled to deal with the influx of refugees and migrants from Syria, Iraq, and other Middle Eastern and North African nations. These migrants are an advantage for Europe’s many ageing nation-states, though this fact has not been the focus of public discourse. Working age residents are needed to contribute to the economy and support residents entering retirement age and ideally the number of working age people should be equal to retirement age people in a nation. Germany has one of the world’s oldest or “grayest” nations and they need more working age residents. Germany experienced an influx of more than 2.1 million immigrants in 2015 due to the "open-door" asylum policy declared by Germany’s Chancellor, Angela Merkel. This policy accepted all migrants seeking asylum and attracted economic migrants, not seeking political asylum. The “open door” policy received mixed reactions by German citizens, ranging from welcome marches to xenophobic fearmongering. To attempt to better understand the opinions of German people about refugees and migrants, this research study implemented a survey in Berlin, Germany. This survey was active from May-July 13, 2016 and it obtained Berlin residents’ opinions as well as background information of the participants (104 total responses). It was hypothesized that Berlin residents who perceive their future economic outlook as “worse” would be less likely to support asylum policy. The data collected via survey responses supported this hypothesis, and it was found that there was a significant difference between the frequency of observations (X2=23.1, p-value< 0.0001207). This insight is useful to governmental actors in any nation that deals with backlash about accepting immigrants, refugees, or migrants. Public policy is never in perfect step with popular opinion but understanding the crux of the issue is a start for crafting better policies. These survey results could assist governmental bodies or non-profit advocates in creating educational opportunities to combat fear and discrimination.
Research Project Title: Assessing the impact of a game-centered, interactive approach for using programming exercises in introductory physics

Student Presenter: Demetrius Tuggle

Faculty Mentor: Chris Orban

Faculty Mentor Department: Physics

Research Abstract: Computer programming is an increasingly desired skill for all STEM fields, not just computer science. We created simple and interactive computer programming activities based on the physics of video games and integrated these into introductory physics classes. Importantly, these activities typically involve less than 75 lines of code. Students completed an online assessment before and after each activity to measure the students’ comprehension of physics concepts and to gauge student perceptions about the activity, such as difficulty, level of enjoyment and whether it changes their attitudes about STEM. The target population ranges from high school students to first year college students. Data have been collected from introductory physics courses at two different universities.
Research Project Title: How does the presence live animals effect the millennial generations reaction to conservation education?

Student Presenter: Lauren Sommers

Faculty Mentor: Kelly George

Faculty Mentor Department: Animal Science

Research Abstract: Zoos and aquariums have unique opportunities to educate the public utilizing human-animal interactions. Many zoos claim success in educating their audiences and inspiring pro-conservation outcomes, but little research exists to confirm this. Existing research focuses on family members and assesses knowledge gained and attitudes of participants depending on variables such as animal observability, animal behaviors, or presences of zoo educators. This study begins to fill these literature gaps, focusing on the millennial generation and measuring participants’ support of conservation and zoos financially and via social media in addition to attitudes and knowledge. Participants were recruited randomly through posted flyers advertising the study. Given that the flyer included the name of the Columbus Zoo & Aquarium, participants more than likely had interest in the study due to previous animal or zoo interest. This potential bias should be avoided in future studies. Presence of live animals is this study’s independent variable. Participants completed a pre-test survey, attended one of two live presentations (randomly assigned) about conservation by the Columbus Zoo and Aquarium, and completed a post-test survey. Controlled in both presentations were space, presenter, topics, and species. One presentation (treatment n=21) included live animals, while the other (control n=13) did not. Results show that treatment group participants answered with significantly more positive attitudes to the following statements about zoo animal care: animal welfare is a focus of the zoo (p=0.016), zoo animals are able to adapt to human-created environments (p=0.002) and zoos create spaces for their animals that allow expression of natural behaviors (p=0.015). Treatment participants also had significantly more positive attitudes toward penguins (p=0.046) and cheetahs (p=0.046). These results matched our hypothesis that human-live animal interactions increase positive attitudes towards the species. Also, the results suggest the presence of live animals increases the positive impacts of zoo messaging.
Research Project Title: The development of evolved, an exhibition on human evolution

Student Presenter: Abigail Sarver-Verhey

Faculty Mentor: Mark Hubbe

Faculty Mentor Department: Anthropology

Research Abstract: Museums are among the main centers of informal science learning, offering a uniquely hands-on approach to education. One area of science that is often seen as difficult to present and thus is not well taught in museums is evolution, particularly in the context of humans. However, evolution, as the foundational principle of biology, is an important area of science with implications for modern life, and thus deserves to be explored through museographic exhibitions. In order to address this need and explore ways to teach evolution in museums, I have developed Evolved, an exhibition that provides an introduction to human evolution through the lens of the modern human body. In the exhibition, visitors will explore the ways evolution has shaped their own body over the past several million years through interactive components that examine the evolutionary history behind their bodily traits. Through these experiences, they not only will see how evolution has shaped the human lineage over time, but also come away with an understanding of it as a science and a force relevant to their own lives. The design of the exhibition was informed by research on past evolution exhibitions, which found that exhibitions that contextualized evolution in a framework relevant to visitors’ own lives were most successful at promoting learning of evolutionary principles and engagement in evolutionary reasoning. Throughout the design process I have explored methods of science communication, hands-on learning, and exhibit design and utilized them to create an engaging and informative experience. The development of this exhibition has spanned all stages of the development process, from constructing a narrative that accurately represents evolution and contextualizes it in a compelling manner, to developing and testing interactive modules that allow visitors to learn evolutionary concepts through hands-on activities. Ultimately, this project has resulted in the development of an exhibition concept, interactives, label text, and a digitally rendered design of the exhibition space.
Research Project Title: Spiritus Ex Machina; The rights of autonomous artificial intelligence by 2050

Student Presenter: Benjamin Harvey

Faculty Mentor: David Staley

Faculty Mentor Department: History

Research Abstract: My research is a serious inquiry into the future, asking the question â€œWhat rights will be granted to artificial intelligence?. In order to examine this topic, I have created a scenarioâ€”a plausible narrative of the future-- by using contemporary events as foundational research on the potential rights of autonomous artificial intelligence. These sources include the New York Times, Quartz, Boston Dynamics, and other reputable sites.

My scenario details the possible way an autonomous AI may come to being, and how it might begin to explore the world around it with emotion being connected with computational hyper-efficiency. In the scenario, the AI, named ADAM, interacts with humans on a highly intelligent, humanistic level, and witnesses the legal and social fight for his recognition as a person develop around him. My scenario examines this fight from the perspectives of ADAM, the human forces that are for and against this recognition, and other, lesser AI who band together to support ADAMâ€™s humanity.

This research into the future will serve as a potential precedent, a road-map, for contemplating and handling the advancement of autonomous AI into human counterparts in the not so distant future.
Research Project Title: Solidified phenomena

Student Presenter: Theodore Morrow

Faculty Mentor: Sandhya Kochar

Faculty Mentor Department: Architecture

Research Abstract: Throughout the process of design, architects must find ways to represent their work. Representation is essential in explaining to others how the project works but is additionally how the architect themselves come to understand and conceptualize their own project. Generally this takes the form of floor plans, cross sections, and various drawings. Such representations, while very good at explaining the configuration of rooms or circulation paths, are unfortunately lacking in their ability to communicate ephemeral phenomenon such as light and ambiance.

Based off of a public competition prompt to produce warning markers for a nuclear waste storage facility and in conjunction with a research seminar on architectural representation, this project pushes the architectural drawing to represent more than just space. Moving back and forth between printed drawings and projected digital films, the research process for “Solidified Phenomena” questions the ability of drawing to represent atmospheres and the place of the drawing in the digital age. In its final stage, “Solidified Phenomena” culminates in the form of an eight foot long printed drawing overlaid with film projection, creating an array of effects which push traditional architectural representation and take a critical position on the drawing’s inability to convey ambiance alone.
Research Project Title: Navigating the self in near future science fiction films.

Student Presenter: Elizabeth Riggs

Faculty Mentor: Ryan Friedman

Faculty Mentor Department: English & Film Studies

Research Abstract: Introduction/Background: For many decades, the genre of science fiction has looked outward and forward through its subjects. Science fiction film, as it tells stories about “another reality,” addresses the concerns of a group as they perceive the direction of their real-world society. While science fiction films have focused largely on the effects on society as a whole, there has been a shift towards the end of the 20th century and into the 21st century to focus more on individuals. Instead of asking where our society is headed, they ask how can a person define themselves despite or through the science of their reality. These films begin in the intimate world of their characters, and slowly reveal aspects of the world around them, leaving the audience to question where, when, and how this “future” takes place, and how the individual fits in it.

Methods: This thesis project builds upon the definition of science fiction, focusing on how emerging science can be understood through the lens of the individual, instead of a society. It analyzes the narrative characteristics of these recent films, and how changing the way a science fiction film presents the future can affect a viewer’s interpretation of its social commentary. In addition, it explores how they attempt to answer questions such as, “what does it mean to be an individual in this futuristic society,” “how do we define human,” “what barriers or complications are presented in self-definition,” and “in what ways has interpersonal interaction changed or become mediated in this ‘near-future’”. The films under study are The Truman Show (1998), Never Let Me Go (2004), Black Mirror (2011-2016), Under the Skin (2013), Her (2013), and Ex Machina (2015).

Conclusion: The expected outcome of this research is first, to demonstrate the complicated relationship between the viewer and the filmic world when it is set in the “near-future,” as well as address and investigate the humanistic focused narratives of these more recent science fiction films. Ultimately, analysis of these films could potentially identify a shift, or at least a new subgroup, in contemporary science fiction.
Research Project Title: The National Park Service in its centennial year: a study in five parts

Student Presenter: Christian Moore

Faculty Mentor: Cheramie No

Faculty Mentor Department: Kristi

Research Abstract: INTRODUCTION:

In its hundredth year, the national park system is a treasured component of the cultural landscape of the United States, but its continued thriving is threatened by a number of forces. The challenges of climate change, soaring visitor numbers, and the encroachment of urban processes and byproducts will require interdisciplinary thinking and action if the NPS is to continue to thrive in its second century. This project tests such an interdisciplinary approach: the five researchers - representing the sciences, engineering, and design - worked together to define the National Park experience in five related themes: arrival, habitation, sequence, atmosphere, and logistics.

METHODS:

In targeting experience, the researchers evaluated the impact the challenges above have on the visitor, the most potent voice for initiating change. "Arrival" explores trends in traffic at visitor centers: vehicles, ridership, group size and approximate age, and distance traveled; "habitation" investigates the balance between amenities and notions of wilderness in campgrounds; "sequence" offers a method for understanding rhythm and spatial sequencing in trails and their impacts on local environments; "atmosphere" reveals awareness and visible effects of ozone pollution; and "logistics" documents the process of conducting interdisciplinary research. The researchers visited thirty national park sites, including two for comparison in Alberta and British Columbia, Canada, over the course of two months in summer 2016. This project sought to employ a variety of data-collection methods, including interviews, photography, hand-drafting, and tabulation to address the five themes.

RESULTS/CONCLUSIONS

The breadth of study sites allowed for cross-park comparison and the identification of common features that define the national park experience in the present day and the existence of common challenges. The resulting data was analyzed, converted to graphic form, and woven together in a research book; brought together in this way, the five themes offer a multifaceted view of our national parks as they approach a new century and give light to both the good and bad of the NPS experience. The research book will be printed in Spring 2018 and distributed to planners and designers both within and outside of the National Park Service as a reference.
Research Project Title: Selective exposure paradigm platform - SEPP - a web application to study communication in high-choice environments

Student Presenter: Dana Brooks

Faculty Mentor: Knobloch-Westerwick Yes

Faculty Mentor Department: Silvia

Research Abstract: Introduction: Serious concerns exist as to whether people selectively attend messages that only reinforce preexisting views, resulting in increasing political polarization and tension. In online contexts, recent developments (social recommendations, social media, user-generated content) present entirely new questions when studying how individuals select and attend to public affairs information. Capturing which messages individuals attend to (selective exposure) and what drives selective exposure is of utmost importance when studying communication processes in the current high-choice media environment.

Method: We developed a Javascript, mySQL and PHP-based web application that allows a researcher to determine how various message cues—e.g., political stance, source, and popularity (äœLIKESä®)—jointly affect a user’s selective exposure. The application can present various types of articles (e.g., science and political news) that align in stance with individual users’ attitudes on societal issues covered in these articles, predetermined by a questionnaire. Combinations of article types with source and popularity cues are systematically rotated; the sequence of articles displayed is randomized to avoid sequence effects. Users’ selective exposure is recorded by the website and stored; the platform records the time users spend on each article, the sequence each article is accessed in, and the political leanings of the individual and responses to the articles. The application allows for a multitude of research designs to answer a variety of research questions in the communication science field.

Results: Data and results from an exemplar data collection will be presented.

Conclusion: Data collected with this web application allows testing hypotheses on what drives selective exposure and how users are in turn affected by the selected messages, which speaks for example to processes such as political polarization, as well as new technological affordances in online contexts.
Research Project Title: A preliminary assessment of the experiential involvement scale and hypnotic responsiveness

Student Presenter: Victoria Bradford

Faculty Mentor: Joseph Green

Faculty Mentor Department: Psychology

Research Abstract: Recently, Lynn and colleagues developed the Experiential Involvement Scale (EIS; Lynn, Evans, Russ, 2017) as an experimental measure designed to assess openness and willingness to experience hypnotic suggestions. The scale is administered before and after hypnosis (items on the post-hypnosis version are worded in the past tense). The 12-item scale measures participants’ willingness to receive suggestions without opposing them, letting go of resistance, being open to whatever happens during the session, and a sense of acceptance about hypnotic experiences. The EIS purportedly measures something beyond participants’ expectancy to respond to hypnotic suggestions and belief about being a good subject. In an early assessment of the psychometrics of the scale, we administered the EIS, along with measures of absorption, fantasy proneness, expectancy, and dissociation to over 160 college students attending The Ohio State University at Lima. Students were then hypnotized with the Harvard Group Scale of Hypnotic Susceptibility, Form A (HGSHS:A; Shor & Orne, 1962). We will examine whether scores on the EIS predict hypnotic responsiveness and correlate with our other scales. Results are forthcoming.
Research Project Title: Risk taking as a function of delusion proneness

Student Presenter: Charles Cayton

Faculty Mentor: Melissa Buelow

Faculty Mentor Department: Psychology

Research Abstract: Individuals who experience delusions—false beliefs about reality—can range from the absence of delusions to a diagnosis of schizophrenia or delusional disorder (APA, 2013; Peters, Joseph, & Garety, 1999). Those who fall between these two anchors exhibit some degree of delusion proneness. Previous research has shown that when delusion prone individuals are asked to make a decision, their responses were faster than non-delusion prone individuals, without necessarily resulting in better decisions (Bensi, Giusberti, Nori, & Gambetti, 2010). This behavior revealed a process referred to as jumping to conclusions (making decisions in the absence of adequate information; Waman & Martin, 2006; van der Leer, Hartig, Goldmanis, & McKay, 2015). Jumping to conclusions could lead to individuals making riskier decisions and engaging in greater risk-taking behavior. The present study extends the previous research by examining this jumping to conclusions bias in risky decision making tasks where immediate and long-term factors can influence the decision making process. Undergraduate student participants (n = 70) completed the Peters Delusions Inventory (PDI; Peters, Joseph, & Garety, 1999), the delay discounting task (DDT; Kirby & Marakovic, 1996), and the Adult Decision Making Competence scale (ADMC; de Bruin, Parker, & Fischhoff, 2007). On the DDT, participants decide between a smaller immediate reward and a larger reward that occurs at some point in the future. The ADMC requires participants to use presented information to determine the best decision in a particular situation. It is hypothesized that the more delusion prone an individual is, the riskier their decisions will be on the DDT and less information will be utilized in the decision making process resulting in poorer performance on the ADMC. Results indicated no correlations between delusion proneness and performance on the DDT (p = .887) or the ADMC (p = .177). Furthermore, no group differences were seen on these tasks between those high and those low in delusion proneness (ps > .332). No support was found for the study hypotheses. The current study has implications for the assessment of decision making in individuals with and without a history of delusions.
Research Project Title: Consequences of different attitudes on portrayal of people

Student Presenter: Jin Cho

Faculty Mentor: Richard Petty

Faculty Mentor Department: Psychology

Research Abstract: People hold attitudes for a variety of reasons. In this research, we are interested in how we perceive others who hold attitudes for moral reasons. For example, someone may not eat fast food because they think the food is unhealthy (a practicality reason). However, someone else might not want fast food because the meat is from animals who have suffered (a moral reason). Previous research has shown that attitudes held with moral (vs. practical) reasons resulted in stronger attitudes (e.g., these attitudes were more difficult to change; Luttrell et al., 2016). Our study takes this research further by looking at something other work has failed to investigate: how people with moral attitudes are perceived by others. To test this, we conducted two studies: one with 150 participants from Ohio State undergraduates and another with 150 participants from the Amazon’s Mechanical Turk. Participants were given vignettes that described a character with either morally or practicality based attitudes on one of three topics: politics, an environmental issue, or a book selection. Afterwards, the participants judged how extreme the character was in their stance, how certain or confident they appeared in their stance, and how difficult it would be to change their attitude. Results indicated that morally (vs. practicality) based attitudes are perceived to be more extreme, certain, and difficult to change.
Research Project Title: The effect of effort on Iowa gambling task performance.

Student Presenter: Tom Crook

Faculty Mentor: Melissa Buelow

Faculty Mentor Department: Psychology

Research Abstract: Problem of Purpose: One challenge that clinicians face when evaluating cognitive function is being able to correctly identify patients who are performing to the best of their abilities over those who are trying to "fake" a poor performance for some sort of secondary gain such as extra time on tests or obtaining a prescription medication. Previous research on malingering has focused on whether current diagnostic measures are able to accurately identify poor effort. However, many standard measures of cognitive impairment, such as the Iowa Gambling Task (IGT, Bechara et al, 1994), have not been extensively examined at their ability to distinguish between valid and invalid performance. The present studies aimed to examine whether performance on the IGT is significantly affected by effort on cognitive tests.

Procedure: In Study 1, participants completed the IGT and at least one measure of effort on cognitive tasks, including Green's Word Memory Test (WMT; Green, 2005), the Minnesota Multiphasic Personality Inventory (MMPI-2-RF; Ben-Porath & Tellegen, 2008), or reliable digit span (RDS).

In Study 2, 109 participants completed the WMT, MMPI-2-RF, RDS, IGT, and the Game of Dice Task (GDT; Brand et al., 2005). In this feigned malingering study, participants were asked to complete the study protocol after receiving a set of instructions that asked them to: a) try their best on all tasks, b) not try their best on all tasks, or c) complete all tasks as though they were trying to obtain academic accommodations due to difficulties with decision making (e.g., slow test-taking).

Results: In Study 1, correlations were found between the IGT and effort measures, such that individuals exhibiting low effort on reliable digit span and the MMPI, but not the WMT, showed less advantageous performance on the IGT. In Study 2, group differences were found in performance on the effort measures. No group differences were found on the IGT or GDT.

Implications: Scores on validity measures may help elucidate a pattern of inconsistent or non-effortful responding on other cognitive tasks. These studies collectively can inform future clinicians as to possible malingering of clinical diagnoses.
Research Project Title: The persuasion of ambivalence

Student Presenter: Lydia Drake

Faculty Mentor: Vanessa Sawicki

Faculty Mentor Department: Psychology

Research Abstract: Introduction

Although much persuasion research has examined a target’s response to a persuasive source, little is known about the content of a message generated by that persuasive source. We tested whether ambivalence affects the arguments generated when persuading. From an attitude strength perspective, high ambivalence should weaken an attitude’s use in generating arguments, leading to an acknowledgement of positive and negative aspects of a topic. On the other hand, people are motivated to reduce ambivalence to hold less conflicted attitudes. One possible way of doing so may be to create a more one-sided attitude-consistent message. Therefore, there should be contexts when ambivalence might reduce or increase attitude use in determining persuasive message content. We expect that how ambivalence affects message generation should depend on whether the message is aimed at 1) another person or 2) the self.

Methods

Thus far, 99 undergraduates reported attitudes and ambivalence about potential mandatory concussion testing of football players and then were instructed to generate a persuasive message about mandatory concussion testing either directed at the self or another person.

Results & Conclusions

Data collection is ongoing; results are forthcoming. We hope to show that when persuading others, individuals with relatively greater ambivalence (+1SD on the ambivalence mean) will write more mixed, two-sided persuasive messages than those relatively unconflicted (-1SD the ambivalence mean), consistent past attitude strength research. When participants write to persuade themselves, the opposite pattern should emerge. Relatively greater ambivalence should be associated with greater one-sided, attitude-consistent message.
Research Project Title: Father's mind-mindedness and emotion regulation in school-age children

Student Presenter: Rachel Dawson

Faculty Mentor: Sarah Schoppe-Sullivan

Faculty Mentor Department: Human Sciences

Research Abstract: Emotion regulation, the internal and external processes involved in initiating, maintaining and modulating the occurrence, intensity and expression of emotions, is vastly important for success in school and throughout life. Prior research has pointed to a link between the development of strong emotion regulation skills and the parent-child relationship. One aspect of the parent-child relationship is mind-mindedness, or parents’ ability to treat the infant as an individual with a mind, which requires parents to interpret infants’ cues correctly and provide accurate response and sensitivity. This research seeks to investigate the associations of father’s mind-mindedness in infancy with children’s emotion regulation at age seven. Participants were recruited from a sample of 182 families from The New Parents Project, a longitudinal study of dual-earner couples and their first-born children. Father’s mind-mindedness was studied at nine months postpartum using a five-minute play interaction between father and child. The interaction was transcribed and coded for mind-mindedness using the Mind-Mindedness Coding Manual (Meins, Fernyhough, 2015). On average 7% of father’s comments during the interaction were mind-minded. At age seven, children performed the attractive toy in a transparent box task to measure emotion regulation. This task was coded behaviorally for child emotion regulation strategies using The Behavior Coding Manual (Wu, Feng, Hooper, Ku, 2017). During the task, 86% of the children showed high problem solving behaviors. In terms of emotional response, 30% of the children showed some sign of distress during the task, and 12% of children utilized self-soothing strategies during this frustrating task. Preliminary analyses, indicated that children high on problem solving at age seven had fathers who used an average of two more mind-related comments when interacting with their child at nine months. However, this difference was not statistically significant. In addition, children who used self-soothing strategies had experienced fewer mind-related comments from their fathers in infancy, and this difference approached significance. Overall, preliminary results suggest that father’s mind-mindedness may play a role in the development of children’s emotion regulation, although modest sample size and an emotion regulation task that was not challenging enough likely diminished the ability to detect significant differences.
Research Project Title: First-person visual imagery perspective increases the effect of priming on judgment

Student Presenter: Katrina Henderson

Faculty Mentor: Lisa Libby

Faculty Mentor Department: Psychology

Research Abstract: Accessible information can shape our judgments of others. We explored how visual imagery perspective (first- vs. third-person) influences the effect of semantic primes on our evaluations of others. In the past, visual imagery perspective has been shown to affect how we process information. Previous research demonstrates that first- vs. third-person perspective differentially facilitates qualitatively distinct processing styles (Libby & Eibach, 2011). In this study, 114 undergraduate students completed a word search containing words related to recklessness or adventurousness. Next, participants viewed action photos shot from the first-person or third-person perspective (e.g., cleaning up a spill). The first-person perspective images portrayed events through the participants' own eyes; whereas, the third-person perspective portrayed events through an observer's eyes, as though participants were omnisciently observing the event. Then, they read a story about a fictional character, John, who engages in activities (e.g., mountain climbing) that are ambiguous with respect to being either adventurous or reckless. Finally, participants rated John on several factors, including his likeability and personality. First-person perspective facilitates bottom-up processing; on the contrary, third-person perspective causes people to rely on top-down processing (Libby & Eibach, 2011). Because first-person (vs. third-person) perspectives attunes us to concrete features of the environment, we anticipated that accessible semantic information would be more influential in the first-person (vs. third-person) perspective condition. We expected the first-person (vs. third-person) perspective to facilitate the effect of semantic priming on judgment. Specifically, we predicted participants to like John more in the adventurous (vs. reckless) condition, and the difference in liking to be greater for participants in the first-person (vs. third-person) perspective condition. Consistent with predictions, we found a significant interaction between the prime and perspective condition when measuring the likeability of John. Participants liked John marginally more after receiving the adventurous (vs. reckless) primes in the first-person condition, and there was no effect of priming in the third-person condition. Results suggest that perspective may influence our tendency to draw on accessible information when forming judgments of others.
Research Project Title: Mental time travel and construal level associations: Functional past- and future-directed thinking

Student Presenter: Kathleen Hudson

Faculty Mentor: Kentaro Fujita

Faculty Mentor Department: Psychology

Research Abstract: Mental time travel, the ability to mentally project one’s self backward and forward in time, is regarded as crucial for goal attainment (Suddendorf & Corballis, 2007). Construal level theory suggests people think about temporally distant (relative to near) events by engaging in greater cognitive abstraction (Trope & Liberman, 2003). Whether this process is the same for past vs. future events, however is unclear. We explore whether past and future processes rely on similar mechanisms (Buckner & Carroll, 2007). We examine these processes’s functionality, suggesting those who do not engage in abstraction to think about temporally distant events will have more difficulty attaining their goals. We explore whether difficulties for individuals with depression stem from employing dysfunctional cognitive tendencies when thinking about past and future (Strauman, 2002; Trivedi & Greer, 2014).

This study aims to address whether cognition is similar between thinking about past and future, what constitutes functional cognition in mental time travel, and how this relates to goal attainment and well-being. We recruited 251 participants from the Department of Psychology’s Research Experience Program. Distant time and abstract words should be more strongly associated if distant events are habitually thought about abstractly; this is assessed using an Implicit Association Test (IAT; Greenwald, McGhee, & Schwartz, 1998). Participants were randomly assigned to conditions presenting time words related to past or future, and completed the Beck Depression Inventory to measure depressive severity and other well-being and goal attainment questionnaires (Beck, Ward, Mendelson, Mock, & Erbaugh, 1961). Data is currently being analyzed, utilizing D Score algorithm (Greenwald, Nosek, & Banaji, 2003) for IAT reaction times, and Process Dissociation Procedure (PDP; Jacoby, L.L. 1991) for error rates.

We expect similar results between two IAT versions, suggesting people engage in similar abstraction processes when thinking about past vs. future. We expect those with more depressive symptoms to show weaker associations between distant time and abstraction, making them more vulnerable to goal attainment failures. These results would indicate abstraction is a functional response to thinking about distant events (past and future), and have implications for future research directions in goal pursuit, depression, and cognitive behavioral therapy.
Research Project Title: Finger lengths and hypnotizability: is there an association?

Student Presenter: Olivia Green

Faculty Mentor: Joseph Green

Faculty Mentor Department: Psychology

Research Abstract: The digit ratio of the second to fourth fingers (2D:4D) is sexually dimorphic with women having a higher ratio than men. In addition, digit ratios may vary by sexual orientation and across some mental illnesses. Lower digit ratios may result from greater exposure to testosterone or androgens during prenatal development and these “masculine” ratios correlate with trait physical aggression (Bailey & Hurd, 2005). Most studies of hypnotic responsiveness fail to find gender differences; however, when differences do emerge, they typically favor women scoring slightly higher than men (see Green & Lynn, 2011; Kolto et al., 2014). In the present study, we photocopied the hands of over 300 college students and then administered a standardized measure of hypnotizability (HGS:SHS:A; Shor & Orne, 1962). Participants also completed the Bem Sex Role Inventory (BSRI; Bem, 1974, 1981), along with other questionnaires assessing absorption, fantasy proneness, and expectancy of being a good hypnotic subject. We will examine whether digit ratios correlate with scores on the HGS:SHS:A and related measures. Results are forthcoming.
Research Project Title: Influence of religiosity on chronic physiologic stress

Student Presenter: Laura Forero

Faculty Mentor: Jodi Ford

Faculty Mentor Department: College of Nursing

Research Abstract: Chronic stress in youth increases risk for poor physical and mental health, thus it is important to understand the factors that influence persistent stress in youth. Religiosity embodies support, self-worth and acceptance and has been associated with lower perceived stress levels in youth. Studies to determine the relationship between religiosity and measures of physiologic stress are necessary. The purpose of this study was to investigate the relationship between religiosity and chronic physiologic stress in adolescents. Secondary data were examined from two linked studies composed of a representative sample of 508 adolescents aged 11 to 17 years in a large Midwestern city. Participants were asked about the importance of and involvement in religious faith via three survey items using a Likert scale: (1) attendance at religious services; (2) attendance at religious youth activities; and (3) importance of religious faith in daily life. Stress levels were measured through hair cortisol, a measure of chronic physiologic stress. Descriptive and multivariate analyses examined the relationship between religiosity and hair cortisol levels. Results for the attendance at religious services show a nonlinear association, with participants who occasionally attended religious services having the lowest levels of hair cortisol while those who attended regularly or not at all were found to have higher levels of hair cortisol. There were no significant relationships between involvement in religious youth activities and chronic stress. Participants who reported the importance of religious faith as very to extremely high had higher levels of hair cortisol than those who reported lower levels of importance of religion in their lives. These results did not support previous work that demonstrated a positive effect of religiosity on perceived chronic stress in adolescents. There may be differences in how adolescents perceive and report stress and measures of chronic physiologic stress. These differences warrant additional study. Further work to establish the relationship of religiosity and spiritual health to chronic physiologic stress are necessary to understand the relationship of this aspect of holistic wellness on mental and physical health of adolescents.
Research Project Title: Valence framing and morality

Student Presenter: Alex Kudart

Faculty Mentor: Richard Petty

Faculty Mentor Department: Social Psychology

Research Abstract: People construct and hold certain attitudes every day, whether it be towards simple objects such as food or retail products, or to more complex ideas such as supporting or opposing a political candidate. Previous research has uncovered that the strength of some people's attitudes depends on whether they're framed negatively or positively (Bizer, Petty 2005); that is, an attitude would be stronger if it were framed in opposition to something or someone, as compared to in support. However, nobody has looked at how individuals are viewed when their attitude is framed in opposition to or support. Based on previous research, we may expect that someone holding an oppositional stance may be seen as more extreme in regard to their attitude, as negative features (i.e. opposition) tend to be given more weight as opposed to positive ones (Baumeister et al. 2001). Moreover, an attitude that is focused on preventing harm can be matched to an oppositional framing, potentially leading to a greater perception that the attitude is based on morality (Gray & Wegner 2007). With this previous research in mind, we explored the effects of valence framing on the perception of others' attitude strength. The experiment was split into two studies with a total of 325 participants. Participants were instructed to read one of three vignettes, either of someone in opposition or support of the following topics: voting in the election of Hillary Clinton versus Donald Trump, protesting for or against environmental protections, or selecting to read Harry Potter versus Twilight. Dependent measures were based on participants' perception of the target's moral basis of the attitude, and extremity. The overall findings uncovered that if the target was portrayed in opposition category, their attitude was believed to be more morally based and extreme in contrast to being portrayed as in the support category.
Research Project Title: Decision-making as a function of delusion proneness

Student Presenter: Meisha Runyon

Faculty Mentor: Melissa Buelow

Faculty Mentor Department: Psychology

Research Abstract: Delusion proneness is an individual-differences characteristic, existing on a continuum from no delusional thoughts to a diagnosis of delusional disorder or schizophrenia (APA, 2013; Peters, Joseph, & Garety, 1999). Previous research has shown that delusion prone individuals are faster at making decisions and request less information to make them, potentially making a decision without sufficient information (Bensi, Giusberti, Nori, & Gambetti, 2010). Some research suggests that delusion prone individuals have a data-gathering deficit rather than a problem with decision making (Linney, Peters & Ayton, 1998). The majority of these research findings have used one classical probabilistic reasoning task called the beads task but performance on other tasks has not been adequately examined. The present study will examine risky decision making in individuals high and low in delusion proneness by using the Iowa Gambling Task (IGT; Bechara, Damasio, Damasio, & Anderson, 1994) and the Game of Dice Task (GDT; Brand et al., 2005).

Undergraduate student participants (n = 70) completed the Peters Delusions Inventory (PDI; Peters et al., 1999) to assess delusion proneness, as well as the IGT and the GDT. The IGT assesses more learning-based decision-making as participants must learn to decide advantageously through trial and error feedback, whereas the GDT takes out this learning component by providing all necessary information to make a decision at the start of the task. It is hypothesized that the more delusion prone an individual is, the riskier they will be on the IGT but not the GDT. There was a negative correlation between performance on the IGT and delusion proneness. There was not a significant correlation with the GDT. An independent samples t-test was conducted using a median split on the PDI. Individuals above the median split selected more from Deck A (a disadvantageous deck) than individuals below the median split.

The present study has implications for the assessment of decision-making in individuals with and without a history of delusions. The results suggest variable decision-making difficulties as a function of self-reported delusion proneness. Replication of this study with a larger sample and with external validation of their delusion proneness symptoms is warranted.
Research Project Title: Religion, moral relativism and cheating behavior

Student Presenter: Cori O'Boyle

Faculty Mentor: Baldwin Way

Faculty Mentor Department: Psychology

Research Abstract: This study looks to investigate the psychological mechanisms involved in cheating behavior, and specifically cheating behavior when primed with religious material. We hypothesize that religious priming will decrease moral relativism. We plan to test this through an online study using Mechanical Turk. Participants will be randomly assigned to the religious or control condition, and then complete a questionnaire measuring moral relativism. Finally, the participants will be given the opportunity to cheat through means of an anagram task. The study is currently underway and once data has been collected it will be analyzed and reported at the Denman.
Research Project Title: The effect of construal level on implicit racial bias

Student Presenter: LaNae Plaxico

Faculty Mentor: Kentaro Fujita

Faculty Mentor Department: Psychology

Research Abstract: Since the Civil Rights movement of the 1960’s, there has been increasing support for racial equality in most domains, including housing, education and many other social, economic, and political domains (Martin & Schumann, 1997). Yet, racial inequality continues to be prevalent despite most people in the modern American society professing to favor equality. Previous research suggests that this may be due to negative implicit attitudes or automatic associations for Blacks (Greenwald, McGhee, & Schwartz, 1998). The present research examines the effects of construal level, on egalitarian (people who are motivated to be non-prejudice (Neill, 2017)) and non-egalitarian participant’s implicit racial bias toward Blacks. High- compared to low-level construal has been shown to improve people’s self control (Fujita & Han, 2009a; Fujita, Trope, Liberman, & Levin-Sagi, 2006) and the correspondence of implicit attitudes to people’s goals (Fujita & Han, 2009b). We hypothesized that people’s egalitarian goals will align better with their performance on the Weapon Identification Task (i.e. that egalitarians will show less bias) in the high-level construal manipulation group than in the low-level construal manipulation group. To manipulate construal level, we used a procedural priming task - the previously validated “Category/Exemplar” task. Then participants completed the Weapon Identification Task (WIT), a task measuring their implicit preference for stereotype congruent pairing (black face/weapon or white face/tool) compared to non-congruent pairing (black face/tool or white face/weapon) (Payne, 2001). Following the Weapon Identification Task, each participant completed various racism and motivation scales as well as a Values Survey (Schwartz, 1992) which served to measure their level of egalitarianism. Our prediction was not supported, though we did observe a significant three-way interaction between racism, construal level and egalitarianism (t120= -2.4358, p=0.016). This interaction revealed that participants that endorsed egalitarian values and were in the high-level construal group, showed less bias on the Weapon Identification Task, the more they reported being racist. Though this finding is counterintuitive to the results we thought would emerge, it shows there is much to be studied in the domain of implicit racial bias and self control.
Research Project Title: Self-control beliefs: Strengthening the muscle through planned acquiescence

Student Presenter: Megan Shroyer

Faculty Mentor: Patrick Carroll

Faculty Mentor Department: Psychology

Research Abstract: Prior work suggests that self-control resources deplete in the short-term but, much like a muscle, can strengthen through regular exercise over time. We examined whether some self-control failures can occur due to planned acquiescence or self-control breaks and, if so, whether the use of these planned breaks might actually increase self-control strength in the long-run just as scheduled breaks can increase physical strength. For example, just as weightlifters may schedule planned breaks in workout routines to increase muscle growth, a dieter may engage in a cheat day, whereby self-control is not depleted but consciously suspended to maximize long-term self-control strength. Thus, the present study examines whether some students are motivated to use scheduled self-control breaks to maximize long-term self-control resources and, in addition, whether those individuals show lower self-control depletion (or greater strength) on successive self-control tasks than students who do not use them or see merit in planned self-control breaks. To examine this, OSU student participants responded to baseline questions regarding their use of and instrumental beliefs (value beliefs) regarding self-control breaks and the general nature of self-control (limits, mutability, conservation needs). Next, participants were randomly assigned to engage in (experimental condition) or not engage in (control) an initial self-control task that involved changing a rule previously learned on a proofreading task. Finally, all participants completed a second self-control task (Stroop task) that required the suppression of initial tendencies (responding to color corresponding to word) in favor of a controlled response (responding to the font color). Preliminary findings are promising but data collection is ongoing, and full results are forthcoming. Understanding whether planned breaks in self-control can be used as a method for strengthening the resource may be beneficial when working with individuals diagnosed with health problems such as diabetes, ADD, or those struggling with addiction.
Research Project Title: Parent discipline predicts children's social competence

Student Presenter: Eve Gabrielle Villaruel

Faculty Mentor: Virginia Tompkins

Faculty Mentor Department: Psychology

Research Abstract: Educators are increasingly recognizing children’s social competence as an important indicator of school readiness. One way in which children’s social competence may be promoted prior to kindergarten is through parents’ discipline. However, there is little research on this relation; studies typically focus on parenting and social competence in older children or parenting is assessed in more generalized ways (e.g., emotional support). We assessed whether parent discipline predicted preschoolers’ social competence (social skills and problem behaviors) over time. In general, we expected that more positive discipline (e.g., an explanation of why the behavior was wrong) would predict greater social skills and that more punitive discipline (e.g., yelling) would predict greater problem behaviors. The sample included 37 primarily Caucasian and African American low-income preschoolers (M = 4.45 years). Parents completed a survey, which included open-ended questions about how they would respond to 12 child misbehaviors (e.g., child hits, child lies); parents were asked to write in how they would respond to each behavior. Each survey response was coded into four categories from most positive to most negative: explanations including explanation of others’ feelings (e.g., discussed how that behavior would make someone else feel), consequence (e.g., timeout) with explanation, consequence alone, and power assertive (e.g., spanking, yelling). Children’s Head Start teachers rated their social skills and problem behaviors with the Social Skills Improvement System Scale (Gresham & Stephen, 2008) at Time 1 and 5 months later at Time 2. We controlled for Time 1 social skills or problem behaviors to control for children’s initial social competence. We found that, controlling for children’s age and initial social skills, parents’ explanations of child misbehaviors significantly predicted children’s later social skills. Although parents’ use of consequences was related to greater problem behaviors and parents’ use of explanations was related to lower problem behaviors, these discipline responses were not significant predictors once initial problem behaviors were controlled. The results suggest that parents’ explanations for misbehavior may be beneficial for children’s social skills perhaps because it models an appropriate means of dealing with conflict with others and focuses the child’s attention on the reasons the behavior was inappropriate.
Research Project Title: Thin slices of deception

Student Presenter: Lorelei Wynn

Faculty Mentor: Phil Mazzocco

Faculty Mentor Department: Psychology

Research Abstract: With all the lies spread in the media, it is advantageous to detect lies based on facial cues. The goal of our experiment is to determine if you can predict lying based on thin slice visual cues from the neck up. In the proposed study, participants watched twenty-four 1 second silent black and white video clips of subjects answering two different questions, one lie and one truth. Participants also reported visual cues that they observed, to help determine whether the subject is lying or telling the truth. Accuracy in detecting lies was supported by our experiment, showing that people can detect when someone is lying above and beyond chance. However, visual cues were not correlated with detection accuracy.
Research Project Title: Expanding valence framing: Choosing versus rejecting similarly desired options

Student Presenter: John Taylor

Faculty Mentor: Duane Wegener

Faculty Mentor Department: Psychology

Research Abstract: Previous work has demonstrated that when people have a clear preference for one option over another, thinking about their attitude as opposing the worse option (opposition frame) versus supporting the better option (support frame) can lead people to hold their attitudes with more certainty (Bizer & Petty, 2005). However, the role of attitude framing is left unclear when choosing between two similarly desired options. We hypothesized that in this case, a support frame would promote attitude certainty. Because opposition frame increases certainty, opposing two similar options might lead to increased certainty in both positions, thereby decreasing certainty in the choice itself compared to supporting both options. In addition to matching the valence of the information to the valence of the frame, it is also possible to match it to the framing of the choice, as people can either think about choices as an opportunity to choose or reject one option. In this study, participants read about two candidates in a 2(information type: positive vs negative about both candidates) x 2(valence frame: positive vs negative) x 2(choice frame: choose vs reject) between subjects design. The confidence results showed a marginally significant interaction between attitude frame and information type, t(335)=1.92, p=.056, as well as a significant interaction between information type and choice frame, t(335)= 5.1589, p<.001. Our results indicate that a three-way matching (i.e. support frame/positive information/choice or oppose frame/negative information/reject) leads to increased confidence and increased behavioral intentions. In the choice condition, those with a three-way match (i.e. support frame/positive information/choice) were more confident about their choice (M = 4.69) than those with mismatches (Ms = 4.07, 3.49, 3.39), F(1,169) = 26.62, p<.001. In the rejection condition, those with a three-way match (i.e. oppose frame/negative information/reject) were also more confident (M = 3.71) than those with mismatches (Ms = 3.55, 3.01, 3.40), F(1, 170) = 2.265, p=.13. This work suggests that a three-way matching (i.e. support frame/positive information/choice or oppose frame/negative information/reject) leads to increased confidence and increased behavioral intentions.
Research Project Title: The influence of gender on decision-making

Student Presenter: David Weinraub

Faculty Mentor: David Melamed

Faculty Mentor Department: Sociology

Research Abstract: Making the right decision is a very hard thing to do in certain circumstances. Today though this is very tough thing to do because people are always being influenced by the world around them. This study will place college students in decision-making circumstances and will see if they can make the ‘right’ choice. There will be an initial survey to gauge participants level of independence or their ability to make their own decisions. After the initial survey, there was an experiment conducted on the chosen participants that tested their ability to make individual decisions in a controlled group setting. Currently the experimental phase being completed but once the data is collected I predict that there will be an association between the gender of the confederates and the decision of the subjects.
Research Project Title: Why do people mate poach?

Student Presenter: Melissa Schweyer

Faculty Mentor: Brunell No

Faculty Mentor Department: Amy

Research Abstract: Introduction

Mate poaching is attempting to steal someone else’s romantic partner (Schmitt et al., 2004). Mate poaching appears to be fairly common, with 35% of women and 57% of men reporting mate poaching attempts (Schmitt et al., 2004). The question of the present study is: Why do people mate poach?

Method

In this study, 89 Introductory Psychology students first read a scenario that explained what mate poaching is. They were asked if they had ever engaged in mate poaching and to write about their most recent experience. They were also asked to list five reasons why they mate poached. Lastly, they were asked to complete Dark Personality questionnaires, including narcissism, Machiavellianism, and psychopathy. Three research assistants coded the narratives to understand the motives people have for mate poaching.

Results

Data revealed that 19% reported having poached for a short-term fling, 15.7% poached for a long-term affair, and 18% poached for an exclusive new relationship. Those who indicated experience with mate poaching scored higher on dark personality traits than those with no mate poaching experience. In addition, coders found nine motivations for poaching; the top three motivations were attraction/lust, attractive personality, and because the targets of the poach indicated they could be poached.

Conclusions

Although it would be sensible to pursue a partner who is single, it appears people are more attracted to those who are already in relationships because they are validated as attractive by others (e.g., Yorzinksy & Platt, 2010). Thus, mate poaching is a common phenomenon. Research on mate poaching will further our understanding of relationship dynamics. For example, relationships that result from mate poaching tend to be less stable, less close, and less intimate relationships in the long run (Foster et al., 2014).
Research Project Title: Pregnancy and the effects of exercise: a systematic review

Student Presenter: Kassidy Ams

Faculty Mentor: Judith Tate

Faculty Mentor Department: Nursing

Research Abstract:

Maternal morbidity continues to be a significant problem worldwide. Yet, for every woman who dies of pregnancy-related causes, 20-to-30 experience acute or chronic morbidity, often with permanent sequelae that undermine their normal functioning. Health behavior interventions, such as increasing physical activity, have potential to reduce the incidence of complications of pregnancy, and reduce the burden of morbidity and mortality for families throughout the world.

The purpose of this systematic literature review was to describe if physical activity before and during pregnancy affects the incidence of complications in first pregnancies or recurrence of complications in subsequent pregnancies. Databases used in this review were PubMed, CINAHL, Web of Science, and Cochrane. The search terms used were (physical activity OR exercise OR walking) AND (pregnancy OR high-risk pregnancy OR preeclampsia).

Extensive electronic and manual citation searches are being performed to identify relevant papers for review. Databases used in this review were PubMed, CINAHL, Web of Science, and Cochrane. The search terms used were (physical activity OR exercise OR walking) AND (pregnancy OR high-risk pregnancy OR preeclampsia). Screening, data extraction, and quality assessment will be undertaken by two reviewers.

Studies will be classified by level of evidence, nature of physical activity, if women participated in physical activity before or during pregnancy, and maternal and infant pregnancy and birth data, and if the incidence of pregnancy complications was reduced when physical activity was increased. We will describe the incidence of pregnancy complications among women who participate in various forms of physical activity before and during pregnancy as reported by these studies. Data will be presented in a summary table.

Further research on increased physical activity and other health behavior interventions is needed. The outcomes of this review will provide direction regarding interventions to be tested in more rigorous research.
Research Project Title: HIV test counselors: the impact on risky behaviors and knowledge of HIV in Iringa, Tanzania

Student Presenter: Natalie Brooks

Faculty Mentor: Thomas McDow

Faculty Mentor Department: History

Research Abstract: Background: HIV counseling and testing (HCT) is the key to proper intervention for HIV/AIDS in communities heavily impacted by the virus. Through counseling and testing offered to the public, HCT strategies can identify infected individuals, raise awareness and expand education to reduce HIV transmission.

Methods: During a four-week period, closed-ended question surveys were administered to students and professors at Ruaha Catholic University and community members of Iringa, Tanzania. Structured interviews with HIV test counselors were conducted in order to discuss community awareness of HIV, the progression of counseling and testing techniques, and recommendations for improving HIV prevention efforts in Iringa. Semi-structured qualitative interviews were conducted with health care providers, representatives from non-governmental organizations, and agencies that serve the HIV/AIDS population in Iringa.

Results: Fifty surveys were completed: 80% of the participants have been tested for HIV before. Due to the stigma behind HIV and getting tested, several older members of the community did not feel comfortable participating in the study however, several young students in the area were willing to answer the questions and provide information about their sexual behaviors. HIV test counselors that were interviewed explained that older people avoid the conversation of sex and would rather not know than find out they are HIV positive. The interviews suggest that majority of clients seeking HIV testing, contraception, and barriers for sexual activities are young adults and adolescents.

Conclusion: These findings demonstrate an increase in effectiveness in young adults but older individuals are not seeking testing or sexual health resources. Though the HIV prevalence is higher for ages 30-49, efforts of test counselors have switched in order to reach out to the younger population because 75% of new infections are in young women and adolescence in Sub-Saharan Africa. HCT techniques have changed over time by introducing sex education in programs, door-to-door testing, and couples testing in order to reach out to the younger population.
Research Project Title: Mainstreaming intergenerational care

Student Presenter: Kelly Cohen

Faculty Mentor: Shannon Jarrott

Faculty Mentor Department: Social Work

Research Abstract: The population in the United States is rapidly aging, and many elders require care. As a result, systems need to be established that will provide the resources for individuals to age with dignity, while decreasing the financial, social, and emotional burdens for caregivers. Intergenerational centers offer an innovative alternative to traditional community-based care, by streamlining day services for children and older adults into one location. However, intergenerational centers are little known and under-utilized. Previous research on intergenerational programming has focused on the benefits of inter-group contact for children and older adults, as well as the challenges to implementing a successful intergenerational program. Benefits for children include positive perspectives of older adults and aging. Older adults reciprocally benefit in areas such as companionship and physical activity. The present study aims to promote the incorporation of intergenerational centers into mainstream options for families when selecting services, by analyzing the motives and knowledge of individuals who currently utilize care at Champion Intergenerational Center. The research design includes a cross-sectional survey for older adults, caregivers, and parents who are enrolled or have dependents enrolled at the center. The survey will determine if intergenerational programming influenced respondents’ choice of care using descriptive statistics. The levels of support that older adults and caregivers have for intergenerational programming will be analyzed with the use of Likert-scales, as well as their knowledge about the intergenerational activities that occur at the center. Intergroup contact theory informs this study, which states that one critical component of successful programming with different populations is support from sources of authority. Older adults and caregivers are stakeholders at Champion Intergenerational Center, and so their knowledge and endorsement of intergenerational care is key to program success. Intergenerational program administrators can utilize the results to attract more families to these centers. Results from the present study may additionally encourage care providers to explore the possibilities of providing services in a shared setting, due to the multi-faceted benefits for program stakeholders.
Research Project Title: Exploring the impact of the U.S. national HIV/AIDS strategy on HIV-related disparities in african american and latino populations, 2010-2015

Student Presenter: Anjali Doshi

Faculty Mentor: Tasleem Padamsee

Faculty Mentor Department: College of Public Health

Research Abstract: Background: HIV is a complex disease and national public health issue that has claimed thousands of lives. In response to this epidemic, President Obama initiated a National HIV/AIDS Strategy (NHAS) in 2010, intended to be implemented over the next ten years. The goals for NHAS are to reduce HIV infections, prioritize HIV-related healthcare services, and decrease stigma and HIV-related disparities.

Objectives: One reason that NHAS was created was to find solutions to HIV-related problems in populations most affected by this disease. Our research aims to understand how policies during the first five years that NHAS was implemented (2010-2015), have impacted two racial/ethnic populations that have been hit the hardest by this virus: African Americans and Latinos.

Methods: The White House asks the Presidential Advisory Council on HIV/AIDS (PACHA) for advice/recommendations on how to implement NHAS, thus we used meeting minutes from PACHA meetings to find information on topics discussed. Therefore, we looked for keywords: African American, black, Hispanic, Latino, race, and ethnicity in the 16 sets of meeting minutes over these 5 years, and summarized this information into one document that discusses the main initiatives/themes NHAS helped implement related to health disparities affecting these two ethnic groups. We also summarized daily news articles from POZ, The New York Times, and Kaiser Health News from 2010-2015 that covered issues related to HIV-related disparities in the African American and/or Latino communities.

Results: Three major themes were seen during the 5 years. First, multiple initiatives were established to help minorities by reducing stigma against people with HIV. Second, social media was used to educate African American and Latino communities on what HIV is and the importance of prevention and treatment. Third, PACHA discussed extensively the need to increase funding for HIV initiatives and to provide these individuals with better access to HIV focused care.

Conclusion: From 2010 to 2015, NHAS implementation focused on increasing HIV education to prevent transmission of the virus, and on improving access to HIV-related healthcare in African American and Latino minority populations.
Research Project Title: Exercise self-efficacy, anxiety sensitivity, and reported exercise in obese adults

Student Presenter: Samantha Goode

Faculty Mentor: Charles Emery

Faculty Mentor Department: Psychology

Research Abstract: Obesity is a significant health problem in the United States due to increasing prevalence and frequent co-morbid health conditions. Physical exercise is regularly included in treating obesity, but few obese individuals partake in regular exercise. Two dispositional characteristics related to physical activity include exercise self-efficacy (confidence in the ability to perform physical activity in challenging situations) and anxiety sensitivity (fear of the physical arousal associated with anxiety). Higher exercise self-efficacy is associated with greater physical activity, while higher anxiety sensitivity is associated with lower physical activity due to physical arousal of exercise being similar to arousal of anxiety. This study was designed to test the following hypotheses among obese individuals: (1) exercise activity would be positively associated with exercise self-efficacy and negatively associated with anxiety sensitivity; and (2) that exercise self-efficacy would moderate the relationship between anxiety sensitivity and reported exercise. 46 obese participants (BMI ≥ 30; mean age = 44 ± 14.8; range = 20-71 years; 82.6% female, 69.5% Caucasian) were recruited from a behavioral weight management program at the Ohio State University Wexner Medical Center and from the Columbus community. Participants completed three questionnaires at a baseline visit: Exercise Self Efficacy Scale (EXSE scale); Anxiety Sensitivity Index (ASI-3), including three subscale scores (cognitive, physical, and social); and International Physical Activity Questionnaire Short Form (IPAQ-SF) with scores from two subscale scores (moderate intensity exercise and total exercise). Data were analyzed with correlational analyses and hierarchical regression analyses. As hypothesized, greater social anxiety was negatively correlated with moderate physical activity, \((r=-0.36, p=0.02)\) and with total physical activity \((r=-0.33, p=0.04)\). However, cognitive anxiety was positively correlated with vigorous activity \((r=0.44, p=0.01)\). Exercise self-efficacy did not moderate the relationship of anxiety sensitivity to reported exercise \((p=0.11)\). The negative relationship between social anxiety and physical activity was expected as physical activity among obese individuals may be associated with perceptions of negative social judgments. Although the relationship between higher cognitive anxiety and more vigorous physical activity was surprising, individuals with higher cognitive anxiety (worried thoughts) may perform vigorous activity exercise in an effort to distract themselves or enhance health.
Research Project Title: Evaluating anxiety and depression in transgender patients at The Ohio State University Transgender Primary Care Clinic

Student Presenter: Benjamin Green

Faculty Mentor: Melissa Davis

Faculty Mentor Department: Family Medicine

Research Abstract: The Transgender Community has extremely high rates of mental health diagnoses compared to its cisgender counterpart, particularly for depression and anxiety. This disparity is due to increased risk factors faced by transgender people. In short, these include discrimination, abuse, and isolation. Little research has been done to evaluate mental health outcomes of this underserved patient population. Within the last 10 years, many medical societies have produced clinical guidelines for treating mental illness caused by gender dysphoria in transgender patients with cross-gender hormone therapy (CGHT). However, treatment of transgender patients remains controversial as many of these clinical guidelines are founded on expert opinion, rather than clinical data on mental health outcomes. Thus, it remains unclear how CGHT affects mental health outcomes in transgender patients. This study aimed to evaluate the existence of a relationship between CGHT and the attenuation of depression and anxiety in this population. The data for this study was collected from patients who were seen within the first two years of The Ohio State University Transgender Primary Care Clinic (OSUTPCC). Mental health was evaluated and tracked using mental health screening questionnaires. With only the analysis of data from the first year, we have yet to see a significant trend in depression and anxiety. Pending the analysis of data from the second year, OSUTPCC will consider bringing additional support to the clinic, specifically for the mental health needs of its patients.
Research Project Title: White noise and impact on alcohol withdrawal: A pilot study

Student Presenter: Krista Hetrick

Faculty Mentor: Esther Chipps

Faculty Mentor Department: Clinical Nurse Scientist at The Ohio State University Wexner Medical Center and an Assistant Professor of Practice

Research Abstract: Purpose: To examine the impact of white noise on patients experiencing alcohol withdrawal in the inpatient setting.

Background/significance: Almost half of the adult US population report regular alcohol use. For patients who consume alcohol on a daily basis, admission to an acute care facility means potentially experiencing withdrawal.

Method: This is a quasi-experimental study. We examined the difference between a prospective group of subjects experiencing alcohol withdrawal exposed to white noise and compared their use of antianxiety medications with a retrospective group of similar patients who were not exposed. The setting is at a community hospital which is affiliated with an academic medical center. Inclusion criteria includes: (1) 18 years of age or older, (2) English speaking, (3) oriented, (4) able to sign consent form, (5) have the CIWA-Ar protocol order and (6) admitted to a medical “surgical unit or the progressive care unit. The sample size is 30 persons per group. For subject in the prospective group, the white noise machine is placed in the subject’s room. Subjects were observed, assessed and treated with the current hospital Clinical Institute Withdrawal Assessment of Alcohol Scale, Revised (CIWA-Ar) protocol. Documentation included the CIWA-Ar scale and frequency and dose of anti-anxiety medications. For the retrospective group, a randomized list of 30 subjects who met inclusion criteria was obtained from the data warehouse. The same data was collected on these subjects. Descriptive statistics will be used to analyze demographic and clinical data. Inferential statistics will be used to compare antianxiety medication dosing and frequency between the two groups.

Results: Data collection has been completed. Analysis and conclusions are pending.

Conclusions: Pending
Research Project Title: Higher morning serum cortisol is associated with prevalent diabetes and higher glycemia among African Americans: The Jackson Heart Study

Student Presenter: Bjorn Kluwe

Faculty Mentor: Joshua Joseph

Faculty Mentor Department: Division of Endocrinology, Diabetes and Metabolism

Research Abstract: Introduction:

Serum cortisol levels have been associated with type 2 diabetes (diabetes) in whites. The role of cortisol in diabetes and glycemia is not fully elucidated among African Americans (AA). We hypothesized that among AAs morning serum cortisol would be positively associated with prevalent diabetes and glycemia.

Methods:

We examined the cross-sectional association of morning serum cortisol with prevalent diabetes, fasting plasma glucose (FPG), Hemoglobin A1c (HbA1c), homeostasis model assessment of insulin resistance (HOMA-IR) and ß²-cell function (HOMA-ß²) in the Jackson Heart Study at baseline (2000-2004). Fasting morning serum cortisol was collected. Diabetes was defined as HbA1c â‰¥ 6.5%, FPG â‰¥ 126 mg/dL, diabetes medications, and/or physician diagnosis. Linear regression models were used to examine the association of log-transformed cortisol with glycemic traits, stratified by diabetes. Logistic regression was used to examine the association of log-transformed cortisol with prevalent diabetes. Models were adjusted for age, sex, education, occupation, systolic blood pressure, waist circumference, physical activity, smoking, beta-blocker/hormone replacement medications and cortisol collection time.

Results:

Among 4,206 AAs (mean age 55 Â± 13 years, 64% female), 19% had prevalent diabetes. The median serum cortisol was 9.2 Âµg/dL (interquartile range: 6.9-12) among all participants. Medians were 10.0 vs. 9.0 ug/dL (p&lt;0.001, Mann-Whitney U test) among participants with vs. without diabetes. A 10% increase in cortisol among participants without diabetes was associated with 0.27 mg/dL (95% CI: 0.20, 0.33) higher FPG and a 1.00% (95% CI: -1.40, -0.60) lower HOMA-ß with no significant change in HbA1c or HOMA-IR. In participants with diabetes, a 10% increase in cortisol was associated with a 2.36 mg/dl (95% CI:1.36, 3.37) higher FPG and a 0.06 (95% CI: 0.03, 0.09) higher HbA1c. Among all participants, quartile 4 vs. 1 of cortisol was associated with a 1.26-fold (95% CI: 1.75, 2.91) higher odds of prevalent diabetes.

Conclusion:

Higher morning serum cortisol was associated with higher FPG and lower ß²-cell function among participants without diabetes and higher FPG and HbA1c in participants with diabetes. Among all participants, higher cortisol was associated with higher odds of diabetes. These findings support a role for morning serum cortisol in glucose metabolism among AAs.
Research Project Title: The United Kingdom's approach to the HIV/AIDS epidemic among African migrants

Student Presenter: Enxhi Myrtaj

Faculty Mentor: Tasleem Padamsee

Faculty Mentor Department: Public Health- Health Services Management and Policy

Research Abstract: The effect of the HIV/AIDS epidemic in the United Kingdom is unevenly distributed within its population. Historically, HIV/AIDS has disproportionately affected men who have sex with men. Beginning in 2000, however, African migrants became another group at high risk of HIV infection. Most African migrants are infected with HIV in their countries of origin, while far fewer contract the disease after arrival in the UK. The objective of this research is to examine the UK government’s response to the policy changes associated with having a growing number of African migrants with HIV. Interviews with officials involved in British HIV policy making were conducted and all transcript data that involved Africans in the UK was coded. Within this data on African migrants, specific nodes were identified for recurring themes, such as discrimination, prevention, research, and treatment, as well as for the policy changes regarding charging for treatment, testing, and immigration. NVivo (a software package for qualitative data analysis) was used to complete detailed coding within each node. This was followed by summarizing the data in each node in order to understand why certain policy changes were enacted to control HIV transmission and treat HIV/AIDS among African migrants. Results from this research show the impact the AHPN (African HIV Policy Network) has had on African migrants’ involvement in government policy, the stigma associated with immigration policy, and the cultural issues that have impacted HIV testing. Other results from this data show that policy changes regarding the charging of immigrants and undocumented people for healthcare from the National Health Service are linked to ideas about health tourism (the belief that people are coming to the UK to take advantage of free HIV treatment). Examining the impact of policies that affect HIV-positive African migrants in the UK can aid in the development of future policies that address stigma, prevent transmission, and treat already infected migrants.
Research Project Title: Telemedicine interventions for the prevention & treatment of cardiovascular condition management: systematic review and meta-analysis

Student Presenter: Jordan Lovely

Faculty Mentor: Roger Bailey

Faculty Mentor Department: Marketing and Logistics

Research Abstract: Technology has important effects on business operations in the medical field, and innovation plays a crucial role in sustaining health. One of these innovations is telemedicine, which broadly refers to the use of telecommunications technologies in medical delivery of care. This service allows for the remote diagnosis and management of patient’s health, and has recently been employed to improve patient outcomes across a large scope of medical problems. The purpose of this research is to look into the success of telemedicine interventions in the prevention and treatment of cardiovascular disease management in patients, and to analyze whether these interventions bring better results than the normal care routine. As cardiovascular disease and other heart problems affect the health of many people around the world, telemedicine interventions can be used to provide health care to those with CVD, and to help monitor those at high risk for heart disease (prevention of CVD). For this reason, this research focuses solely on the use of telemedicine in patients with cardiovascular conditions. The hypothesis is that telemedicine interventions used in the included cardiovascular condition management scenarios are beneficial, and have a positive relationship with health outcomes for patients. Though previous studies have been conducted to test these telemedicine interventions in CVD, they have shown conflicting results. This project provides a systematic review and meta-analysis that statistically combines data from multiple studies. A search of several major databases has provided relevant controlled studies that fulfilled the criteria for inclusion in this review. The selected studies will be analyzed using quality health outcome measures, including mortality and hospitalization. This analysis will provide a comprehensive viewpoint on the effect of these telehealth interventions and could aid in valuing this technological innovation.
Research Project Title: The relationship between responsible drinking policies and football game-day incidents at The Ohio State University: a preliminary study

Student Presenter: Sunder Sai

Faculty Mentor: Paul Bellair

Faculty Mentor Department: Sociology

Research Abstract: Introduction/Background

Studies have shown crime, misconduct, and incidents tend to increase within and around stadiums during football games, particularly, alcohol-related misconducts (Reese and Schnepel 2008, Merlo et al. 2010, Kalist and Lee 2014). Ohio Stadium, home to The Ohio State University (OSU) Buckeyes college football team, hosts 7-8 annual home football games each fall. Minimal research has been presented observing trends regarding incidents during OSU’s home football games. Furthermore, causes for these potential trends remain unknown.

Methods

It is hypothesized that responsible drinking policies, which are reflected through stadium-wide alcohol sales and a no-bag policy, are associated with reduction of game day incidents. Incident statistics from OSU’s Department of Public Safety were examined for the 2012, 2013, 2014, 2015, 2016, and 2017 OSU home football game seasons. Alcohol arrests and citations inside and outside the stadium along with stadium ejections were compared across these seasons. Additionally, game time, game duration, possession time, attendance, points scored, and game-day temperatures were observed as potential variables influencing game-day incidents.

Results

Preliminary findings show a decrease in total alcohol incidents, total arrests, and total ejections between the 2014-2016 seasons. However, there was an increase in these numbers for the 2017 season, which may be due to changes in stadium alcohol policy. Within each season, incidents were highest for evening games that started 6 p.m. or later. The findings also suggest that attendance, game duration, possession time, points scored, and temperature did not appear to have significant relationship to the number of game-day incidents.

Conclusions

This study provides initial findings showing a decrease in overall game-day incidents between the 2014-2016 seasons, which may be due to responsible drinking policies. Stadium-wide alcohol sales may give guests opportunities to drink more moderately inside the stadium. Bag policy could also prevent guests from bringing alcohol into the stadium. The rise in overall game-day incidents for 2017 may be due to changes in stadium alcohol sale policy that could restrict guests from drinking moderately inside the stadium. Causality cannot be established, however. More research will be conducted for future games evaluating trends.
Research Project Title: Sexual behaviors and perceived risk for acquiring a sexually transmitted infection (STI) among undergraduate students attending on-campus STI testing sites, 2016-17

Student Presenter: Leah Sadinski

Faculty Mentor: Maria Gallo

Faculty Mentor Department: Epidemiology

Research Abstract: Introduction:

This study aims to 1) investigate the prevalence of high risk sexual behaviors and perceived risk for STI acquisition among undergraduate students and 2) assess the agreement between perceived risk for STI acquisition and reported engagement in sexual behaviors that increase risk for STI acquisition.

Methods:

Ohio State’s Office of Student Life offers walk-in STI testing free of charge. Clients complete paper intake forms that capture demographics, perceived risk for STI acquisition, and sexual behaviors. Forms from July 2016 to June 2017 were entered into Microsoft Excel and imported into SAS 9.4. Repeat clients during the specified time frame were linked by first and last name and year of birth. Clients who participated in at least one of the following activities within the past 12 months were classified as practicing high risk sexual behaviors: vaginal/anal sex without a condom, sex with an anonymous partner or partner who tested positive for an STI, sex under the influence of alcohol or non-injection drugs, or being in an open relationship. Risk perception was classified as low or high risk. McNemar’s test assessed the agreement between perceived risk and engagement in high risk sexual behaviors. The study obtained approval from the OSU IRB.

Results:

The analysis was limited to undergraduate students and the first visit of repeat clients, resulting in a sample size of 278 records for the 2016-17 academic year. The average client age was 20.5 years (SD = 1.8). The majority of the sample was female (56.5%) and not in a relationship (70.8%). Over half (53.6%) perceived their risk to be low. When asked about sexual behaviors, 90.6% of the sample reported engaging in at least one high risk sexual behavior. McNemar’s test indicated a low level of agreement between perceived risk of acquiring an STI and engagement in at least one high risk sexual behavior (p<0.0001).

Conclusion:

The high level of disagreement between perceived risk and high risk sexual behaviors suggest students do not associate high risk sexual behaviors with an increased risk for STI acquisition. Intervention programs for undergraduate students should emphasize the risk associated with these behaviors.
Research Project Title: State variations in physician capacity to treat opioid dependencies with medication-assisted treatment

Student Presenter: Ryan Yoder

Faculty Mentor: Wendy Xu

Faculty Mentor Department: Public Health

Research Abstract: The opioid epidemic is a current public health crisis that affects millions of Americans. According to the Center for Disease Control and Prevention (CDC), deaths due to opioid overdoses have increased at a rate that has lowered the national life expectancy. Access to opioid treatment for people with opioid dependencies allows people an opportunity to seek recovery for their addiction. Medication-assisted treatment (MAT) is becoming an effective method of care; combining behavioral therapy and medication. The federal government permits clinicians that are not apart of opioid treatment programs to apply for waivers that allow them to individually prescribe MAT drugs. Thus, physician capacity—the proportion of physicians available to prescribe MATs—affects access to this type of care. However, physician capacity to prescribe MATs are rarely touched upon in the literature, even though it is a large factor in increasing access to care.

The purpose of this study is to examine the association between physician capacity to prescribe MATs and related policy and public programs. Using data from the Substance Abuse and Mental Health Services, the number of opioid treatment programs and physicians with specific waivers to prescribe MATs were counted and standardized by population. The State Drug Utilization data from the Center for Medicare & Medicaid Services, age-adjusted opioid overdose death rates from the CDC, and other variables studied were examined by state and by year. Treatment capacity variables were divided into quartiles by year.

The preliminary analysis indicated states in 2016 in the highest treatment capacity quartile—or high access states—had significantly higher reimbursement rates for MAT drugs through their Medicaid programs. However, high capacity states also had the largest recorded opioid overdose death rates. Formal statistical analyses will be performed to gauge the associations between capacity and MAT utilization across states over time. Understanding the commonalities of high capacity states may offer an insight to the policy formulations made to confront the opioid epidemic. Furthermore, research that blends the worlds of public policy and public health are important for combatting this multifaceted problem.
Research Project Title: Social support and physiological dysregulation in elderly Kuwaitis

Student Presenter: Katherine Znidarsic

Faculty Mentor: Douglas Crews

Faculty Mentor Department: Anthropology

Research Abstract: Znidarsic K, Al-Kandari Y, Edes A, Crews DE

Stress generates physiological dysregulation of biomarkers, leading to poor future health and shortened lifespan. In western populations, social support buffers these negative effects, as evidenced by an inverse relationship between perceived social support and risk for morbidity and mortality. Comparable studies from non-western populations are few. This research investigates whether social support similarly buffers against physiological dysregulation in a non-western sample of elderly Kuwaiti individuals (n = 253, aged 60+ years). Indicators of social support include marital status, perceived social support, religiosity, and whether children were living at home. Ten biomarkers were tested for associations with social support: norepinephrine, epinephrine, cortisol, dehydroepiandrosterone sulfate (DHEA-S), systolic and diastolic blood pressure, waist-hip ratio, glycosylated hemoglobin (HbA1c), low-density lipoprotein cholesterol (LDL), and high-density lipoprotein cholesterol (HDL). Each biomarker was tested for associations with sex and age using t-test and linear regression respectively. Associations between indicators of social support and individual biomarkers were tested using ANOVA and post-hoc analyses for men (n = 79) and women (n = 174) separately (α = 0.05). Women had significantly lower DHEA-S than men. There were no sex differences for any other biomarker. In men, age associated negatively with LDL, and in women, age associated negatively with DHEA-S. Significant associations were not observed between age and any other biomarkers. Among men, being married associated significantly with lower diastolic blood pressure and HDL, higher perceived social support associated significantly with lower norepinephrine and diastolic blood pressure, being religious associated significantly with lower LDL, and having children living at home associated significantly with lower DHEA-S. Among women, being married associated significantly with lower norepinephrine and cortisol, and having higher perceived social support associated significantly with lower diastolic blood pressure, HbA1c, and LDL. No significant biomarker differences were observed for women based on religiosity or whether children lived at home. From these analyses, social support results in lower levels of some stress-related biomarkers for both men and women, although sex differences are observed. These results are consistent with those observed in western societies, suggesting social support consistently buffers stress-induced physiological dysregulation across populations.
Research Project Title: Reiki therapy for pain management in young children receiving palliative care

Student Presenter: Allison Martin

Faculty Mentor: Susan Thrane

Faculty Mentor Department: College of Nursing

Research Abstract: Introduction: Chronic persistent pain impacts up to one in ten children, leading to difficulty completing activities of daily living and poor mental health. Studies in adults have suggested that Reiki therapy, a highly accessible form of biofield energy therapy, improves pain and other symptoms. Since research using Reiki therapy for children is minimal, this quasi-experimental pilot study aims to evaluate the feasibility and potential for benefit of administering Reiki therapy to young children receiving palliative care.

Methods: Reiki therapy was administered to one to five year-old inpatients at a large children’s hospital twice per week for three weeks. Sessions consisted of eight hand positions held for two minutes each. Faces, legs, activity, cry, consolability (FLACC) pain scale score was measured pre and post each session. Parents completed a questionnaire each week during the study period, which included a report of their child’s current pain level using a visual analog scale.

Results: The sample included five child-parent dyads at the time of abstract submission. The child sample consisted of three males and two females between ages 13 to 39 months, with a mean age of 26 months. The participants’ age of referral to the palliative care service ranged from 0 to 4 months, with a mean age of two months. All mean pain scores decreased or were unchanged from pre-to posttreatment for each session, without statistical significance. However, within-subject ANOVA tests revealed large clinical effect sizes of partial eta squared = 0.25 for both pre- and post-treatment FLACC pain scores, and a large clinical effect size of partial eta squared = 0.518 for parent-reported pain level.

Conclusions: Decreased or unchanged mean pre-post session pain scores suggest that Reiki therapy reduced participants’ pain, but small sample size hinders statistical significance. Large clinical effect sizes for both FLACC and parent-reported pain scores suggest that repeated Reiki sessions decreased participants’ pain over time. This preliminary study suggests that Reiki therapy may contribute to pain reduction in pediatric palliative care patients when used in conjunction with other complementary and traditional methods. It provides a methodological foundation for further research on Reiki therapy in pediatrics.
Research Project Title: Power in numbers: patient contact improves successful referrals

Student Presenter: Alyssa Fogolin

Faculty Mentor: Hill Yes

Faculty Mentor Department: Nina

Research Abstract: Free clinics often utilize undergraduates to help provide free and quality healthcare services to uninsured or underinsured. The Columbus Free Clinic, CFC, implemented a new type of undergraduate role to increase communication with patients outside of clinic, which helps improve patient outcomes.

A team of undergraduate students served as the first referrals patient advocates at the CFC, who would communicate with patients after a clinic visit. The undergraduates were tasked with increasing the number of patients who could successfully connect with resources outside CFC—including specialty care, imaging services, long term primary care providers, dental services, physical therapy services, or prescription payment assistance programs. Before forming this undergraduate team, less than 10% of patients received the outside services they needed. However, with the team in effect, undergraduates could contact patients more often via phone calls to answer questions, address problems, educate patients about the referrals process, and assist patients in the tedious process. This model of short phone encounters with patients parallels previous models in primary care research which has shown more prevalent success of multiple short encounters than a single long session with patients. Free clinics can provide better services, to more patients, if they take advantage of undergraduate volunteers, who can increase communication with patients outside of normal clinic appointments.

A key aspect of implementing the undergraduate team was the training process, which gave volunteers the necessary background knowledge to best assist patients. The training included HIPAA training, shadowing social work to learn about social determinates of health, shadowing referrals coordinators during clinic, learning how to use the EMR, and doing practice phone calls. Next year, the training process will be expanded even more to include information about specific referral sites, so that the volunteers feel confident answering questions for patients. After receiving training, the referral advocates began making phone calls at CFC. Using a programmed excel sheet, they gather the list of patients they will call each night and call each patient. When talking to patients, the referrals advocates ask if the patient has been able to make an appointment with their referral site, if they had any problems with financial aid, if they are able to attend upcoming appointments and if they see any barriers to being able to attend, and overall if the patient has any questions. All information is recorded and updated until the patient successfully attends their referral appointment and all the patient’s needs are addressed. Patients will be contacted until their appointment is successful or up to 10 times. Referrals advocates can contact up to 15 patients in just one night.

By increasing the number of contact points with patients with the help of undergraduate volunteers, the referral’s success rate has increased. CFC has now expanded the undergraduate phone call volunteers to work with diabetic patients to see if patients have better glycemic control and better outcomes. In the future, CFC hopes to continue expanding the use of undergraduate volunteers to have more communication with patients, hopefully resulting in better patient outcomes.
Research Project Title: A transdisciplinary review of opioid use models

Student Presenter: Sophia Kiselova-Sammons

Faculty Mentor: Lancaster Yes

Faculty Mentor Department: Kathryn

Research Abstract: Background: Currently, the United States is facing a severe substance use epidemic, with the use of prescription and non-prescription opioid drugs occurring at alarming rates. Researchers from myriad disciplines have worked to develop theoretical frameworks to guide responses to substance use, and opioid use in particular. Here, we implement a scoping literature review of these existing frameworks to consolidate their strengths and weaknesses.

Methods: Using literature found from six scientific databases and a refined set of key words, we have compiled a set of prominent articles from a range of academic disciplines addressing opioid use with the support of a conceptual model. After analyzing the benefits and drawbacks of each model, we developed an overarching response to the ways in which the scientific community is succeeding and failing in addressing opioid use.

Results: A total of nine frameworks were identified and reviewed. The strengths of each framework included: considering opioid use as a public health epidemic rather than a criminal act, suggesting more standardized assessments to measure patient outcomes and provide population-level feedback on recovery, catering opioid treatment methods based on the resources available in different settings. While several strengths were noted, the current published literature points to an overall inattention towards the systemic causes of substance use, and the need for more culturally sensitive, holistic approaches to opioid addiction treatment.

Conclusions: This review proves useful in providing an overview of individual strengths and weaknesses of many existing opioid use models, while also presenting suggestions for how future conceptual models might be designed to more comprehensively consider factors influencing opioid use, and to effectively address opioid use as a whole. Specifically, we advocate for substance use to be considered in a socio-ecological framework, loosely based on Urie Bronfenbrenner's (1994) Bioecological Model of Human Development, to allow for the consideration of diversity of social and structural contexts that play into the development of addiction.
Research Project Title: Functionalized ortho-carborane as a metal ion chelator

Student Presenter: Julia Berry

Faculty Mentor: Noel Paul

Faculty Mentor Department: Chemistry and Biochemistry

Research Abstract: Modern medicine frequently relies on magnetic resonance imaging (MRI), and the administration of chelated metal ions as contrast agents is often required to obtain sharp images. However, inevitable deposition of the toxic metal into the body imparts a low level of toxicity. Carboranes, which can possess the ability to bind metal ions, are of interest for their potential application in improvement of current macrocyclic contrast agents. The goal of this study is to develop a stable, carborane-based macrocycle with the capacity to chelate gadolinium ions and be developed into a viable MRI contrast agent. Initial work explored the cyclization of bis(butenyl)carborane via olefin metathesis, but the products exhibited especially low solubility, greatly complicating their purification and further analysis. Thus, studies that explore the feasibility of hydroxy-substituted carborane macrocycles in this hypothesis have been conducted. The reactivity of the ortho-carborane mono- and dianion have been examined in nucleophilic addition to various carbonyl compounds according to literature guidelines, and the products of these reactions were characterized using 1H and 13C NMR, and mass spectrometry. These methods have been considered as a means to introduce hydroxyl groups that may be used to coordinate gadolinium ions or serve as a handle to allow for cyclization. Current studies are expanding on this reactivity and exploring the use of dialdehyde molecules as potential routes to cyclization. Successful development of strong chelating agents would have a significant impact on medical imaging by minimizing deposition of toxic metal into the body, thereby reducing the risk associated with current MRI contrast agents.
Research Project Title: Binding affinities of functional groups to metal cations

Student Presenter: Michelle Fiamingo

Faculty Mentor: Heather Allen

Faculty Mentor Department: Chemistry

Research Abstract: Deciphering cation binding affinities for lipid head groups is essential in understanding the physical underpinnings of trace metal enrichment at the sea-surface microlayer (SSML). These metals and lipids at the SSML are incorporated into sea spray aerosols (SSAs) which in turn impact the climate through a myriad of direct and indirect methods. Surface tension experiments using salt titrations and surface pressure-area isotherms were conducted to probe metal binding to several model lipids, chosen for their high surface activities and varying headgroup moieties. In addition, Brewster Angle Microscopy (BAM) was utilized to study lipid domain morphology to provide a molecular insight into how dipalmitoylphosphatidic acid (DPPA) molecules pack in the presence of divalent and trivalent cations. It was found that the trace metals exhibited strongest binding to the phosphate headgroup, followed by the carboxylate headgroup. By applying the Langmuir-Szywkooski equation to binding fits, ion affinities for the phosphate headgroup were determined in the order of Al3+ &gt; Fe3+ &gt; Zn2+ &gt; Mg2+ &gt; Ni2+ &gt; Mn2+ &gt; Ca2+. Thus, we conclude ion binding to phosphate groups plays a significant role in selective enrichment of trace metals at the SSML.
Research Project Title: Ethanol steam reforming on nickel-cerium oxide catalysts

Student Presenter: Joshua Graham

Faculty Mentor: Robert Baker

Faculty Mentor Department: Chemistry and Biochemistry

Research Abstract: Water and ethanol vapors react at high temperatures in an ethanol steam reforming reaction on nickel catalyst to evolve hydrogen as well as producing acetaldehyde, ethylene, methane and other carbon byproducts. This reaction is of interest because the production of hydrogen gas from a naturally produced source such as ethanol has direct renewable energy applications. The addition of semiconductors to steam reforming catalysts has been studied to examine the effects on product selectivity, catalytic rate enhancement and stabilization of the catalyst. In this study the effect of semiconductive cerium oxide nanoparticles arranged in specific surface morphologies on a nickel surface was studied. The cerium nanoparticles were shown to change the selectivity and rate of the ethanol steam reforming reaction. The product distribution and rate of product turnover was studied using batch mode gas chromatography, while surface morphology was studied using X-ray photoelectron spectroscopy.
Research Project Title: Electrochemical performance of polymer and potassium salt electrolyte

Student Presenter: Justin Dilenschneider

Faculty Mentor: Yiying Wu

Faculty Mentor Department: Department of Chemistry and Biochemistry

Research Abstract: Current batteries require further research to fulfill the stability, cost, and energy requirements of modern technology. Potassium-oxygen batteries show promise in their large specific energy and high round-trip efficiency; however, further research is required to develop this technology. Using a salt-in-polymer electrolyte instead of an organic based electrolyte could improve the cycle life of the battery while retaining its efficiency and performance. As of yet, little research has been conducted to determine the performance of these salt-in-polymer electrolytes in potassium-oxygen batteries. We address this shortcoming by investigating important parameters including the cycle life, overpotential, columbic efficiency, and rate capability of a potassium-oxygen battery using these salt-in-polymer electrolytes.
Research Project Title: Synthesis and characterization of piezoelectric porous membrane support

Student Presenter: Shoko Kanemoto

Faculty Mentor: Hendrik Verweij

Faculty Mentor Department: Material Science Engineering

Research Abstract: Membranes are often used for water recovery in both industrial and municipal settings. One of the continuing issues during the operation is fouling which is induced by the accumulation of contaminants on the membrane surface or within the pores, degrading the water flux and filtration performance. The current defouling methods are not 100% effective, yet time consuming and costly as they may require equipment shutdown, membrane removal from the line, and use of chemicals. The piezoelectric porous membrane support can introduce a self-cleaning, fouling mitigation function to the membrane to avoid fouling, entirely. This material can generate ultrasonic waves when subjected to alternating voltage at the characteristic resonance frequency, and the subsequent cavitation and shear stress at the surface of the membrane inhibit the formation of the fouling layer. alpha-quartz is a piezoelectric material that is, lead-free, insoluble in water, and possesses permanent piezoelectric effect at its single crystal phase. The purpose of this works is to investigate the synthesis method of alpha-quartz (SiO$_2$) membrane support, and the characterization of its water filtration, mechanical resonance, and fouling mitigation properties. The silica was obtained as nanopowder and consolidated into a disk-shape by pressing, followed by thermal treating through sintering. The successful synthesis was achieved through the use of additives and granulation before pressing and sintering at the optimal pressure and temperature of 70MPa and 1400°C, respectively. The crystalline phase was investigated under XRD, and the result was compared against calculated powder diffraction spectrum in Diamond. The vibrational frequency was studied through acoustic emission test and tank test, and analyzed with COMSOL modeling. The mitigation property was investigated through dead-end filtration testing. The development of this membrane support can offer more environmentally friendly solution to the problem of fouling and external cleaning process of the water filter membranes.
Research Project Title: The preparation of quinone methide precursors to re-alkylate aged acetylcholinesterase

Student Presenter: Ravali Kode

Faculty Mentor: Christopher Callam

Faculty Mentor Department: Chemistry and Biochemistry

Research Abstract: Organophosphorus (OP) compounds are known to have detrimental effects on the enzyme, acetylcholinesterase (AChE). AChE is found in the central and peripheral nervous system. This enzyme hydrolyzes the neurotransmitter acetylcholine (ACh) into choline and acetate. When AChE is exposed to OP compounds, such as pesticides or chemical nerve agents, it covalently inhibits and after a period of time goes through an aging process. When the enzyme is inhibited or aged, this leads to a buildup of acetylcholine in the body. In this state, the side effects include muscle twitches, reduced vision, paralysis, vomiting, convulsions, and eventually death. A group of compounds known as pyridinium oximes can reactivate the inhibited AChE. However, if there is prolonged exposure, the enzyme becomes de-alkylated and transitions from an inhibited state to an aged state. There are currently no known pharmaceutical treatments for this aged species. Our research focuses on developing a small molecule that can be used to re-alkylate the aged enzyme. Computational studies and literature show that compounds known as quinone methides (QMs) and quinone methide precursors (QMPs) have the ability to act as a re-alkylating agent. Our research involves synthesizing a family of QMP like compounds that can be used to re-alkylate aged AChE. Our current library of compounds consists of frameworks such as benzene, pyridine and pyrrole with varying functional groups. Varying these groups allows us to further analyze both electronic and steric interactions the compound has on the active site and how it affects AChE. The synthesis and screening of these compounds will be presented.
Research Project Title: Synthesis and characterization of Br double perovskite precursors: Cs2AgBr3 and CsAgBr2

Student Presenter: Nicholas Harvey

Faculty Mentor: Matt Gray

Faculty Mentor Department: Chemistry

Research Abstract: Renewable energy over the years has been of growing interest for many reasons. My research is focused on synthesizing lead-free halide materials and mapping out their phase diagrams. The specific phase diagram that has been of focus is the CsX, BiX, AgX (X= Br, Cl). This system has been of interest because of the interest in the double perovskite that can be made in the middle of these diagrams. The double perovskites are materials that are used in the applications of solar cells which aim to increase the efficiency of these cells. The bromine analogs of these materials have been made more pure than the chlorine versions.
Research Project Title: Polarity-reversal cascade for C-H functionalization of heteroarenes

Student Presenter: Xin Gu

Faculty Mentor: David Nagib

Faculty Mentor Department: Chemistry and Biochemistry

Research Abstract: Nitrogen-containing heteroarenes are medicinally important core in many therapeutic drugs. Applying and improving methods of C-H functionalization on existing drugs and drug candidates facilitates drug discovery and is a major focus on synthetic organic chemistry. Besides other methods for heteroarene C-H functionalization, Minisci reaction, in which a two-component coupling between a nucleophilic radical and an electron deficient heteroarene, is of interest and considered as a powerful tool for C-H functionalization. Typically, the generation of the nucleophilic radical is achieved via the oxidation of a weak C-H bond or halogen-abstraction. In the interest of examining new methods to generate nucleophilic radicals, that can be employed in the Minisci reaction, a three-component process has been developed and successfully employed to functionalize three classes of heteroarene substrates in moderate to good yields. This three-component Minisci reaction involves the generation of an electrophilic radical that upon addition to ethyl vinyl ether, generates the desired nucleophilic radical. This polarity-reversal cascade allows for additional functionality to be installed into the side-chains of compounds, whereas with the classical variant the radical precursors must be pre-functionalized, and allows for further derivatization of medicinally useful molecules.
Research Project Title: Synthesis, crystal structures, and magnetic properties of double perovskites containing 5d transition metals

Student Presenter: Nathalie Milbrandt

Faculty Mentor: Patrick Woodward

Faculty Mentor Department: Chemistry and Biochemistry

Research Abstract: Transition metal oxides containing 5d ions have exhibited many exotic magnetic properties, the underlying mechanism of which has not yet been fully understood. Many of the unique characteristics of 5d transition metal oxides are thought to be dependent on the strong spin orbit coupling and the extended d orbital. Double perovskites provide a great platform to study the magnetic interactions among 5d transition metal ions because they are amenable to various types of element substitutions. For 5d1 and 5d2 electron configurations, diversely exotic magnetic properties have been found such as ferromagnetism, antiferromagnetism, and spin glass. Octahedrally coordinated transition metal ions with a 5d4 configuration should possess a nonmagnetic J=0 state, due to the effects of strong spin orbit coupling, however, recent studies by different groups have shown that there exists nontrivial magnetic moments in some compounds. By synthesizing new double perovskites containing 5d transition metals, the exotic magnetic properties can be explored.

Solid state synthesis has been performed on targeting stoichiometry of and Ba2MlrO6 (M= Lu, and Fe) and SrLaMlrO6 (M= Zn, Mg, and Ni) which are all in a d4 electron configuration. The crystal structures of the products have been studied using X-ray powder diffraction. The Ba2FeIrO6 crystallizes in a hexagonal structure, the Ba2LuIrO6 crystallizes in a cubic double perovskite structure, and all the other iridates crystallize in a monoclinic double perovskite structure. Preliminary magnetic data shows that Ba2LuIrO6, SrLaZnIrO6, and SrLaMgIrO6 are paramagnetic and SrLaNiIrO6 is likely antiferromagnetic. Further magnetic data and heat capacity data are needed for these as well as the other iridates to determine and verify their magnetic properties. This study is expected to expand our knowledge of the interesting magnetic phenomena presented by 5d transition metal oxides in different crystal structures and with different B site cations.
Research Project Title: From feedstocks to medicines: new protocols for use of acrylates and dienes for the synthesis of valuable chemical intermediates

Student Presenter: Milauni Mehta

Faculty Mentor: Thaliyil Rajanbabu

Faculty Mentor Department: Chemistry

Research Abstract: Cobalt catalyzed heterodimerization of readily available conjugated dienes and alkyl acrylates affords a highly enantioselective heterodimerized product which can then be used in pharmaceutical and fine chemical synthesis. Known optimal conditions for this reaction include treatment of conjugated diene (1.00 eq) and methyl acrylate (1.10 eq) with isolated catalyst 1,3-bis(diphenylphosphino)propane cobalt dibromide [DPPPCoBr2] (0.05 eq), activator NaBARF (0.075 eq) and reducing agent Zn° (0.50 eq) in 0.15 M in dichloromethane [DCM] at room temperature for 4 hours, affording an isomeric mixture of the heterodimerized product in a 4:84:12 ratio as determined by GC analysis. Limitations for this reaction include the expensive cost of synthesizing NaBARF, excess use of Zn° and long reaction times. We have discovered a cost-efficient substitute, InBr3, for the activator NaBARF as well as a more environmentally friendly substitute, Li3N, for the Zn° reducing agent. This project involved scanning activators and reducing agents as well as their equivalence with respect to catalyst to create new optimal conditions for the heterodimerization reaction. The optimal condition was determined to be treatment of 1,3-(E)-undecadiene and methyl acrylate with the racemic ligand DPPP or chiral ligand (S,S)-BDPP (0.05 eq.), cobalt salt (0.05 eq.), reducing agent Li3N (0.10 eq.) and activator InBr3 (0.10 eq) in DCM (0.35 M) at room temperature to afford an isomeric mixture of the same ratio distribution as known conditions. The major isomer, the 1,4-addition product, was characterized via GC, GC-MS, 1H-NMR, and 13C-NMR. The reagents for these optimized conditions are readily purchasable thus significantly reducing the costs of the reaction. These conditions were expanded to functionalized substrates with varying degrees of conversion. The heterodimerized product has an α,β-unsaturated carbonyl which can then be further functionalized via Michael addition or cyclization reactions which provides synthetic utility for medicines and valuable chemical intermediates.
Research Project Title: Development of advanced multifunctional polymer binders for cathode materials in lithium-ion batteries

Student Presenter: Adam Schmidt

Faculty Mentor: Jung-Hyun Kim

Faculty Mentor Department: Mechanical and Aerospace Engineering

Research Abstract: Reducing costs and improving environmental friendliness for the manufacturing processes of lithium-ion (Li-ion) battery cells are important goals of today’s battery research. Presently, the industry standard polyvinylidene fluoride (PVdF) binder “the glue holding the electrode together” requires a toxic solvent, N-methylpyrrolidone (NMP), during the electrode fabrication processes. Since the purchase and proper disposal of NMP contributes about 13% of the total cost for Li-ion battery production, finding a water-soluble replacement for PVdF would be economically beneficial. The purpose of this research is to develop an effective binder material that uses a water-based solvent, so that currently used toxic solvents can be phased out, reducing cost and increasing environmental friendliness. Lithiated polyacrylic acid (LiPAA), a possible alternative binder, uses a water-based solvent and has other desirable properties, such as increased adhesion force, increased cycle life, and decreased capacity fade. LiPAA is not currently a feasible binder, however, because electrodes produced using LiPAA are particularly brittle, which causes cracking during the battery manufacturing process, leading to reduced cycle life. In order to alleviate this undesirable mechanical behavior, LiPAA will be doped with styrene-butadiene rubber (SBR) and sodium alginate (Na-Alg). We hypothesize that adding these elastic materials to the brittle LiPAA will provide the electrode with the desirable electrochemical properties of LiPAA, while mitigating its brittleness. We will apply various compositions of LiPAA, Na-Alg, and SBR binders to a LiNi0.5Mn1.5O4 cathode. We will assess the quality of the coating and microstructure using scanning electron microscopy (SEM). We will fabricate cathodes with different binders into coin-type Li-ion battery cells to measure electrochemical performance. We will examine the effects of binder composition on the physical and electrochemical properties of cathodes in Li-ion batteries. We expect to find a water-soluble binder that facilitates the transfer of electrons without causing the electrode to fail through brittle fracture.
Research Project Title: Electrocatalytic properties of hydrogen absorbing Zintl phases

Student Presenter: Dominic Ross

Faculty Mentor: Josh Goldberger

Faculty Mentor Department: Chemistry and Biochemistry

Research Abstract: Low abundance of platinum and palladium, alongside the increased need for environmentally conscious energy options, such as fuel cells, has brought low cost catalysis to the forefront. However, to date there has been a lack of much investigation into novel catalysts beyond platinum alloys. Our work seeks to demonstrate the viability of novel Zintl phase catalysts and their hydrides (e.g. BaGa2 & BaGa2H2, BaGaGe & BaGaGeH) for electrocatalytic half reactions of interest to upcoming energy technologies, such as proton exchange membrane fuel cells â€“ which currently require high platinum loading. BaGa2H2 is expected to demonstrate excellent catalytic properties, and serves as a model system for the general reactivity trends of Zintl phase compounds before and after hydrogenation. Here, we measure the catalytic activity for the hydrogen evolution reaction (HER) and the oxygen evolution reaction (OER) of BaGa2 and its hydride by cyclic voltammetry, as well as investigation of the catalytic activity of GdGa for HER. In addition, we are investigated methods for electrochemical growth, from solution phase metal salts, of Zintl phases with small domain size and high surface area available for catalysis. Furthermore, by use of a sacrificial hydrogen source and applied electric potential, we attempt development of a method to electrochemically hydrogenate Zintl phase compounds.
Research Project Title: Synthesis of quinone methide precursors as acetylcholinesterase reactivators

Student Presenter: Sydney Sillart

Faculty Mentor: Christopher Callam

Faculty Mentor Department: Chemistry

Research Abstract: Organophosphorus (OP) agents are responsible for the inhibition of the enzyme acetylcholinesterase (AChE). AChE is responsible for the hydrolysis of the neurotransmitter acetylcholine. OPs are covalent inhibitors of AChE and have been used as chemical warfare agents as well as pesticides. Without functioning AChE, acetylcholine accumulates and leads to serious adverse health effects, such as vomiting, paralysis, and even eventual death by respiratory failure. The magnitude of the effects and rate of death are determined by the OP’s toxicity. There are known therapeutics, called pyridinium oximes, which can reverse the inhibition and reactivate AChE if administration occurs before aging. If left untreated, aging will occur, which is a dealkylation of the OP that is bound in the active site. Aging causes the OP to form a highly stable, charged alkyl phosphonate. There are currently no effective treatments to reverse the aging process, as aged AChE is unresponsive to reactivation by pyridinium oximes.

Our research focuses on synthesizing and testing small organic compounds that can hopefully re-alkylate the aged enzyme and enable it to be activated by pyridinium oximes. Quinone methide precursors (QMPs) are of particular interest because their structure resembles that of other molecules that are capable of binding to the active site of AChE. Furthermore, QMPs have been shown to have the ability to alkylate DNA, so they could potentially realkylate aged AChE as well. Their reactivity can be intensified by addition of other functional groups to their framework. Many libraries of QMPs have been synthesized, specifically libraries derived from different quinolone and isoquinoline frameworks. The aim is that one of these derivatives synthesized will be the key to realkylating aged AChE efficiently, and eventually lead to the reactivation of the enzyme. We will present multiple synthetic efforts towards the assembly of QMPs and screening assays with aged AChE.
Research Project Title: Synthesis and evaluation of pyridine based quinone methide precursors for aged acetylcholine esterase reactivation

Student Presenter: Jenna Tabbaa

Faculty Mentor: Christopher Callam

Faculty Mentor Department: Department of chemistry and biochemistry

Research Abstract: Organophosphorus compounds (OPs) such as tabun, sarin and soman are used as chemical warfare nerve agents. The advancements of chemical warfare agents used for military tactics exceed the research to inhibit the effects of the nerve gases. The demand to study OP nerve agents is crucial because of the damaging effects to people, the commercial availability, and even the stockpiles in countries. Exposure to OPs affects the central nervous system and causes a buildup of acetylcholine in the body by inhibiting acetylcholinesterase (AChE). The AChE is initially inhibited followed by an aging process. There are known therapeutic oximes for inhibited AChE, pyridinium oximes; however, there are no known treatments for aged AChE. We are developing a library quinone methide precursors (QMPs) to be used as potential re-alkylators. These QMPs can be used to potentially re-alkylate the aged OP-AChE complex followed by reactivation. This research is vital to enhance the pharmaceutical measures and further inspire more research done to medically counteract the aging process. Several frameworks were synthesized through synthetic routes including nucleophilic substitution, reductive amination, and Mannich reactions. We will present the synthesis of a small library of pyridine QMP frameworks and the screening of these compounds as re-alkylators and re-activators of both the inhibited and aged AChE (electric eel and human).
Research Project Title: Five-member ring heterocycles as aged acetylcholinesterase therapeutics

Student Presenter: Nathan Yoshino

Faculty Mentor: Ryan Yoder

Faculty Mentor Department: Chemistry and Biochemistry

Research Abstract: Organophosphorus compounds (OPs) are widely implemented as chemical nerve agents and pesticides. These OPs bond to and inhibit a catalytic residue, Serine-203, in the enzyme acetylcholinesterase (AChE) which is responsible for the hydrolysis of acetylcholine. After exposure to OPs, AChE is initially inhibited for a period of time followed by an aging process, wherein the inhibited Ser-203 residue dealkylates and forms a stable phosphonate anion in the active site. There are known treatments for inhibited AChE in the form of therapeutic oximes, but no treatments for aged AChE currently exist. If left untreated, acetylcholine will build up in the central nervous system. Previous research has demonstrated quinone methides to realkylate phosphonates and other biological molecules, and currently a lead compound in the form of a quinone methide precursor (QMP) has been found. This research studies the potential of QMPs and QMP like compounds to realkylate the stable phosphonate anion on Ser-203 in aged AChE and allow for subsequent reactivation.

Using computational methods, libraries of QMPs and QMP like compounds were tested to determine their affinity for the aged AChE active site. The computational methods Molecular Docking and Molecular Dynamics were used. In Molecular Docking, poses of lowest energy conformations of a ligand within the aged AChE active site were generated and analyzed. The generated poses reveal how the ligands interact with the enzyme and provide structural insight to the success of certain QMPs. In addition, the distance from the aged serine residue to the ligand will be measured. Molecular Dynamics evaluates the ligands' interaction with the enzyme over time in a fluid environment. Using the most favorable poses from Molecular Docking, the ligands were simulated to interact with the ligand over 1 nanosecond. The results from Molecular Dynamics will be used to determine which section of the enzyme that the ligand spends most of its time. Ligands that favor the active site are the most promising realkylators.

In addition to computational studies, ligands that have shown high affinity with the active site were synthesized. The ligands were synthesized through synthetic routes including nucleophilic substitution, amidation, and Mannich reactions and were characterized by nuclear magnetic resonance spectroscopy (1H and 13C) and high-resolution mass spectrometry. These compounds were exposed to aged AChE with a therapeutic oxime to determine the reactivation.

With no known treatments for aged-acetyl cholinesterase, this research intends to find compounds that can effectively and practically realkylate aged AChE to treat the thousands affected by OPs each year. Computational methods will be used to identify QMPs with high potential for realkylation. Target compounds will be synthesized in the laboratory. Once synthesized, the compounds will be tested to determine their realkylation in vitro.
Research Project Title: Study of fluorinated quinone methide in the resurrection of aged acetylcholinesterase

Student Presenter: Dennis Yang

Faculty Mentor: Christopher Callam

Faculty Mentor Department: Chemistry

Research Abstract: The recent usages of the organophosphorus (OP) nerve agent sarin in chemical warfare, as well as the longstanding concerns regarding the toxicity of OP-based pesticides, has brought OP compounds into the limelight. The toxicity of OPs is founded in their ability to inhibit acetylcholinesterase (AChE), the enzyme involved in the hydrolysis of a key neurotransmitter, acetylcholine. Inhibited AChE is subsequently dealkylated in a process referred to as aging. Standard decades-old treatments involving atropine and oximes are only capable of treating inhibited AChE to a limited extent; moreover, no known drugs are capable of reviving or treating aged AChE. These facts present the urgent need to develop a therapeutic agent or combination thereof that is capable of re-alkylating aged AChE and more effectively reactivating inhibited AChE. In recent years, our research team has established a quinone methide precursor with a pyridine framework that has demonstrated unprecedented efficacy in resurrecting aged AChE—that is, converting aged AChE to its native state. Our work has further indicated a pH effect on performance. In this present study, a variety of our leading compounds were fluorinated in the prospects of optimizing performance; fluorine was chosen for its well-documented capabilities of favorably affecting pKa, intrinsic potency, and permeability of pharmaceutical agents. The compounds were synthesized, characterized via NMR and MS to ensure identity and purity, then screened with human and electric eel AChE to evaluate therapeutic effectiveness. The results of the screening will be discussed in depth at the convention. Presently, research efforts have shifted to the synthesis of a new target molecule, 2-(aminomethyl)pyridin-3-ol, that will allow access to a host of novel reaction pathways, in the aspiration of identifying compounds that have an even greater efficacy in treating OP exposure.
Research Project Title: Effect of sulfur-containing dopants on filling efficiency for conducting polymers

Student Presenter: Victoria Yee

Faculty Mentor: Vishnu Sundaresan

Faculty Mentor Department: Mechanical Engineering

Research Abstract: Cellular physiology is sensitive to minute changes in the chemical composition of its environment. Therefore, understanding the effect of ionic concentration is significant to understanding healthcare (diagnosis and treatment). Electrically conductive polymers, such as polypyrrole, exchange ions with solution by the application of electrical potentials and thus alter the chemical composition of the solution without the use of microfluidics. Calculation of morphology-dependent parameters, such as filling efficiency, assists in quantifying these transport phenomena. In an effort to understand how conducting polymers may influence cellular physiology, a conducting polymer’s cation storage capacity was measured to calculate the ability of the conducting polymer to change the chemical makeup of an ionic solution. Polypyrrole samples were fabricated using three dopants (p-toluene sulfonate, dodecyl sulfate, and dodecylbenzenesulfonate) at charge densities of 0.4 C/cm\(^2\), 0.8 C/cm\(^2\), and 1.2 C/cm\(^2\). These membranes were pretreated with cyclic voltammetry until all ion exchange was reversible and then characterized by chronoamperometry. All tests were conducted with 100mM potassium chloride solution. The number of ions exchanged by polypyrrole with the solution was calculated by fitting the data to an exponential function used to describe ion transport and compared to the theoretical maximum ion storage of the polypyrrole film. Preliminary findings indicated that filling efficiency (ionic ingress divided by the theoretic maximum) was approximately equal across all dopants. As all three dopants possess a similar morphology, they form polymers with a comparable number of redox sites, and filling efficiency is largely dependent on the number of available redox sites. These findings establish that the filling efficiency of polypyrrole is independent of the dopant for a given dopant morphology.
Research Project Title: Azo dyes as ionochromic anion indicators

Student Presenter: Sydney McKee

Faculty Mentor: Noel Paul

Faculty Mentor Department: Chemistry and Biochemistry

Research Abstract: Organic azo dyes, which contain the nitrogen-nitrogen double-bonded azo functional group (-N=N-), have found wide use as valuable textile dyes, tissue stains, and pH indicators. These highly conjugated systems can be synthesized via the electrophilic substitution of activated aromatic rings with arenediazonium salts, resulting in molecules that exhibit high molar absorptivities within the visible light range. Originally, it was thought that structures based on 1,8-bis(dimethylamino)naphthalene may have led to dyes that could exhibit ionochromic sensitivity to various aqueous anions. However, it was found that potential dyes containing this motif were impure and difficult to isolate. This structure was thus abandoned in favor of coupling the diazonium salts with a wide variety of nucleophiles in both aqueous and organic media in order to find an optimal synthetic strategy. Particularly pure dyes were exposed to varying pH and anion concentrations in a range of solvents, and the changes of their UV-vis spectra were assessed. These experiments have provided guidance for the identification of future candidates for further analysis. In the context of water sanitation and health, a successful indicator would serve as a facile and cost-effective method of identifying hazardous anion concentrations in drinking water.
Research Project Title: Radical-mediated, one-pot synthesis of oxazoles from alcohols and nitriles

Student Presenter: Darsheed Mustafa

Faculty Mentor: David Nagib

Faculty Mentor Department: Chemistry

Research Abstract: Heterocycles are found in many classes of natural products, pharmaceuticals and materials. In pharmaceutical development, investigating a diverse library of compounds can provide a rapid and effective way to screen for lead compounds and identify beneficial pharmacophores via structure-activity relationship analyses. Thus, the rapid assembly of heterocycles with divergent functionality is an important focus in organic and medicinal chemistry. Oxazoles are one class of aromatic heterocycles that have shown interesting anticancer and anti-fungal properties. In general, oxazoles have been synthesized using a variety of methods. Some noteworthy limitations of these preparations include using starting materials that are not readily available, and incorporating harsh conditions such as the use of very strong acids (HCl & H2SO4) or elevated temperatures. Noting these drawbacks, we hypothesized that we could take advantage of chemistry previously developed in our laboratory for the b-selective C\(^\text{–}\)H amination of alcohols. Our new method involves addition of an alcohol into nitriles to form an imidate. This imidate then undergoes b-selective amination to provide an intermediate oxazoline heterocycle, itself a valuable structural motif in some classes of pharmaceuticals. The intermediate oxazoline is then further oxidized in situ to access differentially substituted oxazoles. This strategy provides rapid access to a library of heterocycles with privileged architectures found in anti-cancer medicines.
Research Project Title: Improved stability of a C-C bond coupling catalyst for thermal CO2 fixation

Student Presenter: Skyler Ware

Faculty Mentor: Robert Baker

Faculty Mentor Department: Chemistry

Research Abstract: The electrochemical conversion of carbon dioxide to value-added, multi-carbon products has been studied as a pathway to renewable fuel sources and as an alternative to current carbon capture and storage methods. Delafossite copper iron oxide films have been shown to thermally fixate carbon dioxide and selectively catalyze C-C bond coupling from CO2 to produce acetate. However, the catalyst alone is not stable and deactivates after approximately ten minutes following the reductive dissolution of surface iron species. The addition of gaseous oxygen as a sacrificial electron acceptor prevents the reductive dissolution of iron and stabilizes the catalyst for several hours; however, excess oxygen scavenges the electrons used for acetate production, resulting in lower yield and reduced conversion efficiency. The purpose of this study was to determine the optimum oxygen flow rate to maximize acetate production while minimizing catalyst deactivation. An electrolyte solution was purged with both carbon dioxide and oxygen before and during electrolysis using the copper iron oxide catalyst as the working electrode. The carbon dioxide flow rate was held constant, while the oxygen flow rate was varied over several trials. Acetate production was quantified by 1H-NMR spectroscopy, and the post-reaction catalyst was characterized by XPS and SEM/EDX imaging. The optimal oxygen flow rate significantly slowed iron reduction and stabilized the catalyst for up to 12 hours with only a modest drop in acetate selectivity. This enhanced stability will allow further examination of the surface chemistry over long-term reductions, including the mechanism of acetate production and the role of both metals in the catalytic process.
Research Project Title: From feedstocks to value-added chemicals: a mechanistic study of a cobalt-catalyzed reaction between 1,3-dienes and acrylates

Student Presenter: Montgomery Gray

Faculty Mentor: Rajanbabu Yes

Faculty Mentor Department: Thaliyil

Research Abstract: Powerful methods have been developed to provide a diverse set of intermediates for the synthesis of pharmaceuticals and other fine chemicals. In particular, 1,3-dienes can be functionalized into enantiopure 1,4-dienes through cobalt catalyzed-heterodimerization with either ethylene or methyl acrylate. Since these precursors are abundantly available and, the chemistry highly selective, such reactions provide inexpensive routes to value-added intermediates. The optimization of the reaction conditions for large-scale synthesis depends on a deeper understanding of the mechanism of the reaction, which is still not entirely understood. Traditional kinetic analysis can provide insights on mechanistic details, but often does not suffice to provide a complete picture of this system because of accompanying side reactions in the process, deactivation/inhibition of the catalyst, and the lack of continuous data as the reaction progresses. Therefore, a kinetic study using reaction progress kinetic analysis (RPKA) was performed on the cobalt catalyzed hydrovinylation reaction to aid in the determination of the mechanism of the reaction. In-situ infrared spectroscopy is used to collect data for the system allowing for continuous concentration data to be obtained. The reactants, catalytic system, and solvent chosen for this study were 2,3-dimethyl-1,3-butadiene and methyl acrylate, 1,3-bis(diphenylphosphino)propane cobalt (II) bromide, zinc powder, and zinc bromide, and dichloroethane respectively. The possibility of catalyst deactivation with time, catalyst deactivation due to product and ligand interactions, and deactivation due to the reagents used are specifically examined during this study. The experimental data suggest that the reaction is inhibited by neither the ligand, product, nor the acrylate, but instead, the reaction is inhibited by the diene. Future studies will examine how this reaction can be improved using the new found understanding of its kinetics and mechanism.
Research Project Title: Role of phosphorylation in regulation of cancer biomarker plastin 2 activity

Student Presenter: Richa Agrawal

Faculty Mentor: Dmitri Kudryashov

Faculty Mentor Department: Chemistry and Biochemistry

Research Abstract: Regulation of the actin cytoskeleton is integral to many essential cell processes. Plastins (PLS1, 2, 3) are highly conserved proteins that are critical to dynamic actin remodeling by binding actin filaments and bundling them together. Unlike isoforms 1 and 3, ectopic expression of PLS2 correlates with enhanced metastatic potential of various epithelial cancers. PLS2 possesses the unique potential to be phosphorylated at Ser5 and Ser7, on its short N-terminal peptide (NTP), and this phosphorylation has been directly linked to both enhanced metastasis of prostate and melanoma cancer cells as well as localization to cell membrane structures characteristic of invasive cancer cells. Besides, the characterization of the phosphoproteome of many cancers has shown phosphorylation at many other specific sites in PLS2, which have not been previously studied. We aimed to elucidate the regulatory role of the PLS2 NTP phosphorylation via both removal and interchange of this peptide with that from ubiquitously expressed and non-invasive PLS3 isoform, as well as the effect of some of the other sites shown to be phosphorylated in vivo via phosphorylation mimics. To this end, we created NTP-deletion mutants for PLS2 and mutants with interchanged NTPs from PLS2 and 3. We also created five individual phosphorylation-mimicking mutations in wild type PLS2. Subsequent assessment of F-actin binding and bundling abilities compared to wild type PLS2 and previously studied PLS2-S5D indicated that NTP-deletion and -replacement mutants are capable of bundling and binding actin as efficiently as wild type protein, suggesting that the NTP does not directly affect interaction of PLS2 with actin in vitro. However, several phosphorylation-mimicking mutations display altered actin binding and bundling ability, suggesting that phosphorylation may play an important role in regulation of PLS2 activity. Overall, clarifying this role and determining the detailed mechanisms underlying the PLS2 regulation may lead to development of new cancer therapy strategies to prevent metastasis.
Research Project Title: FGFR2-CLIP1 fusion and N550H mutation: properties of drug resistance and up-regulated pathways

Student Presenter: Kaitlin Baker

Faculty Mentor: Sameek Roychowdhury

Faculty Mentor Department: Comprehensive Cancer Center

Research Abstract:

Objectives - In cancer, the fibroblast growth receptor (FGFR) has been shown to be altered through fusions, point mutations and copy number variations. Unfortunately, resistance develops in patients treated with FGFR inhibitors. The mechanisms of resistance are not well studied and we hypothesize that secondary mutations within FGFR are what drive resistance. The purpose of this study is to characterize an FGFR2-CLIP1 fusion and a secondary FGFR mutation and investigate its sensitivity to drugs, and up-regulated pathways.

Methods - Genetic testing was performed on a patient with metastatic cholangiocarcinoma and findings revealed an FGFR2-CLIP1 fusion. Subsequently, the patient received the FGFR inhibitor, INCB054828. The patient showed a 5-month positive response. However shortly thereafter had progressive disease. Genetic testing of autopsy samples revealed an N550H mutation was found within the fusion, suggesting that the N550H mutation confers resistance to INCB054828. In order to further investigate this we created three NIH3T3 cell lines with empty, FGFR2-CLIP1, and FGFR2-CLIP1 N550H vectors. We used these cells for in-vitro testing of various FGFR inhibitors such as BGJ398, Ponatinib, Dovitinib, and AZD 4547. The cells were dosed with increasing concentrations of drug from .1nM to 20 uM and after 72 hours cell viability was assessed to calculate the half maximal inhibitory concentration (IC50) of each inhibitor. Protein expressions was analyzed by western blot analysis to look for pathways activated by the fusion.

Results and Conclusion - Results showed that the FGFR2-CLIP1 fusion and N550H mutation cells were sensitive to the drugs of BGJ398, Ponatinib, Dovitinib and AZD 4547. Cells that contain the empty vector were not affected by the drugs. Western blot analysis show that the fusion and mutation cells are activated through phosphorylation of the AKT, MEK, and FRS2 alpha downstream pathways.

Significance - With these findings it is possible to create effective treatment of those patients that develop these unique fusions and mutations.
Research Project Title: Characterization of the novel KLK2-FGFR2 fusion in prostate cancer

Student Presenter: Hannah Barker

Faculty Mentor: Sameek Roychowdhury

Faculty Mentor Department: Internal Medicine

Research Abstract: Objectives of the Study. The fibroblast growth factor (FGFR) family is a critical aspect of essential cellular processes. Deregulation of the FGFR family members through mutations, fusions or copy number variations can alter homeostasis in several ways, often leading to mutant driven cancer. A prostate cancer patient seen in Dr. Roychowdhury’s clinic was found to have a novel KLK2-FGFR2 gene fusion by an in-house next generation sequencing assay (NGS). The mechanisms of how this fusion is driving prostate cancer are unknown.

Methods. To characterize the fusion, two stable NIH3T3 cell lines- one with the vector alone (Empty) and one with KLK2-FGFR2 activating fusion- were generated. These two cell lines were used for in vitro studies. Evaluation of sensitivity to several FGFR inhibitors was conducted by treatment of both cell lines with increasing doses of BGJ398, Ponatinib, Dovitinib, and AZD4547. Cell viability was assessed after 72 hours using MTS assay. Protein expression was analyzed by western blot analysis. Lastly, cell migration was investigated via a transwell migration assay.

Results and Conclusions. Drug sensitivity assays revealed that NIH3T3 KLK2-FGFR2 cells were sensitive to all four FGFR inhibitors used. Of all four, NIH3T3 KLK2-FGFR cells proved most sensitive to Ponatinib. Western blot analysis revealed upregulation of phosphorylated AKT, MEK, and PI3K. This suggests a mechanism of improper regulation of the mTOR pathway. The migration assays showed NIH3T3 KLK2-FGFR2 cells increased migration activity in comparison to the NIH3T3 Empty cells, giving insight to the activity in the cancer cells.

Significance. Research thus far has given insight to the mechanisms in which the gene fusion between KLK2 and FGFR drove this patient’s prostate cancer. Further investigation will lead to greater understanding and characterization of the novel fusion, which has the potential to be clinically significant.
Research Project Title: Synergistic targeting of pediatric solid tumors with BRD4 and AURKA inhibitors as dual drugs

Student Presenter: Emily Bopp

Faculty Mentor: Nilay Shah

Faculty Mentor Department: Pediatrics

Research Abstract: **BACKGROUND**: Children diagnosed with high-risk neuroblastoma face considerable clinical challenges. Despite aggressive multimodal therapy, nearly half of all patients have treatment-refractory or recurrent disease, ultimately dying of the cancers. Novel therapeutics have been developed to target biological pathways in neuroblastoma, including the BRD4 inhibitor, IBET-151, and the aurora kinase A (AURKA) inhibitor, MLN8237. Both drugs were tolerated in clinical trials but lack efficacy alone. Our in vitro studies show that, when used together, the drugs synergistically inhibit cell growth and viability of neuroblastoma cell lines. **HYPOTHESIS**: We hypothesized that BET-151 and MLN8237 act synergistically against neuroblastoma by targeting common pathways, including MYC/MYCN, through different mechanisms. **METHODS**: We tested this hypothesis through two specific aims: 1) validation of the synergistic effects of the drug combination against neuroblastoma tumor xenografts in immunodeficient mice and 2) confirmation of the pharmacodynamic effects of dual drug treatment on common biological targets through RNA and protein analysis. **RESULTS**: Dual drug use significantly slowed xenograft growth in all models tested as compared to control (p<0.03). The combination of IBET-151 and MLN8237 significantly extended survival as compared to either drug alone against tumor xenografts derived from two MYCN-nonamplified neuroblastoma cell lines, SK-N-AS and SK-N-SH (p<0.025). The two drugs were superior to IBET-151 alone against tumor xenografts of the MYCN-amplified NB1643 cell line, and the two drugs were more effective in maintaining tumor suppression after drug washout than MLN8237 (p<0.05). MLN8237 use was associated with increased target gene expression, but concomitant use of IBET-151 repressed that increase. The use of both drugs was more effective than either drug alone at repressing protein expression downstream targets, including MYC, MYCN, MCL1, CDK4, and CDK6, as evaluated by western blot. **CONCLUSION**: Combined BRD4 and AURKA inhibition is effective against neuroblastoma. These data provide support for advancing the drug combination towards clinical trial alone or in combination with chemotherapy as a novel approach against neuroblastoma.
Research Project Title: EGFL7 antagonizes NOTCH signaling in AML and represents a novel targeted therapy

Student Presenter: Zachary Brannan

Faculty Mentor: Adrienne Dorrance

Faculty Mentor Department: Internal Medicine

Research Abstract: Acute myeloid leukemia (AML) is a disorder characterized by rapid and uncontrolled proliferation of immature blasts. Our group showed previously that epidermal growth factor-like domain 7 (EGFL7) plays an important role in AML and that a higher expression associates with a more aggressive disease course (Papaioannou et al., PNAS 2017). EGFL7 is a secreted protein that has an angiogenic role through the regulation of endothelial cell growth, proliferation, and migration. However, the mechanism by which EGFL7 functions in AML has not been extensively examined. We found EGFL7 was able to bind many different signaling proteins important for hematopoiesis and cancer including NOTCH1 and NOTCH2. Stimulation of blasts with recombinant EGFL7 (rEGFL7) protein resulted in decreases in NOTCH target genes and reduction in the levels of activated NOTCH intracellular domain (NICD) along with concomitant decreases in apoptosis and differentiation. Conversely, blasts treated with Parsatuzumab resulted in reactivation of NOTCH signaling, and increases in cell differentiation and apoptosis. Using a mouse xenograft model we found that in vivo treatment with Parsatuzumab results in prolonged survival and decreases in leukemic burden. Overall, our data demonstrates that EGFL7 contributes to silencing NOTCH signaling in AML by antagonizing canonical NOTCH ligand binding. Reactivation of NOTCH signaling in vivo using an anti-EGFL7 blocking antibody results in decreased disease burden and prolonged survival, and supports EGFL7 as a potential new therapy for patients with AML.
Research Project Title: Effects of SDHD H50R missense mutation on thyroid tumorigenesis

Student Presenter: Karthik Chakravarthy

Faculty Mentor: Lawrence Kirschner

Faculty Mentor Department: Internal Medicine

Research Abstract: Thyroid cancer is among the most common cancers and is the most frequent type of endocrine malignancy. It has also been increasing in prevalence over the past decade. Increased risk of thyroid cancer has been associated with Cowden syndrome (CS), which is an inherited endocrine tumor disorder. CS has been associated with germline mutations in PTEN tumor suppressor gene, identified in about 85% of CS-associated and 10% of sporadic thyroid cancers. Germline variations in Krebs cycle enzyme complex succinate dehydrogenase (SDH) genes were first observed in patients with pheochromocytoma/paraganglioma and recently discovered in patients with CS. Moreover, CS patients with variants in succinate dehydrogenase subunit D (SDHD) gene either alone/in combination with PTEN mutation have increased thyroid and breast cancers risk compared to patients with PTEN-only mutations. Studies examining SDHD germline variations have identified the His50Arg (H50R) variation as associated more frequently with sporadic thyroid tumor cases in patients. Therefore, modeling this tumor progression in vivo is essential to better understand how such mutations in the human patient population lead to thyroid cancer. Previous studies of mouse models with thyroid-specific Sdhd deletion displayed larger thyroid volumes, decreased follicle size, and increased cell density/proliferation compared to wildtypes. Novel mouse models with thyroid-specific Sdhd deletion and/or global Sdhd H50R mutation were generated using CRISPR-Cas9 genome editing technology, yielding a heterozygous Sdhd H50R mutant founder mouse to generate experimental Sdhd H50R mouse models: SdhdH50R/Wt, SdhdH50R/H50R, and Tpo-SdhdH50R/- (heterozygous Sdhd H50R mutation with thyroid-specific deletion of wildtype allele). In contrast to the embryonic lethality observed in Sdhd null animals, SdhdH50R/H50R mice were viable and born in normal Mendelian ratios. Models were characterized by determining thyroid volumes by ultrasound, examining cell proliferation and thyroid follicle size, and identifying mitochondrial changes. Pathology of the SdhdH50R/Wt founder mouse revealed that there were no tumors present within the thyroid glands. However, closer analysis of thyroid tissue revealed dysplasia, alterations to follicles, and greater cellular proliferation compared to SdhdWt/Wt. These effects suggest putative initiation of tumor development and potential progression to cancer, thus lending support that the Sdhd H50R mutation may cause thyroid tumorigenesis due to loss of function.
Research Project Title: MicroRNA-mediated modulation of radioresistance of glioma stem cells

Student Presenter: Sonny Caradonna

Faculty Mentor: Rajbir Singh

Faculty Mentor Department: Comprehensive Cancer Center

Research Abstract: Glioblastoma (GBM) is the most common tumor of the central nervous system, with its deadly nature owing to a high rate of invasion and angiogenesis. A key player in the GBM pathogenesis is a distinct subpopulation of tumor cells which are capable of self-renewal, highly angiogenic and possess the potential for extensive proliferation and multi-lineage differentiation. This cell population termed Glioma Stem Cells (GSCs) is highly resistant to the chemo- and radiotherapies. In response to radiation therapy, GSCs are capable of triggering the activation of multiple signaling pathways including Wnt, Notch, and Hedgehog. The efforts to foster therapeutic interventions will prove futile, without first targeting the GSC population. The miRNA network adds a dimension of regulatory control, which serves to maintain pluripotency and reprograms multiple stemness and radioresistance promoting pathways. However, not much information is available that could provide mechanistic insights regarding how specific miRNAs modulate radioresistance pathways. Our initial efforts involving a global screening of microRNA profiles in different GSCs after radiation treatment resulted in identification of multiple microRNAs that were significantly altered in response to radiation. We selected 7 microRNAs as potential candidates, with each having several targets in Notch, Wnt, PI3K/Akt, and Hedgehog signaling pathways. We used specific lentiviral constructs to create overexpression/knockdown of each microRNA in GSCs. Using these stable GSC clones, we carried out multiple in vitro studies to analyze the effects of the respective alteration in phenotypes. Studies included growth kinetics, cell proliferation, invasiveness, apoptosis and cell cycle. We also carried out an extensive in silico analysis to identify the potential targets of these microRNAs. This was followed by analyzing various downstream components of the target genes. Additionally, we carried out a context-based assessment of the overall effects to probe if there is an integration of one or more pathways that could lead to radiation sensitivity. Our in vitro findings also revealed their roles in regulating stemness and metastatic ability in vivo. Lastly, our study provides a basis for understanding the role of miRNAs in radioresistance phenotype and furthermore, it may lead towards another tool to inhibit GSC proliferation and/or survival.
Research Project Title: Pre-clinical tipifarnib activity in cutaneous T-cell lymphoma

Student Presenter: Joanne Du

Faculty Mentor: Anjali Mishra

Faculty Mentor Department: Department of Internal Medicine

Research Abstract: CTCL is a rare form of Non-Hodgkin’s Lymphoma with clinical presentations of red scaly patches and plaques on the skin and characterized by malignant CD4+ T-lymphocytes. Beginning with Mycosis Fungoides, an indolent skin-limited form, CTCL can progress to an aggressive leukemic form, Sezary Syndrome. There are currently minimal effective treatments for progressed CTCL so we sought to seek the effectiveness of a novel therapeutic modality, Tipifarnib, a farnesyltransferase inhibitor (FTI). FTIs currently have unknown exact antitumorigenic mechanisms but show promise as anticancer drugs. It is thought that FTIs inhibits the activity of the oncogenic Ras protein in tumor cells through the inhibition of the enzyme farnesyltransferase, resulting in the inhibition of cancerous cell proliferation (Appels, N, et al. Oncologist 2005). Tipifarnib has demonstrated clinical activity as a single agent in patients with relapsed and refractory lymphomas (Witzig, TE, et al. Blood 2011). Utilizing CTCL patient-derived cell lines, we ran experiments to investigate the efficacy of tipifarnib in vitro. Tipifarnib portrayed decreases in cell viability in CTCL lines in vitro as well as increased apoptosis. Tipifarnib had a cytotoxic effect in which half maximal effective concentration (EC50) was achieved on the CTCL cell lines in doses ranging from 7.5 nM to 50 nM, but notably had no cytotoxic effect on normal donor CD4+ cells in vitro. Furthermore, in vivo studies with interleukin-15 (IL-15) transgenic CTCL mice (Mishra A, et al. Can Discovery 2016) revealed a decrease in gross lesions severity (0.5±1.22 out of a possible score of 5) compared to vehicle-treated mice (3.33±0.57, p=0.0076). Histologically, IL-15 transgenic mice develop characteristic malignant CD4+ T-cell infiltrates in the dermis and epidermis. Tipifarnib-treated mice, however, have minimal lesions in the skin. These dramatic changes are reflected in a significantly decreased histologic severity score in tipifarnib-treated mice (3.8±0.75 out of a possible score of 7 (compared to vehicle-treated mice (7±0, p=0.0002). These promising findings suggest that tipifarnib may be an effective treatment of CTCL and an inhibitor for malignant T-cells.
Research Project Title: Modulation of MDM2 sensitizes dedifferentiated liposarcoma to cholesterol directed therapy

Student Presenter: Bryce Demoret

Faculty Mentor: James Chen

Faculty Mentor Department: Biomedical Informatics

Research Abstract: Background: Dedifferentiated liposarcoma (DDLPS) is a highly morbid, mesenchymal tumor characterized by amplification of the 12q chromosomal loci. Overall survival is typically less than 15 months in the advanced setting and standard therapies remain severely toxic. Superior treatment options are clearly needed. Amplification of the MDM2 oncogene is observed in 100% of all DDLPS; however, to variable levels. Previously, we have reported that MDM2 levels correspond with cellular growth and drug metabolism, but little is known about the effects of MDM2 alterations on global metabolomic profiles. These profiles will help us pinpoint dysregulated pathways that explain, at least partially, the functional effects associated with MDM2 amplification. Methods: Six DDLPS cell lines were brought directly into culture from patients. MDM2 levels were determined via western blot and RNA-sequencing. Metabolomics data was generated using the Metabolon platform. Cell viability assays were performed in ZOOM IncuCyte or measured by XTT. Atorvastatin was used to inhibit cholesterol synthesis. MDM2 levels were altered using SAR405838 and MI-192 to raise and lower expression respectively. Drug synergy was calculated via Chou-Talalay method to determine combination indices (CI) using Compusyn software. Results: MDM2 levels are inversely correlated with metabolites in the lipid and cholesterol pathway (Fisher’s, p < 0.001). MDM2 low DDLPS cell lines were exquisitely sensitive to HMG-CoA reductase inhibitors (statins) in the low micromolar range. Lipid metabolite profiling of MDM2 low versus high cell lines treated with atorvastatin demonstrated that twice as many lipid metabolites were altered in MDM2 low versus high cells (Chi-square, p < 0.001). MDM2 levels by RNA-seq demonstrated significant correlation between MDM2 gene expression and atorvastatin IC50 doses (r = 0.963). MDM2 modulation by use of SAR405838 and MI-192, separately, in combination with atorvastatin displayed antagonism (average CI = 1.50) and synergy (average CI = 0.63), respectively. Conclusions: Modulation of MDM2 alters cholesterol metabolism in DDLPS and may serve as a druggable target.
Research Project Title: KMT2D impact on metastasis in squamous cell Carcinoma

Student Presenter: Cara Dauch

Faculty Mentor: Amanda Toland

Faculty Mentor Department: Cell Biology and Genetics

Research Abstract: BACKGROUND: Following basal cell carcinoma, squamous cell carcinoma (SCC) is the second most common skin cancer in the United States. Approximately 1 in 10 people in the United States will develop SCC during their lifetime, but this number continues to rise due to increases in exposure to ultraviolet radiation.

OBJECTIVE: KMT2D, which functions as a tumor suppressor gene, is one of the most frequently mutated genes in SCC. TP53 plays a critical role in regulating cell division and apoptosis; previous studies show a regulatory connection between TP53 and KMT2D. My study hypothesis is that when there is a loss of function of KMT2D, there is also loss of TP53 expression and subsequent function. This loss of TP53 function together with loss of KMT2D, allows cancer to metastasize at an increased rate. The objective of our study is to analyze the effects on expression of the TP53 gene and tumor phenotypes, when KMT2D is knocked down in cell lines.

METHODS: CRISPR-Cas9 was used to knock-down KMT2D expression in the SCC cell line, COLO-16. Clonogenic assays, which measure the growth of cell colonies, were used to analyze how fast unaltered COLO-16 grows compared to two COLO-16 KMT2D mutated cell lines (X18314 and X18449). MTT assays were used to analyze cell proliferation rates in the 3 cell lines. Scratch assays were used to analyze the change in cell migration over time in the same 3 cell lines.

RESULTS: Thus, far we have studied the impact of KMT2D knock-down independent of TP53 status. Clonogenic assays showed that X18314 and X18449 both had a growth advantage over COLO-16, with values of 0.57, 0.75, and 0.52, respectively. MTT assays showed that cell proliferation rates were 1.4 and 1.69-fold greater in X18314 and X18449 than in COLO-16. Migration photographs showed that X18314 and X18449 both closed faster than COLO-16.

CONCLUSION: When KMT2D is knocked-down in the COLO-16 cell line, cells show phenotypes including growth advantage and increased migration compared to COLO-16 with wildtype expression. Future studies will evaluate the impact of KMT2D in another cell line, SRB-12 and will evaluate the impact of KMT2D loss on TP53 expression and function.
Bloom’s syndrome (BS) is an autosomal recessive genetic disease caused by loss-of-function of the BLM helicase. BLM localizes to the nucleus and functions in DNA damage repair and homologous recombination. BS is characterized by growth impairment, immunodeficiency and susceptibility to many types of cancer. BLM also localizes to the nucleolus where it facilitates RNA polymerase mediated rRNA transcription. Our lab has demonstrated that nucleolar localization of BLM is dependent on two serines in the C-terminus of the protein, Ser1342 and Ser1345; both are high confidence phosphorylation sites. Mutation of both serines to aspartate (phospho-mimetic), but not alanine (phospho-dead), results in approximately eighty percent reduction in BLM nucleolar localization. This study tests the hypothesis that altering the nucleolar localization of BLM will affect organismal growth and tumorigenesis.

Aspartate or alanine alterations were introduced in Blm, the mouse homolog of BLM, using CRISPR/Cas9 gene editing technology. Two lines of mice (BlmDD/DD for aspartate and BlmAA/AA for alanine) were established and shown to be viable and fertile. The effects of BlmDD/DD and BlmAA/AA mutations on organismal growth were determined by weighing mice weekly over a 3 to 20 week period. BlmDD/DD mice are significantly smaller than wild-type littermates at 8, 12 and 16 weeks old, while preliminary data indicate that there are no significant differences in size or weight between BlmAA/AA mice and wild-type littermates. This suggests that reduced nucleolar localization of Blm decreases organismal size because the BlmDD/DD helicase mutant has reduced nucleolar localization compared to wildtype. To test the effects of the BlmDD/DD and BlmAA/AA alleles on tumorigenesis, both lines have been crossed to Apc+/Min mice, a model of intestinal tumorigenesis. BlmDD/DD;Apc+/Min mice develop more intestinal adenomas than Blm+/+;Apc+/Min littermates. These data suggest that reducing Blm nucleolar localization increases tumor susceptibility because the BlmDD/DD helicase mutant has reduced nucleolar localization compared to wildtype.
Research Project Title: Application of thermoresponsive polymer to the development of a velocity-dependent cell-sorting microdevice

Student Presenter: Jesse Fine

Faculty Mentor: Daniel Gallego-Perez

Faculty Mentor Department: Biomedical Engineering

Research Abstract: Low-cost velocity dependent cell sorting in 2D is a currently nonexistent technology for cancer research. The development of such a device would enable further research on the treatment of various deleterious cancers. One example is Glioblastoma Multiforme (GBM), which metastasizes based off the high motility of a single cell. Here we present a low-cost device capable of sorting these cells in a point-of-care time frame. Separation would enable development of highly specific therapeutic agents to limit cancer metastasis in patients. This device consists of microfluidics channels situated under microtextured Polydimethylsiloxane (PDMS) coated with the thermoresponsive polymer Poly(N-isopropylacrylamide) (PNIPAM). Cells are seeded in one end of the device and orient themselves parallel to the striations patterned into the PDMS; traveling further across the device over time. At a specific location location (determined by velocity of target cells and time passed), low-temperature fluid can be passed through the microfluidic channel below which triggers a selective conformational change in the PNIPAM. This change shifts PNIPAM from nonpolar to polar, causing the polymer to release previously-adhered cells into solution in favor of binding to media. Establishing the PNIPAM layer capable of releasing cells while allowing them to adhere to microtextures on the PDMS involved a multi-step process. First, PDMS stamps are made of varying thickness, then they were placed in a plasma cleaner and exposed to Nitrogen for 1,3, and 5 minutes at 30 Watts, 8-10 MHz, and ~1000microTorr. Then, samples were exposed to N-isopropylacrylamide (NIPAM) via immersion into a polymer solution and via dropping that solution onto samples and baked at 3 hours or 5 hours. Cell detachment analysis, goniometer experimentation, and SEM images showed that a 1 minute Argon gas exposure, with 1 minute of NIPAM immersion and a 3 hour bake yielded the most successful layer that lifted cells without inhibiting the PDMS microtexture. After adding the microfluidic channels and seeding cells, they can then be collected for future analysis.
Research Project Title: Wee-1 kinase inhibitor AZD-1775 radiosensitizes esophageal cancer to radiotherapy

Student Presenter: Andrew Hu
Faculty Mentor: Linlin Yang
Faculty Mentor Department: Radiation Oncology

Research Abstract: Background: Esophageal cancer is a deadly cancer that has a 5-year survival rate of 18%; a survival rate that has remained unchanged for decades. Esophageal cancer cells often lack a functional G1 checkpoint due to a mutated p53 gene and rely on G2 checkpoint to repair DNA damage. WEE1, a tyrosine kinase, regulates the G2 DNA damage checkpoint of cells, making it a promising target for esophageal cancer treatment. The purpose of this study was to determine the capacity of AZD-1775, a potent WEE-1 inhibitor, to abrogate the radiation-induced G2 checkpoint arrest and modulate radiosensitivity in esophageal cancer cell (ECC) models.

Materials and Methods: Alamar blue assay and clonogenic assays were carried out in 4 ECC cell lines (Squamous cell carcinoma: Flo-1, KYSE-30; Adenocarcinoma: OE-33, SK-4) to explore the drug toxicity and potential of AZD-1775 as a radiosensitizer in ECC cell lines. The effects of AZD-1775 on radiation-induced checkpoint response of ESS cells were determined in vitro by analyzing cell cycle via flow cytometry, detecting alterations on cell cycle markers through Western blotting, and comparing changes on mitotic catastrophe by immunofluorescence staining. Human esophageal cancer cell xenografts were generated to explore the radiosensitization effect of AZD-1775 on ECC tumors in vivo.

Results: Alamar blue assay showed that the IC50 concentrations of AZD-1775 on ECC cells are between 300 - 600 nM, whereas exposure to 100 nM of AZD-1775 didnâ€™t significantly increase cytotoxicity. Clonogenic assay showed that the addition of 100 nM AZD-1775 sensitized ECC cells to radiation therapy. Study of the mechanisms underlying AZD-1775 radiosensitization revealed that AZD-1775 significantly abrogates radiation-induced G2 checkpoint arrest as expected, and attenuates radiation-induced phosphorylation of CDC2. In addition, AZD-1775 stabilized DNA damage caused by radiation, eventually leading to cell death, as measured by increased mitotic catastrophe. AZD-1775 displayed radiosensitivity modulation for the tumors in the xenografts model.

Conclusion: These results show that inhibition of WEE-1 by AZD-1775 has the potential to be an effective strategy for radiation sensitization in esophageal cancer cells.
Microsatellite instability (MSI) is a term used to describe the somatic addition or loss of bases within repetitive DNA sequences called microsatellites, and is characteristic of certain cancer types—specifically endometrial cancer (~30% of patients), colorectal cancer (~15% of patients) and stomach cancer (~15% of patients). MSI can have prognostic and predictive implications, and recently MSI was shown to be a predictor of response to anti-Programmed Death Ligand 1 (PD-L1) immunotherapy, which has substantially improved outcome in several cancers. Although the thyroid is one of the most common cancer sites, the prevalence of MSI in thyroid cancer has not been accurately defined. Previous studies on MSI in thyroid cancer have focused almost exclusively on the most common histological subtype, papillary thyroid carcinoma (PTC). Herein we have screened for MSI in a large set of thyroid cancer samples representing all major histologic subtypes.

METHODS

Defining MSI status has been standardized by polymerase chain reaction (PCR) of five selected microsatellites, and tumors are considered MSI-positive (MSI+) if at least two of the five markers show MSI. We screened a total of 187 thyroid cancer cases including: 123 PTC, 30 follicular thyroid carcinomas (FTC), 20 medullary thyroid carcinomas, and 14 anaplastic thyroid carcinomas.

RESULTS

MSI was observed in two of 30 FTC cases by PCR. None of the other thyroid cancer cases presented MSI. This result is being validated by an independent protein-based MSI detection method.

CONCLUSIONS

The presence of MSI in FTC, even a small percentage of cases, could have important clinical implications. Screening for MSI is already performed for newly diagnosed colorectal cancers in Ohio hospitals, as part of the Ohio Colorectal Cancer Prevention Initiative. FTC patients could likewise be screened for MSI upon diagnosis, and patients shown to be MSI positive could be treated with the remarkable anti PD-L1 immunotherapy.

We are currently following up on this initial study by building a tissue microarray to screen 130 additional FTCs for MSI, and using next-generation sequencing to screen a large data set of sequenced thyroid cancer DNAs. Together this project will provide a comprehensive evaluation of MSI in thyroid cancer.
Research Project Title: Cardio-oncology: the mechanism of tyrosine kinase inhibitor-induced heart failure

Student Presenter: Cody Justice

Faculty Mentor: Sakima Smith

Faculty Mentor Department: Internal Medicine

Research Abstract: Introduction: Pazopanib is an FDA-approved anti-neoplastic therapy for renal cell carcinoma (RCC), the most common type of kidney cancer in adults. Pazopanib halts tumor angiogenesis via inhibition of vascular endothelial growth factor receptors. Pazopanib provides additional months of progression free survival for RCC patients; however, this medication leads to hypertension in ~57% of patients treated. Additionally, pazopanib is associated with QTc prolongation, myocardial ischemia and heart failure. Our goal is to enhance our fund of knowledge regarding the mechanism of cardiovascular toxicity associated with pazopanib to reduce morbidity for patients.

Methods: Wild type mice were orally dosed with 100 mg/kg of pazopanib once daily for 22 days. Blood pressures (BP) were collected weekly. Echocardiograms (ECHO) and surface electrocardiogram (ECG) analysis was performed on all mice at baseline and at the end of dosing. At the conclusion of dosing, ventricular cardiomyocytes were isolated and used for western blotting or sent to electrophysiology for further analysis. The electrophysiologist was blinded to the identity of the samples. Additional samples were obtained from the mice for molecular analysis and phenotyping.

Results: Our previous data clearly demonstrate that pazopanib leads to an elevation in BP in mice. However, in this study there were no abnormalities were seen with ECHO imaging or ECG. Western blot analysis revealed no differences in protein expression of FGF-2, VEGF-A, VEGFR, and angiotensin II receptor type-1 and -2. Notably, electrophysiology showed that action potential magnitude significantly decreased over time when paced at 5 Hz, while this abnormality was not observed at 0.5 Hz. Additionally, prolonged action potential duration (APD) became more prominent at 5 Hz compared to 1 Hz. These effects were seen only in myocytes from pazopanib-treated mice.

Conclusions: These experiments demonstrate that pazopanib induces cardiomyocyte electrical abnormalities in mice after 22 days of treatment in the absence of baseline global cardiac abnormalities. We hypothesize that pazopanib leads to prolonged APD via inhibition of fast sodium depolarization and failure of activation of Ito current channels. In order to support this hypothesis in vivo, this study will be repeated using more sensitive and invasive ECG techniques in combination with adrenergic stress.
Research Project Title: The role of miR-4516 in the metastasis of cutaneous squamous cell carcinomas

Student Presenter: Mason Fisher

Faculty Mentor: Mason Toland

Faculty Mentor Department: Cancer Biology and Genetics

Research Abstract: Cutaneous Squamous Cell Carcinoma (cSCC) is the second most common cancer diagnosed in individuals with fair complexions, with around 700,000 cases treated each year. Although most cSCC tumors are superficial and are removed by surgical excisions, about 2-6% of the tumors will metastasize to other regions of the body, leading to a 44% mortality rate in individuals with distant metastatic tumors. A microRNA expression assay was performed in the Toland laboratory on 48 samples including primary and metastatic cSCCs to see which microRNAs were differentially expressed between metastatic versus non-metastatic cSCCs. The novel microRNA-4516 (miR-4516) was shown to be downregulated by 55% in metastatic tumors compared to non-metastatic tumors. Work by others showed that miR-4516 is activated by PUVA treatment in a keratinocyte cell line, and it directly targets STAT3, a known oncogene. My initial studies using quantitative PCR and Western blot analysis showed that miR-4516 expression had no effect on STAT3 mRNA or protein expression in cSCC cell lines. However, increased miR-4516 led to increased migration in our cSCC cell lines during migration assays, suggesting that miR-4516 has pro-metastatic effects rather than anti-metastatic effects like we initially hypothesized. Aryl hydrocarbon receptor (AHR) is a transcription factor that is abnormally activated in cancer and shows increased activation by UV radiation, which can be mimicked in vitro using FICZ. AHR has two predicted binding sites in the promoter region of miR-4516. Ongoing studies are determining how increased UV exposure affects miR-4516 expression in keratinocyte cell lines and if AHR plays a role in miR-4516 expression. The results of this study could lead to an increased understanding of the mechanisms leading to metastasis of cSCCs and could also identify potential therapeutic targets in patients, leading to better clinical outcomes.
Research Project Title: Therapeutic targeting of microRNA-214 in cutaneous T-cell lymphoma

Student Presenter: Leah Grinshpun

 Faculty Mentor: Anjali Mishra

Faculty Mentor Department: Internal Medicine

Research Abstract: Cutaneous T-cell lymphoma (CTCL) is a rare non-Hodgkin lymphoma of skin-homing malignant CD4+ T-cells. Long-term survival in advanced-stage patients is extremely poor, highlighting the need to identify potential novel targets to inhibit key oncogenic processes. Recently, our lab described increased global binding occupancy by bromodomain-containing protein-4 (BRD4), a histone-binding protein that interacts with large transcriptional complexes to drive gene expression, in CTCL patients. BRD4 has been shown to bind di-acetylated TWIST1 in several cell types. TWIST1, a cellular regulatory protein not normally expressed in CD4+ T-cells, is aberrantly expressed in CTCL, but its function in the disease remains unclear. MicroRNA-214 (miR-214) is an oncogenic miR that is overexpressed in CTCL patients and is associated with poor outcomes. The mechanisms by which miR-214 levels are regulated in CTCL are not known.

Here, we show that miR-214 can be regulated by both BRD4 and TWIST1 in CD4+ T-cells. We identified increased BRD4 binding occupancy at the promoter region of miR-214 in CTCL patient cells, which was validated by increased miR-214 expression. Additionally, treatment with JQ1, a specific inhibitor of BRD4, significantly decreased miR-214 expression in both patients and patient-derived cell lines. We demonstrated that specific silencing of TWIST1, as well as in combination with silencing of BRD4, results in significant decrease in miR-214 levels. Furthermore, we identify a novel target of miR-214, Kruppel-like factor 12 (KLF12), a protein with tumor suppressive functions in other cell types, but whose role in lymphoma is not known.

To test our findings in-vivo, we used IL-15 transgenic mice, which spontaneously develop CTCL by 8 weeks of age. Mice treated with anatagomiR-214 showed a significant reduction in the extent of neoplastic disease in the skin.

We conclude that miR-214 overexpression in CTCL is in part driven by increased binding of TWIST1 and subsequent recruitment of BRD4 to the miR-214 promoter region. Specific targeting of miR-214 in-vivo using an antagomiR results in reduced disease severity in a transgenic mouse model of CTCL. MiR-214 therefore represents a novel approach and a rational therapeutic target in CTCL.
Research Project Title: The role of microglia in chemotherapy-induced fatigue

Student Presenter: Browning Haynes

Faculty Mentor: Leah Pyter

Faculty Mentor Department: Psychiatry and Behavioral Health

Research Abstract: Introduction/Background:

Fatigue is one of the most common persistent symptoms cancer survivors experience after receiving chemotherapy. The specific mechanisms involved in chemotherapy-induced fatigue still remain unknown.

Neuroinflammation is a leading hypothesis underlying chemotherapy-induced sickness behaviors, including fatigue. Microglial activation is involved in many short-term and long-term neuroinflammatory responses that affect behavior. Therefore, we hypothesized that microglial activation leads to chemotherapy-induced fatigue.

Methods:

Thirty-two healthy, female Balb/c mice (1/cage) received either chemotherapy (30 mg/kg paclitaxel; i.p) or vehicle (n=16/group) every other day for a total of 6 doses. Two days after the final dose of treatment, a first wave of treatment balanced mice was euthanized and their brains were harvested; these mice represent the short-term effects of chemotherapy. A second wave was collected 21 days after their last dose of treatment to represent the long-term effects.

Body mass and food intake data were collected regularly throughout the project. To assess fatigue, locomotion and wheel running were measured using surgically implanted electronic transmitters and in-cage wheels respectively throughout the study period in the latter group. To assess microglial activation, brain sections that influence fatigue (hypothalamus and hippocampus) from each mouse will be stained with Iba-1 antibody and then counted. Correlational analyses will determine the potential relationship between microglial activation and chemotherapy-induced fatigue.

Results:

By the end of the chemotherapy treatment, mice gained less weight than the vehicle group. In the second wave of mice, chemotherapy decreased wheel running at night during treatment, but increased wheel running consistently for three weeks after the last dose. Microglial activation data are in progress.

Conclusions:

Activated microglia may have a role in chemotherapy-induced fatigue. Our data suggest that chemotherapy’s effects on fatigue vary temporally. Without fully understanding the mechanisms underlying behavioral comorbidities experienced by cancer survivors, cancer treatment will continue to fall short of its full potential.
Research Project Title: Physical activity delays development of obesity-induced pancreatic ductal adenocarcinoma in mice

Student Presenter: Ali Lahooti

Faculty Mentor: Zobeida Cruz-Monserrate

Faculty Mentor Department: Internal Medicine

Research Abstract: Pancreatic ductal adenocarcinoma (PDAC) is a deadly disease for which prevention strategies are unavailable. One of the major risk factors for developing PDAC is obesity, which is a worldwide epidemic. However, obesity is a modifiable risk factor that is reduced via increasing the levels of physical activity. Increased physical activity has been linked to a decrease in the levels of systemic inflammation in obese individuals. Therefore, the goal of our study was to investigate whether increased physical activity reduced development of obesity-induced PDAC, using genetically engineered mouse models (GEMM) of PDAC. We proposed that this would happen through decreases in local and systemic inflammation. To investigate the effects of physical activity, we used a GEMM of PDAC in which conditional expression of mutant KRasG12D is targeted to pancreatic acinar cells (Elastase-CreERT) via cre recombination (KRasG12D/CRE). KRasG12D/CRE and littermate control CRE mice were fed a high fat diet (HFD) for 4 weeks while having access to either a functional or a locked voluntary activity wheel for 4 hours a day, 5 days a week. Systemic levels of inflammation were evaluated in serum through blood collections at baseline, 2 weeks, and 4 weeks after the start of the experiment. Presence of PDAC and pancreatic intraepithelial neoplasia (PanIN) lesions were evaluated in the pancreas. Immunohistochemistry of inflammatory markers were performed in the pancreas and adipose tissue of mice. In addition, genetic profiles from adipose tissue were analyzed. The results of our study show that mice with access to functional running wheels, while on a HFD, gained less weight and developed fewer PanIN lesions than mice with access to locked wheels. Furthermore, we observed a decrease in the levels of systemic pro-inflammatory cytokines and identified gene expression changes in the adipose tissue of KRas mice that correlated with increased physical activity. Our results reveal that physical activity reduces the risk of obesity-induced PanIN lesions and PDAC development. These studies will contribute to the identification of novel mechanisms by which physical activity prevents and / or delays PDAC.
Research Project Title: Determining the role of point mutation E566A in cholangiocarcinoma therapy resistance

Student Presenter: Alexandria Lenyo

Faculty Mentor: Sameek Roychowdhury

Faculty Mentor Department: Internal Medicine

Research Abstract: Introduction / Background. The fibroblast growth factor receptor (FGFR) family regulates several critical cellular processes. Genetic alterations in FGFRs, including gene fusions and single nucleotide variations can lead to malignancies in cells affected. Several FGFR inhibitors are in clinical trials, and some patients show initial disease regression while on these targeted therapies. Unfortunately, most patients develop resistance to targeted therapies within a short time, and their disease progresses. The mechanism of this acquired resistance and methods to prevent resistance are largely unexplored.

Methods. Next generation sequencing identified an FGFR2-KIAA1598 gene fusion in a cholangiocarcinoma patient. The patient was placed on a clinical trial for the FGFR inhibitor, BGJ398, and showed significant tumor reduction. Unfortunately, she progressed eight months after starting BGJ398. A repeat tumor biopsy was sequenced, identifying a single point mutation, E566A, in the FGFR2 kinase domain suggesting that resistance to BGJ398 is driven by E566A. To determine the effect of E556A on response to therapy, we have stably transduced NIH3T3 cells with either empty vector, FGFR2-KIAA1598 WT, or FGFR2-KIAA1598 E566A. The three conditions were dosed with increasing amounts of BGJ398 and other FGFR inhibitors, and the half maximal inhibitory concentration (IC50) was determined. Western blotting was utilized in order to compare levels of protein expression among the empty vector, FGFR2-KIAA1598 WT, and FGFR2-KIAA1598 E566A cells.

Results. The results indicated that FGFR2-KIAA1598 WT responded to BGJ398, while FGFR2-KIAA1598 E566A was resistant. We also explored other FGFR inhibitors and found that FGFR2-KIAA1598 WT and FGFR2-KIAA1598 E566A were equally sensitive to Ponatinib, yet neither were sensitive to Dovitinib. FGFR2-KIAA1598 WT cells were sensitive AZD4547 and JNJ-42756493, but FGFR2-KIAA1598 E566A cells were resistant to these inhibitors. Western blotting identified an upregulation of the mTOR/PI3K/AKT pathway.

Conclusions. A deeper understanding of the mechanism and implications of acquired resistance to FGFR inhibitors can lead to novel clinical strategies to prevent drug resistance. We have identified various FGFR inhibitors with varying levels of efficacy against FGFR2-KIAA1598 WT and FGFR2-KIAA1598 E566A, and have identified key signaling pathways involved in the resistance mechanism of the point mutation E566A.
Research Project Title: Silvestrol-related rocaglates as a potential treatment for malignant peripheral nerve sheath tumors (MPNST)

Student Presenter: Mindy Hoang

Faculty Mentor: Long-Sheng Chang

Faculty Mentor Department: Pediatrics

Research Abstract: Introduction: Currently, there are no effective medical therapies for MPNSTs, a very aggressive type of soft-tissue sarcoma that grows around nerves and with a poor 5-year survival rate of less than 40%. Previously we have shown that silvestrol, an anti-neoplastic natural compound which inhibits protein translation through eIF4A, possesses potent anti-tumor activity against these tumors (Oblinger et al. 2016. Neuro Oncol. 18:1265-77). However, silvestrol has suboptimal drug-like properties, such as bulky structure and poor oral bioavailability. The objective of our research is to investigate silvestrol-related rocaglates, didesmethylrocaglamide (DDR) and rocaglamide(ROC), for their bioavailability and anti-tumor effects.

Methods: Actively growing STS26T and ST8814 MPNST and 697 and silvestrol-resistant 697-R leukemia cells were treated with various concentrations of silvestrol-related rocaglates. Cell proliferation was measured using resazurin assays. Flow cytometry was performed to determine cell-cycle distribution. Western blots were used to assess drug-affected signal transduction pathways.

Results: Among 10 silvestrol-related rocaglates, DDR and ROC potently suppressed MPNST cell proliferation with the IC50 (50% inhibitory concentration) value in the low nanomolar range (5nM for DDR and 15-20nM for ROC), similar to silvestrol. 697-R cells are silvestrol-resistant due to over-expression of the MDR1 multidrug transporter. However, unlike silvestrol, DDR and ROC inhibited the growth of 697-R cells at IC50 values similar to those of the parental silvestrol-sensitive 697 cells, suggesting that DDR and ROC are possibly more orally-bioavailable. DDR and ROC arrested MPNST cells at the G2/M phase of the cell cycle. A notable increase in cell death was observed in treated MPNST cells, and this was confirmed by increased levels of cleaved PARP, an apoptosis marker. Additionally, DDR and ROC reduced the levels of several mitogenic kinases, including AKT, in treated cells. Experiments are in progress to evaluate the anti-tumor activity of ROC in an animal model for MPNST.

Conclusion: DDR and ROC have more favorable drug-like properties than silvestrol. With high potency, these silvestrol-related rocaglates may become a possible treatment for MPNST.
Research Project Title: The role of potent BTK/ITK inhibitor ibrutinib on the development of mature dendritic cells and effective T-cell responses in-vivo under inflammatory conditions.

Student Presenter: Gregory Halsey

Faculty Mentor: Abhay Satoskar

Faculty Mentor Department: Microbiology

Research Abstract: Vaccines and therapies for cancer are limited in their capacity to activate T-cells, important mediators of anti-tumor immunity. T-cells recognize specific protein antigens presented in the context of MHC molecules on the surface of dendritic cells (DCs); binding to MHC-antigen complexes and co-stimulatory molecules mediates activation of the T-cell’s effector functions. Mature DCs increase expression of MHC and co-stimulatory molecules, facilitating increased MHC-antigen complex specific activation of T-cells. The microenvironment surrounding tumors has been shown to suppress T-cell activation by altering local DC characteristics, specifically, the presentation of tumor antigens to T-cells. The aim of DC-based cancer therapy and vaccination is to prime a patient’s T-cells to recognize and attack cancer cells by exposing them to mature DCs loaded with tumor antigens and infuse them back into the patient, however, many DC-based therapies are not clinically effective because current cell culturing strategies do not generate sufficient mature DCs. Ibrutinib is an irreversible inhibitor of Bruton’s tyrosine kinase (BTK) and interleukin-2 inducible kinase (ITK) approved by the FDA for the treatment of chronic lymphocytic leukemia and mantle cell lymphoma; BTK is expressed by DCs and involved in immunomodulatory signaling pathways.

DCs were generated from mouse bone marrow and cultured in the presence of vehicle or ibrutinib for 7 days. The DCs were then labeled with fluorescent dye to track movement and injected subcutaneously into mouse footpads. DC surface marker expression and frequency in lymph nodes was measured using flow cytometry.

In our study, ibrutinib induced migration to lymph nodes and increased expression of MHC-II and co-stimulatory molecules which promote DC-mediated helper T-cell activation and proliferation. These preliminary results suggest a novel effect for ibrutinib, enhancement of DC migration and maturation, a valuable clinical application for the treatment of certain cancers. Next, we will study ibrutinib’s effects on MDSCs, immature myeloid cells partially responsible for tumor microenvironment immune suppression, using a mouse-breast cancer model. Since it is known that both MDSCs and DCs can be derived from monocytes which migrate into tissues in response to inflammation, we suspect ibrutinib also acts on these cells to promote DC-maturation and T-cell activation.
Research Project Title: Identification of novel drug combinations for the treatment of pediatric acute megakaryoblastic leukemia

Student Presenter: Samantha Hodges

Faculty Mentor: Christina Guttke

Faculty Mentor Department: Pharmaceutics

Research Abstract: Background: Acute megakaryoblastic leukemia (AMKL) carries an extremely poor prognosis in pediatric patients despite high-intensity chemotherapy, hematopoietic stem cell transplantation, and improvements in supportive care. Given that significant improvements in long-term outcome are not expected with conventional therapy alone, new therapeutic strategies are urgently needed. Using high-throughput screening (HTS) we have found JAK inhibitors to have selective activity for AMKL. Single agent activity was confirmed using in vitro and in vivo models of AMKL. However, since kinase inhibitor monotherapy is not expected to induce durable responses, we sought to evaluate novel combinations of the potent JAK inhibitor, ruxolitinib, with the standard of care, cytarabine, and other compounds (nucleoside analog, HDAC inhibitors, proteasome inhibitors, microtubule poison) demonstrating single agent activity in our HTS.

Method: Single agent and combinations were tested using a 96-well plate format; cells were cultured in the presence of increasing drug concentrations at a fixed ratio; at 72 hours cell viability was determined using MTT. The half maximal inhibitory concentration (IC50) was evaluated by nonlinear regression analysis using GraphPad Prism. A combination index value was calculated using CalcuSyn to evaluate their interactions.

Result: We found the interaction of ruxolitinib in combination with cytarabine, gemcitabine, bortezomib, romidepsin, and cabazitaxel to be additive to synergistic (Combination Indices [CI] range 0.11-0.95); in contrast panobinostat and carfilzomib demonstrated an additive to antagonistic interaction (CI range 0.99-1.7).

Conclusion: We found multiple ruxolitinib-drug pairs to have an additive to synergistic interaction including cytarabine (AML standard of care), gemcitabine (nucleoside analog), romidepsin (HDAC inhibitor), bortezomib (proteasome inhibitor), and cabazitaxel (taxane). Ongoing studies aim to determine the underlying mechanism(s) driving the selective activity of ruxolitinib for AMKL. Though ruxolitinib demonstrated single agent activity in vivo ongoing studies are evaluating the PK parameters and efficacy of novel combinations in murine models of AMKL. We have prioritized evaluation of compounds that are currently FDA approved so that our findings can be more rapidly translated to the clinic. Our long-term goal is to identify optimal drug combinations with ruxolitinib that demonstrate promising therapeutic benefit, translate the findings to clinical trials, and ultimately improve long-term outcomes of children with AMKL.
Research Project Title: Role of macrophage migration inhibitory factor in cell proliferation and angiogenic gene expression in oral cancer cells

Student Presenter: Nabiha Islam

Faculty Mentor: Christopher Weghorst

Faculty Mentor Department: College of Public Health

Research Abstract: INTRODUCTION: The relationship between the immune response and cancer cell development (tumorigenesis) is being studied in a wide variety of cancers. Macrophage migration inhibitory factor (MIF) is a pro-inflammatory cytokine involved in the innate immune response. This cytokine is present in most human cells, working through a variety of pathways that may increase or suppress the expression of genes involved in the development of new blood vessels (angiogenesis) and the inflammatory response and may play a role in the proliferation of tumorigenic cells. An exploration of MIF’s contribution to the tumor microenvironment may prove to be an important target in oral cancer therapy. METHODS: In this study, human normal oral mucosal and squamous cell carcinoma cells were treated with various levels of MIF, ranging from 1 ul/mL to 100 ul/mL. To explore changes in cell proliferation and gene expression in the absence of MI, cells were also treated with MIF antagonist ISO 1, which inhibits the cytokine in the cell. The proliferation of these treated cells was measured, under the hypothesis that MIF enhanced cells would grow at faster rates than inhibited cells, especially in tumorigenic cells. The levels of gene expression of VEGFA, a key indicator of angiogenesis, and IL-8, involved in the inflammatory response and a promoter of angiogenesis were measured via PCR reactions. RESULTS/CONCLUSIONS: Preliminary results suggest MIF effects cell proliferation in both normal and cancer cells, as well as the expression of genes involved in angiogenesis.
Research Project Title: Influence of the microenvironment on resistance to Ibrutinib-treatment in chronic lymphocytic leukemia-an in vitro study

Student Presenter: Parviz Kanga

Faculty Mentor: Fabienne McClanahan

Faculty Mentor Department: Hematology

Research Abstract: Introduction: Chronic Lymphocytic Leukemia (CLL) is the most common adult leukemia in the Western World. CLL causes the rapid proliferation of mutated B-lymphocytes (CLL cells). While CLL is incurable, the drug Ibrutinib significantly extends the lifespan of patients by irreversibly binding to Brutonâ€™s tyrosine kinase (BTK), a protein that directly stimulates the growth of CLL cells. Ibrutinib treatment is effective in reducing tumor load; however, patients rarely experience complete remission. We hypothesize that different microenvironments within the body may provide differential stimuli to CLL cells, affecting their ability to be bound by Ibrutinib. Our aim is to explore the strength of binding between Ibrutinib and BTK across CLL cells isolated from the SP, PB, and BM of leukemic mice.

Methods: CLL cells were isolated from the SP, PB, and BM of leukemic mice (n=6) and protein lysates were prepared. Samples were treated for one hour with Ibrutinib or DMSO vehicle and then labelled with a competitive, fluorescent probe that detected the relative amounts of unbound BTK in each sample following drug exposure. Electrochemiluminescence immunoassay was used to measure output across organs. A western blot was performed using the same protein lysates to determine the relative protein expression of BTK across organs. Immunoassay outputs for each sample were normalized by their respective BTK expression.

Results: There was no statistically significant difference in Ibrutinib binding when comparing CLL cells from the SP, PB, and BM. There was also no statistically significant difference in BTK expression in CLL cells across organs.

Conclusion: Our in vitro data suggests that the binding affinity of Ibrutinib to BTK does not change when comparing treated CLL cells from the SP, PB, and BM of leukemic mice. This suggests that remission may not be facilitated by the differential binding affinity of Ibrutinib in different organs. Future, in vivo, experiments should be performed to account for interactions between organs and provide a more complete view of the organ microenvironments.
As bona fide regulator of immune reaction, the NF-κB family of transcription factors is implied to support cancer development by promoting cell survival and cell growth. The NF-κB family functions as dimers from 5 subunits, with the p50/p65 heterodimer being expressed in almost all mammalian cells. Recent findings from our lab indicated that NF-κB can also function in cancer cells to counter the immune elimination from innate and adaptive immune systems. In a previous experiment comparing p65+/+Ras and p65−/−Ras MEFs by RNA sequencing, 1,946 genes were found to be downregulated in p65−/−Ras. Once grouped based on their biological function, 51 were classified as genes that participate in cellular movement, secretion, enzyme production, and gene expression.

Methods

The 51 genes from before were further subjected to NF-kB regulated gene data base search to eliminate the 16 genes already published as those that aren’t targets of the factor eliminated, leaving 35 as possible targets that could carry out the suppression of immune cells caused by the NF-κB pathway. Primers for each gene were designed with a web-based primer program (primer 3.1). RNA was extracted from p65+/+Ras and p65−/−Ras MEFs. Extracted RNA was further reverse transcribed into cDNA. cDNA from p65+/+Ras and p65−/−Ras MEFs was subjected to real time quantitative PCR analysis with Sybre Green PCR kits (Roche) to test for differential expression and primer quality.

Results

With successful amplifications, we identified 6 differentially regulated genes which had not been previously reported being regulated by NF-kB. Other genes are currently under further investigation.

Conclusions

Primers were designed that were able to confirm the differentially regulated genes. These 35 genes encoding secreted factors are now narrowed to 6. We will continue to work on these genes to further understand their regulation and function in tumor development. Differentially expressed genes will be further analyzed with RNA prepared from p65+/+Ras and p65−/−Ras MEFs with successful primers. This experiment will be repeated thrice, and t tests will be utilized to further confirm the statistical difference between p65+/+Ras and p65−/−Ras MEFs. Eventually, primers for human genes will be designed and tested with cDNA from pancreatic cancer.
Research Project Title: The impact of in utero BPA exposure and the mechanisms of its effects on the development of breast cancer

Student Presenter: Claire Kovalchin

Faculty Mentor: Craig Burd

Faculty Mentor Department: Molecular Genetics

Research Abstract: Previous studies have shown that in utero exposure to diethylstilbestrol (DES), a synthetic form of estrogen, increases the risk of developing various forms of cancer, including breast cancer, later in life. While DES is no longer prescribed to pregnant women, exposure to other environmental compounds may be having a similar effect. One such compound, bisphenol A (BPA) acts as a synthetic estrogen, and has been detected in human amniotic fluid emphasizing the need to understand if environmental estrogens can promote cancer. Similar to DES, in utero BPA exposure in rodents alters the morphology of the mammary gland and increases the risk of developing cancer. The exact mechanism by which BPA increases susceptibility is unknown. To identify changes to the mammary gland after in utero BPA exposure, we utilized immunohistochemistry to show that alterations of two key proteins, Ki67 and ERα, in the stroma, correlate to significant defects in the epithelium. These data suggest that BPA induced stroma alterations may promote epithelial transformation to cancer. To characterize the global alterations within the stroma and epithelium, we performed RNA-seq analysis in primary rodent mammary glands following in utero BPA exposure. These data identified significant alterations to genes associated with the extracellular matrix. We thus analyzed BPA treated mammary glands to demonstrate increased collagen deposition within the extracellular matrix, a molecular phenotype previously shown to increase cancer risk. Together these data suggest that in utero BPA exposure alters the expression of several important stromal proteins within the mammary gland, causing changes that may lead to an elevated risk of developing cancer.
Research Project Title: Characterization of microRNAs as post-transcriptional modulators of topoisomerase IIα in etoposide (VP-16) resistant K562 cells

Student Presenter: Evan Kania

Faculty Mentor: Jack Yalowich

Faculty Mentor Department: Pharmacology

Research Abstract: The 170 kDa enzyme DNA topoisomerase IIα (TOP2α/170) induces covalent complexes with DNA and produces transient double-strand DNA breaks crucial for processes such as replication and normal chromosomal disjunction at mitosis. TOP2α/170 is an important target for clinically effective anticancer agents, such as etoposide (VP-16), since these drugs stabilize the otherwise short-lived enzyme-DNA covalent complexes, thereby inducing cytotoxic DNA damage. However, the efficacy of these agents is limited by chemoresistance. Our lab has characterized acquired resistance to VP-16 in human leukemia K562 cells. The cloned resistant cell line K/VP.5 contains reduced levels of TOP2α/170. The goal of this project is to investigate post-transcriptional alterations that may account for decreased TOP2α/170 protein in these resistant cells.

To assess post-transcriptional regulation of TOP2α/170, a luciferase reporter plasmid containing the 3’UTR-untranslated region (3’UTR) of TOP2α/170 mRNA was constructed. This reporter plasmid, designated TOP2α/170-3’, is being utilized to determine the effects of microRNAs (miRNAs) as modulators of TOP2α/170 expression via binding to its 3’UTR. Of primary interest are those miRNAs overexpressed in resistant cells, as they are more likely to cause a decrease in TOP2α/170 expression. A miRNA array generated by our lab produced a list of miRNA expression levels in K562 and K/VP.5 cells. hsa-miR-9-5p and -3p were studied because these two miRNAs had seed sequences in the TOP2α/170 3’UTR and were overexpressed in K/VP.5 cells. Quantitative PCR confirmed that expression levels of both miRNAs were greater in K/VP.5 than K562 cells. Dual firefly and renilla luciferase assays performed with K562 and K/VP.5 cells transfected with the TOP2α/170-3’UTR luciferase expression plasmid indicated decreased luciferase expression in K/VP.5 compared to K562 cells confirming altered post-transcriptional regulation in resistant cells. Moreover, dual luciferase assays performed with parental K562 cells that were co-transfected with TOP2α/170-3’UTR and hsa-miR-9-5p resulted in a decrease in luciferase expression validating a role for this miRNA in acquired resistance.

Future studies will involve mutagenesis of hsa-miR-9-5p’s seed sequence in the TOP2α/170-3’UTR firefly expression vector, as well as western blots of TOP2α/170 in K562 cells transfected with hsa-miR-9-5p to further establish the role of this miRNA in post-transcriptional regulation of TOP2α/170 expression.
Research Project Title: Targeting novel PRMT5 inhibitor drugs in mantle cell lymphoma

Student Presenter: Judy Nayal

Faculty Mentor: Robert Baiocchi

Faculty Mentor Department: Internal Medicine

Research Abstract: Targeting Novel PRMT5 Inhibitor Drugs in Mantle Cell Lymphoma

Judy Nayal, JiHyun Chung, Shelby Sloan, and Robert Baiocchi

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Background: Mantle cell lymphoma (MCL) is a B-cell non-Hodgkin lymphoma developing from antigen-experienced B cells. Protein Arginine Methyltransferase 5 (PRMT5) is protein within a family of enzymes, which catalyzes arginine methylation of histone and non-histone proteins. PRMTs are directly involved in many cellular functions such as gene transcription and RNA processing, multiple signaling pathways, stem cell differentiation, and apoptosis. PRMT5 drives symmetric dimethylarginine methylation marks on histones H3R8 and H4R3. PRMT5 methylated histones lead to transcriptional repression of target tumor suppressor and regulatory genes. PRMT5 has been found to be overexpressed in cancer cells and epigenetically silences a wide range of regulatory genes and tumor suppressors. Overexpression of PRMT5 causes cellular hyper-proliferation and promotes tumor survival. Inhibition of PRMT5 restores regulation to multiple cell cycle and signal transduction pathways, expression of multiple anti-cancer genes and preclinical studies show great potential as a novel therapy for MCL.

Methods: PRMT5 inhibitor drugs (PRT220, PRT382) were titrated in a dose-dependent fashion (1nM-1000nM) in presence of MCL cell lines CCMCL and Jeko. Cells were harvested after 24, 48, 72, and 96 hour incubation and MTS assay performed to measure cell proliferation. Apoptosis was evaluated by Annexin/V-PI staining and analysis by flow cytometry. Western blots will examine histone marks (Ame2H3R8, Sme2H3R8, SDMA) and signaling pathways (PI3K/AKT and FOXO1).

Results: PRT220 and PRT382 showed dose-dependent anti-proliferative activity in MTS assays and pro-apoptotic cell death by flow cytometry. Western blot analysis has demonstrated PRMT5 inhibitor activity leads to loss of the symmetric dimethyl epigenetic marks but not asymmetric marks, consistent with selective PRMT5 inhibitory activity. PRT220 and PRT382 have also demonstrated impressive in vivo anti-tumor activity using an aggressive model of MCL (CCMCL1). Work examining PI3K/AKT and FOXO1 activity is currently underway.

Conclusion: PRMT5 appears to be an attractive target in MCL and our preclinical drugs show potent anti-tumor activity. Our goal is to identify a drug candidate to submit to FDA for new drug application and clinical development in phase I trials.
Research Project Title: Production and purification of recombinant proteins for cancer treatment

Student Presenter: Jakob Nypaver

Faculty Mentor: Zhiwei Hu

Faculty Mentor Department: Surgery

Research Abstract: Working under Dr. Zhiwei Hu, I will be producing and purifying recombinant proteins that Dr. Hu previously co-invented at Yale University. Dr. Hu has recently invented newer versions with improved efficacy after joining Ohio State. The proteins, called ICON and L-ICONs (for lighter or light chain ICON), are therapeutic agents that are designed to be able to simultaneously target cancer cells, cancer stem cells and tumor neovasculature in the tumor microenvironment. These protein agents are antibody-like immunoconjugates that can mediate immunotherapy via the host immune system to fight cancer. Recombinant DNA technology will be used for the production of these recombinant proteins. The production of the proteins will occur in the months before the research forum. Briefly, a mammalian cell line, for example, Chinese Hamster Ovary (CHO), will be transfected with plasmid DNA, producing recombinant DNA coding for the specific target protein. Following transfection, the cells will be grown in complete growth medium until the contingency is approximately 80-90 percent. Once the cells have reached this threshold, they will be dissociated transferring them to a serum free medium, where the cells will grow in suspension. This dissociation process will be repeated weekly adding fresh cells to the serum free medium colony. Next, the supernatant of the serum free medium will be collected, which contains the recombinant protein. To test for the protein in the medium, cell ELISA will be used to test for the binding affinity of the protein. After approximately one-to-two liters of serum free medium is collected, the protein will be purified using affinity column purification. The experimental success will be determined by the amount of recombinant protein purified which will be evident based on an absorption graph run throughout the purification. A protein “peak” will be clearly seen on the graph for successful purification. This purified protein can be used in further experiments such as animal studies testing its therapeutic ability against cancer.
Research Project Title: Distinct mechanisms of NOTCH1 in subtypes of non-small cell lung cancer

Student Presenter: David Lopez

Faculty Mentor: Sara Sinicropi-yao

Faculty Mentor Department: Bioinformatics

Research Abstract: The Notch signaling pathway is one of the most commonly activated signaling pathways in cancer altering mechanisms in cell proliferation, differentiation and survival. Unlike many other cancer-related genes, NOTCH1 appears to act divergently as an oncogene in lung adenocarcinoma and a tumor suppressor in lung squamous cell carcinoma. Recent work in the lab has identified pathways that may underlie the divergent role of Notch in cancer based on a comprehensive co-expression analysis of lung datasets from The Cancer Genome Atlas (TCGA). Unique patterns of gene co-expression with NOTCH1 were observed in lung adenocarcinoma and squamous cell carcinoma. In lung adenocarcinoma we observed distinct patterns of co-expression with angiogenesis and immune pathways while in squamous cell carcinoma we observed distinct patterns of co-expression associated with the cell cycle. IHC and RNA sequencing analysis of in vivo NOTCH1 knockdown tumor models demonstrated differences in expression of vascular, immune, and cell cycle related genes in lung adenocarcinoma and lung squamous cell carcinoma. Additional analyses are underway to validate these mechanisms. Improving our understanding of these regulatory mechanisms of NOTCH1 in specific lung cancer subsets is valuable to help guide the development of NOTCH1 targeted therapeutics.
Research Project Title: Molecular mechanisms underlying Rab9 GTPase regulation of the autophagic pathway

Student Presenter: Ayush Peddireddi

Faculty Mentor: Anne Strohecker

Faculty Mentor Department: Department of Surgery

Research Abstract: Autophagy is an essential cellular process that maintains normal cell functioning in the face of nutrient deprivation-induced stress. This is achieved by the encapsulation and degradation of cellular components, upon which the metabolic precursors are recycled for reuse. Dysregulation of the pathway can lead to several consequences. Dysregulation or defective autophagic machinery leads to neurodegeneration, as a growing amount of unwanted protein can accumulate and lead to diseases such as Alzheimer’s or Parkinson’s. Therefore, it is of great clinical significance to identify novel regulators within the pathway. Through a small shRNA screen, the GTPase Rab9 was identified as a potential negative regulator of autophagy. The Rab family comprises the largest group of small GTPases, and Rab9 is well known to operate within the vesicle trafficking pathway from the late endosome to the trans-Golgi network. However, Rab9’s specific role in autophagy is less well known. As Rab9 is a GTPase, we hypothesize that its GTP/GDP binding domain is critical for function. To test this hypothesis, HEK 293T cells were transfected with plasmids that were either inert, wild-type or hydrolysis-resistant that rendered the Rab9 GTPase in a constitutively active (GTP-locked) conformation. Following starvation-induced autophagy, an LC3 flux assay was conducted with the collected lysates. Results showed that the cells locked in the GTP confirmation displayed the least levels of autophagic flux relative to the control and wild-type samples, providing further support that the constitutively active regulator is the most potent. Further confirmation will include the use of a dominant-negative mutant that renders the GTPase locked in its GDP-bound state, and creating a cell line in which Rab9 mutants are stably expressed at all times. With the accrued results, the mechanisms by which Rab9 regulates autophagy can be better understood; which will inform subsequent efforts to regulate the autophagic pathway therapeutically in response to pathogenicity.
Research Project Title: IL-6 blockade combined with MEK inhibition reduces cancer-induced cachexia

Student Presenter: Neil Makhijani

Faculty Mentor: Thomas Mace

Faculty Mentor Department: Internal Medicine

Research Abstract: A large percentage of patients with pancreatic cancer and various other gastrointestinal cancers suffer from cachexia, which is characterized by the loss of skeletal muscle and adipose tissue mass that cannot be reversed by nutritional intervention. Nearly half of all cancer patients experience cachexia leading to severe decreases in quality of life, with 20-30% of all cancer-related deaths resulting from cachexia given there is no treatment to directly combat this syndrome. Our group has shown that elevated interleukin-6 (IL-6) levels correlate to poor prognosis in patients with pancreatic cancer and is a potential factor that may promote cancer cachexia. A recent clinical study showed that biliary cancer patients treated with a MEK inhibitor had anti-cachectic results. Thus, we hypothesized that antibody (Ab) blockade of IL-6 can be utilized to enhance the efficacy of MEK inhibition as a treatment modality for pancreatic-induced cancer cachexia. Currently, an accurate in vivo model of pancreatic-induced cancer cachexia is unavailable; therefore, we tested the combination of IL-6 blockade with MEK inhibition on using an accepted model of cancer cachexia - CD2F1 mice bearing C26 tumors. Mice treated with MEKi or the combination of anti-IL-6 Ab plus MEKi resulted in tumor inhibition compared to vehicle controls (p<0.007). Additionally, mice administered anti-IL-6 Ab in combination with MEKi prevented tumor-induced weight loss and protected hindlimb and adipose tissue compared to vehicle-treated mice (p<0.05). MEKi combined with IL-6 Ab blockade treatment reduced expression of cachexia associated markers (MAFBx, MuRF1, Atg5, Bnip3, and Musa1) in the tibialis anterior muscle of tumor-bearing mice. These results were confirmed using an in vitro model, C2C12 myotube cells, which exhibited less muscle atrophy in cells treated with MEKi and anti-IL-6 Ab compared to vehicle controls. Overall, these pre-clinical results indicate that the blockade of IL-6 combined with MEK inhibition may help reduce cachexia in pancreatic cancer patients.
Research Project Title: Efficacy of oncolytic herpes simplex virus and cisplatin combination in treatment of ovarian clear cell carcinoma

Student Presenter: Puneet Modgil

Faculty Mentor: Selvendiran Karuppaiyah

Faculty Mentor Department: Obstetrics & Gynecology

Research Abstract: Introduction: Ovarian clear cell carcinoma (OCCC) is an aggressive malignancy that has a bleak prognosis due to the resistance of the tumor to first-line chemotherapeutics such as cisplatin, which calls for novel treatment schemas to manage the malignancy. Oncolytic herpes simplex virus (oHSV) is genetically modified from the wild-type variant to replicate within specific tumor cells (using the lytic pathway to trigger apoptosis of cells), and is being used in treating glioblastoma and melanoma. The success of these trials laid the foundation for use of oHSV in other malignancies such as OCCC. Our group has found evidence that viral binding of oHSV to the cell membrane is mediated by glycoprotein C, which interacts with chemoresistance gene TMEM205.

Hypothesis: We hypothesize that oHSV pre treatment leads to downregulation of TMEM205, causing increased accumulation of intracellular cisplatin, through a synergistic effect.

Methods: To test this hypothesis, we examined the effect of cisplatin or/and oHSV in different OCCC cells using SRB assays for cell proliferation to assure that cisplatin has no antagonistic effect on oHSV. Specifically, this project used OVTOKO and JHOC cell lines as they have been the most well established models in OCCC research. We also performed western blot, RT-PCR, and immunocytochemistry (ICC) to evaluate biomarkers implicated in apoptosis and potential mechanisms of oHSV and cisplatin mediated tumor death. Future experiments will examine the efficacy of cisplatin and oHSV in vivo through murine models, and analyze gene expression from tumor lysates.

Results: We report that TMEM205 is a membrane protein as shown by our ICC and all the tested OCCC cells and human tissues had moderate to high expression of TMEM205 as quantified western blots and qRT-PCR. oHSV decreases the expression of TMEM205 causing increased cisplatin accumulation within the cell, which in turn leads to enhanced apoptosis in OCCC cells.

Conclusions: This study aims to be the first to investigate the combination of oHSV and chemotherapeutics in the context of OCCC. Further, through identification of the effects on protein expression levels, we hope to determine a preliminary mechanism of oHSV and cisplatin adjuvant therapy.
Research Project Title: The effects of 13-cis retinoic acid and romidepsin on neuroblastoma GD2 expression for antibody-based immunotherapy

Student Presenter: Jessica Mormol

Faculty Mentor: Nilay Shah

Faculty Mentor Department: Center for Childhood Cancer and Blood Diseases

Research Abstract: BACKGROUND: Antibody-based immunotherapy against GD2, a disialoganglioside expressed in neuroectodermal cell membranes, is commonly used in conjunction with retinoid therapy for high-risk neuroblastoma. Previous studies showed improved patient survival when treated with alternating cycles of anti-GD2 therapy and 13 cis-retinoic acid (RA). However, this combination was determined based on pragmatic reasons and the two therapies may not be complementary. Pan-HDAC inhibition has been previously shown to augment anti-GD2 immunotherapy, and HDAC1/2 inhibition has been shown to induce neuronal differentiation in neuroblastoma. HYPOTHESIS: We hypothesize that RA may inhibit GD2 expression in neuroblastoma, potentially impairing the efficacy of anti-GD2 immunotherapy, and specifically HDAC1/2 inhibition with romidepsin can rescue this effect.

METHODS/AIMS: To test this hypothesis we pursued the following aims: 1) determination of the effects of RA and romidepsin individually and in combination on GD2 expression on neuroblastoma cell lines in vitro, 2) evaluation of the effects of RA and romidepsin on GD2-directed antibody-dependent cell-mediated cytotoxicity (ADCC) in vitro. RESULTS: We demonstrated by flow cytometry that GD2 decreases in neuroblastoma cells treated with RA, while GD2 increases in neuroblastoma cells treated with romidepsin, and the concurrent use of romidepsin and RA mitigates the downregulation of GD2. Furthermore, these changes in GD2 correlate with the efficacy of NK-cell-directed ADCC as induced by dinutuximab in vitro against neuroblastoma cell lines. CONCLUSIONS: These data suggest that the efficacy of current anti-GD2 immunotherapy could be improved either by the restructuring of the timing of retinoid therapy and/or by the inclusion of HDAC1/2 inhibitors to the regimen. Studies in animal models and using patient-derived xenografts are ongoing at the time of abstract submission.
Research Project Title: Targeting HSP90β in diffuse large B cell lymphomas

Student Presenter: Alexander Prouty

Faculty Mentor: Robert Baiocchi

Faculty Mentor Department: Internal Medicine

Research Abstract: Background: Diffuse large B-cell lymphoma (DLBCL) is the most common histologic subtype of lymphoma in the United States. DLBCL is an aggressive malignancy that is made up of large, transformed B lymphocytes. Currently, treatment for relapsed, refractory DLBCL is associated with poor outcomes, treatment-related toxicity, with no standard treatment, thus, there is a need for novel approaches. Heat Shock protein 90 (HSP90) has emerged as an attractive target in cancer given its ubiquitous role in promoting constitutive signaling in multiple cancer driver pathways. Here we evaluate the anti-tumor activity of a novel HSP90 inhibitor, SNX2112 against two distinct subtypes of DLBCL. Our preliminary data shows SNX2112 induces death of DLBCL cells and modulation of pro-death and survival client proteins and that it may represent an attractive agent for patients diagnosed with this aggressive lymphoma.

Methods: A stock concentration (10mM) of SNX2112 (Esanex Pharmaceuticals) was prepared in DMSO vehicle. DLBCL cell line (SUDHL4, SUDHL10, OCI LY1, HBL1) proliferation was measured with MTS colorimetric assays in the presence of the tested drug (10nM-1uM) for 24, 48, and 72hr. Flow cytometry was used to assess cell death via Annexin V/PI staining. Finally, molecular effects of the drug were investigated through use of western blotting to examine the inhibitor effects on well described client proteins (DNMT1, HDAC1, NFκB, PARP).

Results: SNX2112 was displayed anti-tumor activity in a panel of DLBCL cell lines in a dose dependent fashion. Potent anti-proliferative activity in apoptosis assays showed mean IC50 of 110 nM at 48 hours. Western blot analysis demonstrated decreased levels of the DNMT1 enzyme and PARP protein cleavage indicating induction of programmed cell death.

Conclusion: The study’s results indicate that HSP90 is a promising therapeutic candidate for further preclinical investigation. We are evaluating the anti-tumor activity of SNX2112 in a model of aggressive DLBCL and also identifying direct client proteins that bind HSP90 to better understand the mechanism of action. If preclinical in vitro and in vivo data indicates an effective therapy, then it would provide rationale for further testing in phase 1 clinical trials in humans.
Research Project Title: DNA methylation in papillary thyroid cancer-specific gene expression

Student Presenter: Altan Turkoglu

Faculty Mentor: Pearly Yan

Faculty Mentor Department: Internal Medicine

Research Abstract: Introduction

Gene expression is known to be perturbed by modifications in DNA promoter methylation. DNA methylation in humans primarily occurs in the context of a cytosine followed by a guanine, or CpG. Reduced representation bisulfite sequencing (RRBS) profiles DNA methylation at single-base resolution. Papillary thyroid cancer (PTC), the most common form of thyroid cancers, is most often sporadic with only 5-10% familial attribution. Since disease etiology is often not associated with gene mutations, we seek to integrate RRBS DNA methylation with total transcriptome gene expression data to arrive at PTC-specific genes impacted by promoter DNA methylation.

Methods

Twenty-three paired tumor and non-tumor adjacent samples were sequenced using both RRBS and RNA-Seq methods. Briefly, methylKit Rscripts were used to call methylation statuses for RRBS sequencing data. Using 200 base-pair tiled windows, differentially methylated regions (DMRs) were identified using logistic regression.

In a paired statistical test, differentially expressed genes (DEGs) were uncovered using DESeq2. Principal components analysis (PCA) examined whether expressed transcript profiles could separate samples by their tumor and non-tumor adjacent status, as well as identified possible sample processing batch effect. Gene Set Enrichment Analysis (GSEA) was also performed to show statistically significant changes in various curated gene sets. By integrating proximal promoter DMRs with DEGs, anticorrelative relationships would signify PTC-specific genes impacted by DNA methylation.

Results

RRBS data displayed 11,500 significant CpGs, with a trend of hypermethylation. DESeq2 analysis revealed the presence of 2,000 up-regulated and 3,166 down-regulated DEGs at 2-fold change cutoff. GSEA analysis showed that curated gene sets for PTC were significantly affected between tumor and non-tumor adjacent samples. PCA results from gene expression showed separation of samples by tumor and non-tumor adjacent.

Conclusions

Tumor and non-tumor adjacent samples from PTC reveal distinct differences in both their expression and methylation patterns; by analyzing where these changes take place, specific genes can be identified for further study. Previously, a small number of mutations along long intergenic non-coding RNA (lincRNA) have been shown to predispose patients to PTC. Such lincRNA may be a target for future analysis, and additional correlations may be made leveraging known genetic markers from literature.
Research Project Title: Hyaluronic acid alters vessel behavior in CXCL12-treated HUVECs

Student Presenter: Alex Seibel

Faculty Mentor: Jonathan Song

Faculty Mentor Department: Mechanical and Aerospace Engineering

Research Abstract: Hyaluronic acid (HA) is a key component of the extracellular matrix known for absorbing water, swelling, and causing higher solid stress in tumors. HA’s anionic behavior may provide important biochemical effects as well, altering the potency of growth factors present in the tumor microenvironment. Tumors obtain nutrients by relying on growth factors such as CXCL12 to recruit blood vessels and promote vessel leakage. Recent work suggests that additional positively-charged residues on CXCL12’s β and γ isoforms cause different biochemical functionality compared to the predominantly-studied α isoform. For our studies, we wanted to determine whether the presence of HA in a tumor’s microenvironment could alter the relative response strength of CXCL12’s various isoforms on blood vessel sprouting and apparent vascular permeability. The vessel microenvironment was modeled using a 3-channel microfluidic device with Human Umbilical Vein Endothelial Cells (HUVECs) in the outer channels forming monolayers against a 3D collagen matrix (with or without HA) in the center channel. HUVECs were cultured with media containing recombinant CXCL12 (α, β or γ, 100 ng/ml). Results show that total HUVEC sprouting area follows an α>β>γ trend in isoform-treated HUVECs without HA, which matches the rank order for binding affinity of CXCL12 isoforms to their receptor CXCR4 on endothelial cells. The presence of HA decreased overall sprouting response but shifted potency towards CXCL12’s γ isoform. Vascular permeability studies also showed an α>β>γ trend without HA. With HA present, control and α-treated HUVECs became less permeable while γ-treated HUVECs became more permeable. Overall results suggest that the additional positively-charged residues on the β and γ isoforms facilitate binding to the more negatively-charged, HA-infused collagen matrix, leading to a more potent vessel response when HA is present. Knowing how HA can impact CXCL12 isoform potency on vessels will be very helpful for the design of CXCL12-targeted cancer therapies.
Research Project Title: Treatment of hypoxic ovarian cancer using a potential STAT3-targeting compound HO-4200

Student Presenter: Maria Riley

Faculty Mentor: Selvendiran Karuppaiyah

Faculty Mentor Department: Obstetrics and Gynecology

Research Abstract: Ovarian cancer continues to have the highest case-fatality ratio of any gynecologic cancer. The failure of current therapies to treat patients, especially in cases with drug resistant tumors, is one of the biggest barriers in ovarian cancer therapeutic research. Hypoxic environments (1% O2 concentration) have been shown to play a role in tumorigenesis as well as increase the development of resistance to chemotherapy. Tumor hypoxia (1% O2 concentration) increases cell proliferation due to activation of various oncogenic signaling pathways when compared to normoxic environments (20% O2 concentration). In order to combat chemo-resistant tumors, we used a compound previously developed in our lab which is based on a diarylidenyl piperidone HO-4200 backbone conjugated to an N-hydroxypyrroline (nitroxide precursor) group. Using two ovarian cancer cell lines (A2780 and SKOV3), we performed a Western Blot and determined that HO-4200 inhibits phosphorylation of STAT3 at Tyrosine705. Also, through the use of Western Blot we have confirmed that there is an increase in STAT3 phosphorylation at Tyrosine 705 in hypoxic environments compared to normoxic environments. Bromodeoxyuridine assays demonstrated that reducing STAT3 expression (via silencing RNA) decreases cell proliferation even in a hypoxic environment. The efficacy of HO-4200 as compared to other therapeutic agents was also authenticated by Western Blot and Annexin V. In conclusion, hypoxic environments lead to an increased expression of phosphorylated STAT3 and HO-4200 demonstrates cytotoxicity via inhibition of the pSTAT3 at Tyrosine 705. Furthermore, studies addressing the efficacy of HO-4200 in hypoxic tumor environments are underway.
Research Project Title: Notch signaling promotes functional natural killer cell maturation in human pediatric tonsils

Student Presenter: Blaire Schumacher

Faculty Mentor: Aharon Freud

Faculty Mentor Department: Pathology

Research Abstract: Human natural killer (NK) cells are large granular lymphocytes that develop in secondary lymphoid tissues in distinct stages characterized by specific surface markers. The innate immune system is humans’ first line of defense against cancer cells, which makes NK cell biology an important component of cancer immunotherapy. Our previous work has shown that functionally mature NK cells express the activating receptor NKp80, which is acquired after the NK cell specific receptor CD94 during the later stages of maturation. Thus in our experiments, NKp80 acquisition was used as the transition marker for NK cell maturity. Human NK cell developmental mechanisms have yet to be fully described, but Notch signaling has been studied in the context of NK cell development. The Notch signaling pathway consists of a trans-membrane receptor protein, Notch, which is triggered by a ligand (i.e. Delta-like), via direct cell-to-cell contact. We hypothesized that Notch signaling may be involved in regulating the transition into mature NK cells from their precursors. To test our hypothesis, we isolated immature NK cells, defined as lineage(-)CD34(-)CD117(+/-)CD94(+)NKp80(-)CD16(-), from human pediatric tonsils and cultured them for 14 days with human interleukin (IL)-7 and either no stromal cells, murine OP9 bone-marrow derived stromal cells (OP9), or OP9 cells expressing human Notch ligand delta-like-1 (OP9-DL1). The immature NK cells cultured in the presence of DL1 had greater NKp80 acquisition compared to cells cultured on OP9 cells or in the absence of stroma. Treatment with a known Notch inhibitor, DAPT, inhibited NKp80 expression when compared to our control. Culture derived NKp80 cells showed other characteristics of mature NK cells; increased expression of transcription factors TBET and EOMES, and effector molecules Perforin and Granzyme A. The culture derived NKp80 cells were also capable of producing Interferon-γ when stimulated with IL-12, IL-15, IL-18. Therefore, we concluded that Notch signaling promotes the functional maturation of NK cells. Future studies are underway to determine how Notch regulates the transcription of target genes required for NK cell functional maturation.
Research Project Title: Global profiling of INK/ARF occupancy through DamID

Student Presenter: Adam Sychla

Faculty Mentor: Christin Burd

Faculty Mentor Department: Molecular Genetics

Research Abstract: The progression of benign tumor growth is often restricted by oncogene-induced senescence (OIS), a cellular state of irreversible cell growth. It is known that this process frequently involves the p16 tumor suppressor pathway. Senescence is ultimately controlled by the accumulation of p16, but the intermediary steps which cause p16 transcriptional upregulation are unknown. Here, I employ a DamID assay to investigate how the INK/ARF locus, which encodes p16, is regulated during OIS. In DamID, an E. coli originating Dam methylase is fused to transcription factors. DNA brought in proximity to the Dam protein by the transcription factor is then methylated. Patterns are investigated by methylation-sensitive restriction enzyme digest and qPCR. I selected putative INK/ARF binding proteins using ChiP data from the UCSC Genome Browser. I then made three fusion constructs; Dam-CTCF, -TEAD3, and -SMAD3. Afterwards, I mapped the steady-state binding patterns for each of these constructs across the 90kb INK/ARF regulatory region. In this way, I quantified the usage of several known binding sites and identified novel transcription factor interactions. With this knowledge, we can now investigate how oncogene activation remodels transcription factor binding to engage and eventually subvert the tumor suppressive functions of the INK/ARF locus.
Research Abstract: Introduction/Background: Obesity is more closely associated with endometrial cancer than any other cancer in women. Further, the rapidly increasing incidence of endometrial cancer has paralleled the rising prevalence of obesity in the United States and many other countries. Preliminary work in our lab (using cell lines and patient-derived samples) has found that the pro-cancer protein STAT3 may be activated in obesity-associated endometrial cancer. We therefore sought to evaluate whether inhibiting STAT3 with HO-3867 and metformin could inhibit endometrial hyperplasia or carcinogenesis driven by a high-fat diet (HFD) in mice.

Methods: C57BL/6 mice were obtained and separated into two groups. The control group was fed control feed, and obesity group was fed a 40% HFD for 16 weeks. After 16 weeks, the HFD mice were split into 4 treatment groups: control HFD, metformin medicated water (200mg/kg), HO-3867 medicated feed (100ppm), and a combination of metformin + HO-3867. After 15 weeks of treatment, all mice were sacrificed while in estrous and tissue was collected. Samples were fixed for IHC and downstream transcriptome analysis.

Results: Highest mouse body weights were 2-3 times higher in the HFD vs. control group. Of note, the HFD group had significantly enlarged uterine size, while the HFD+Met group showed slight edema compared with the control group. The endometrial histology, examined using H&E staining, showed increased endometrial gland numbers in the HFD+control group than in the HFD+Met group. Increased gland size percent (diameter>50 µm) was also noticed in the HFD group as well as increased number of gland sizes in all other groups except HFD+Met. Further, IHC pictures reveal that HFD results in cystic and hyperplastic glands; which was reduced to hyperplastic non-physiological, noninvasive proliferation with morphologic pattern of glands in irregular shapes and varying sizes when treated with metformin/HO-3867 or both.

Conclusion: Sustained HFD promotes uterine hypertrophy and proliferation of endometrial gland tissue in mice. The combination of metformin and the STAT3 inhibitor HO-3867 reduced weight and inhibited the impact and spread of endometrial hyperplasia over time. Profiling at transcriptome and molecular levels is being carried out to further address the exact gene architecture associated with these effects.
Research Project Title: Optimization of 4LB5, an anti-NCL immune-agent for targeted cancer therapy

Student Presenter: Zachary Uzzel

Faculty Mentor: Valerio Embrione

Faculty Mentor Department: Cancer, Biology, and Genetics

Research Abstract: Nucleolin (NCL) is a multifunctional nucleolar protein. A few of the functions of NCL include regulation of mRNA translation, promoting maturation of specific microRNAs (miRs) associated with multiple human cancers, and the biogenesis of ribosomes. Under normal cellular conditions, NCL is not expressed on the cell surface, but becomes expressed on the cell surface of actively proliferating cancer cells. Nucleolin is a potential target for anti-neoplastic treatments because binding this protein can inhibit its function. Our lab developed 4LB5, a human-derived single-chain fragment variable (scFv) that binds to cell surface NCL. Currently, 4LB5 is difficult to produce as recombinant protein in a prokaryotic system. This project investigates new methods to optimize the production of 4LB5. One of the current problems with the production of 4LB5 is the solubility of the protein during extraction from bacteria, and its following purification. While producing 4LB5 in E. coli cells, the protein might be either localized in the bacteria’s inclusion bodies or become insoluble, due to unfavorable interactions with the extraction buffer. For this project, we tested two different versions of 4LB5 plasmid. The original 4LB5, cloned in pET22b plasmid, and a new 4LB5, in which the heavy and light chains of the fragment variable have been switched, and the amino acid sequence codon-optimized for E. coli expression. Each 4LB5 protein version was then extracted in different buffers from E. coli cells to increase the solubility, and increase the amount harvested for purification. In a different test set, additions of glycylglycine or ethanol were used during induction to increase the solubility of the target protein 4LB5 for extraction. We hypothesized that different conditions in the extraction protocol, such as different ionic conditions or pH, would allow for the highest amount of protein to be purified between the different testing conditions. Standardizing the 4LB5 production protocol will aid in the development of a new treatment for cancer patients and be helpful for further investigation into the biology of NCL.
Research Project Title: A model for pediatric specific lymphoma identifies prognostic genes in cancer survival

Student Presenter: Rieko Sotojima

Faculty Mentor: Jennie Rowell

Faculty Mentor Department: Nursing

Research Abstract: Introduction: In the United States, cancer is the 2nd leading cause of death in children. Nearly 16,000 children and adolescents are diagnosed, and about 2,000 die from the disease annually. While there is a substantial difference between pediatric cancers and adult cancers, the existing treatment regimens for pediatric cancers are modified from adult therapies. Approximately 90% of childhood cancer patients experience a lot or a great deal of suffering from side effects of treatments that are non-specific. Yet, identifying more specific treatment options through genetic markers has been problematic, as overall childhood cancers are rare and sample sizes are small. In order to uniquely study the pediatric cancer, we utilized pet dogs, the most human-relevant cancer animal model.

Methods: Using chemotherapy naive tumor samples collected from 71 dogs diagnosed with aggressive lymphomas, we first analyzed gene expression using the Affymetrix Genechip Canine Genome 2.0 array. Additionally, we performed whole genome methylation analysis (MeDIP) on a subset of 6 dogs. Data was then normalized and analyzed using a genomics statistical suite (SAS). We further validated our expression results in an online publicly available database of 91 pediatric lymphoma tumors with survival data.

Results: After selecting significant transcripts (fold-change $>3$ and $p<0.001$) in subset of dogs, it was correlated with survival time. We identified 6 prognostic genes that were differentially expressed and significantly associated with cancer survival. We also identified 633 differentially methylated first exons of genes ($p<0.01$) using methylation analysis. 1 gene was identified when overlapping both the expression and methylation analysis. The expression of this gene was significantly associated with survival in pediatric lymphoma ($p=0.013$).

Conclusions: This study is one of the first to provide an alternative model for and genetic understanding of the aggressive lymphomas in children. Focusing on the molecular properties of pediatric cancer will provide clinical utility.
Research Project Title: Acute myeloid leukemia: Distinguishing long non-coding RNA DANCR in leukemic stem cells

Student Presenter: Allison Walker

Faculty Mentor: Adrienne Dorrance

Faculty Mentor Department: Hematology/Oncology - Comprehensive Cancer Center

Research Abstract: Acute myeloid leukemia (AML) is a clonal, neoplastic disease comprised of bulk blasts and leukemia stem cells (LSCs). LSCs are thought to be responsible for disease initiation and maintenance and are resistant to standard therapies leading to relapse.

Long non-coding RNAs (lncRNA) are 200 nucleotides or longer and function by gene regulation and imprinting, but are not translated into proteins. However, a role for lncRNAs in regulating LSCs has not yet been identified.

This project describes for the first time the role of the lncRNA, DANCR, in LSC function. First, expression was determined using Real-Time PCR (qRT-PCR) in AML patients’ and healthy donors’ bone marrow (BM). DANCR expression varied between patients but was on average elevated compared to healthy controls (p<0.01). Using Long Term Culture Initiating Cells (LTC-IC) assays. It was determined that DANCR expression was significantly higher in AML-LSC enriched populations (n=4, p<0.01). A transferrin-conjugated anionic lipopolyplex nanoparticle (NP) loaded with a siRNA against DANCR or scramble control was performed in CD34+ enriched AML cells. Twenty-four and 48 hours, DANCR expression significantly decreased compared to a scramble control. To determine the role of DANCR in LSC self-renewal, Colony Forming Unit (CFU) and sequential re-plating assays were performed after DANCR knockdown (n=3 patients). After re-plating, we found significantly fewer colonies compared to scramble control (p=0.03, average decrease≈38.9%). Using membrane labeling retention assays, we found that CD34+ patient samples treated with Tf-NP-siDANCR had significant decreases in the number of quiescent CTVmax/CD34+ cells (P<0.05) compared to Tf-NP-siSCR controls.

In vivo we found that mice treated with NP, against DANCR (CD45.2-NP-siDANCR) or CD45.2-NP-siSCR. BM was harvested from treated mice and transplanted into BoyJ recipient mice. Secondary transplants were performed to test the engraftment ability of LSCs, a key feature of stem cells. DANCR knockdown significantly decreased engraftment of transplanted cells and consequently increased overall survival (P<0.001).

Overall, our data is the first to demonstrate a functional role for the lncRNA, DANCR, in LSCs and establish a novel strategy to target LSC for patients with AML.
Research Project Title: Characterization of L-plastin's Bundling Mechanic

Student Presenter: Jonathan Wright

Faculty Mentor: Dmitri Kudryashov

Faculty Mentor Department: Chemistry and Biochemistry

Research Abstract: The actin cytoskeleton, a vital component of the eukaryotic cell, is composed of helical actin filament polymers whose organization is controlled by numerous partners. Plastins are a family of conserved actin binding proteins which bundle filamentous-actin. There are three tissue specific isoforms of plastin expressed in humans: I-plastin in intestines and kidneys, T-plastin in solid tissues, and L-plastin in hematopoietic cells. Importantly, L-plastin is ectopically expressed in multiple epithelial cancers, contributing to their metastatic behavior. Plastins possess tandem actin binding domains (ABDs) and an N-terminal regulatory domain. Each ABD binds a separate filament to create a crosslinked bundle, while the EF-hands regulatory domain deactivates ABD2 binding in a Ca2+ dependent manner. Interestingly, in S. cerevisiae, a lethal phenotype of several nonfunctional actin mutants can be rescued by mutations of a yeast plastin homolog (fimbrin) via an unknown mechanism. This study is focused on elucidating a mechanism of regulation of human plastins. To do so, we reproduced three of the rescuing fimbrin mutations (WEL/CYP), all of which reside in ABD1, in human L-plastin and analyzed their properties in vitro via differential co-sedimentation with F-actin. We found that the WELCYP construct possessed a bundling efficiency far greater than wildtype L-plastin, suggesting a relieved inhibition of ABD2 by ABD1. Furthermore, a full-length construct of L-plastin with an inhibited ABD2 actin binding interface could overcome abolished bundling by introducing the WELCYP mutations into the construct. This supports that the residue substitutions of WELCYP interrupt ABD1’s allosteric regulation over ABD2, allowing ABD2 to interact through a larger interface, potentially by an additional actin binding site. ABD1’s regulation over ABD2 poses a novel mechanism for plastin bundling and suggests additional plastin functionality. Dysregulation spearheads cancer’s potent impact, and L-plastin’s influence in metastasis could manifest through dysregulation of ABD2’s activity through a yet unknown mechanism.
Research Project Title: Regulation and targeting of nucleolin in skin cancer

Student Presenter: Ashley Braddom

Faculty Mentor: Dario Palmieri

Faculty Mentor Department: Cancer Biology and Genetics

Research Abstract: Nucleolin (NCL) is an abundant nucleocytoplasmic protein found overexpressed in cancerous cells compared to normal tissues. NCL is localized on the cell surface of cancer cells (but not on their normal counterparts), where its altered expression leads to oncogenic effects, such as the stabilization of AKT and Bcl-2 mRNAs. NCL is also involved in the regulation of the biogenesis of specific oncogenic microRNAs, small non-coding RNA molecules involved in post-transcriptional regulation.

Targeting NCL has shown promise as a potential cancer therapy, and to this end, we developed a single chain variable fragment, called 4LB5, which binds the NCL RNA binding domains with high affinity. This study aims to validate 4LB5 as a potential compound for skin cancer treatment and provide further evidence in support of NCL targeting as an approach for cancer treatment. To do this, we defined a pathway leading from DNA damage to the altered cellular processes that cause cancer, via changes in the expression of NCL. Direct targeting of NCL by miR-203 was demonstrated through luciferase assays and miR-203 transfections. To investigate the regulation of miR-203 by p53 in response to DNA damage, we exposed skin cancer cell lines to UV-irradiation. Western blots confirmed the up-regulation of miR-203 in response to increased p53. We postulate that in cells with mutated p53, expression of miR-203 is impaired leading to excessive NCL production. By treating skin cancer cells with 4LB5, we hypothesized that we could reduce cellular proliferation by counteracting the upregulation of NCL. Cell surface binding of 4LB5 to NCL in melanoma cell lines was demonstrated through ELISA while a decrease in cellular proliferation was observed through alamarBlue and colony assay. We demonstrated through Real-Time PCR that the effects of 4LB5 are achieved, at least in part, through reductions of oncogenic NCL-dependent miRNAs. Western blot confirmed that down-regulation of these miRNAs results in an up-regulation of the tumor suppressor PTEN and a decrease in activated AKT. These findings provide a possible mechanism of NCL upregulation in cancer and support 4LB5 as a potential tool for the treatment of different types of skin cancers.
Research Project Title: Are you tanning your colon? The role of cutaneous UVB exposure in colon cancer development

Student Presenter: Anna Callahan

Faculty Mentor: Tania Oberyszyn

Faculty Mentor Department: Pathology

Research Abstract: Keratinocyte Carcinomas (KC), including Basal Cell (BCC) and Squamous Cell Carcinoma (SCC), are the most common types of human cancers, developed primarily by ultraviolet light-B (UVB) exposure. Recent evidence has shown that patients with KCs are up to 130% more likely to develop second primary cancers, such as colon cancer. These studies suggest that UV light exposure of the skin may have tumor promoting effects on internal organs in addition to its cutaneous effects. To test this, we recently developed a mouse model in which UVB-induced cutaneous SCC and sporadic colorectal cancer develop in the same mouse. In the current study, we wanted to examine the effects of cutaneous UVB exposure on colon tumor development. We divided mice into the following eight treatment groups to isolate the effects of AOM and DSS in combination with UVB: 1) PBS+Water/No UVB 2) PBS+DSS/No UVB 3) AOM+Water/No UVB 4) AOM+DSS/No UVB 5) PBS+Water/UVB 6) PBS+DSS/UVB 7) AOM+Water/UVB 8) AOM+DSS/UVB. We hypothesized that cutaneous UVB exposure would alter tumor development, inflammation, and gene expression in the colon. Mice that were treated with AOM+DSS with and without UVB exposure developed similar numbers of grossly apparent colon tumors. Interestingly, mice in the AOM+Water/No UVB group did not develop colon tumors whereas mice in the AOM+Water/UVB did. This data supports our hypothesis that cutaneous UVB exposure affects the colon microenvironment leading to enhanced colon tumor development. To determine the exact effects of UVB exposure on the colons of mice exposed to AOM, DSS, or the combination, we are currently examining histological grade, changes in inflammation and performing transcriptome analysis in colon tissues isolated from these mice. The results of these studies will shed light on the mechanism by which chronic cutaneous UVB exposure alters the colon and the development of colorectal cancer.
Research Project Title: Targeting FACT to radiosensitize glioblastoma cancer stem cells

Student Presenter: Amanda Deighen

Faculty Mentor: Monica Venere

Faculty Mentor Department: Radiation Oncology

Research Abstract: The prognosis for glioblastoma (GBM) is particularly bleak with recurrence nearly universal. Research from our laboratory and others has shown a subpopulation of cells within these tumors, called cancer stem-like cells (CSCs), likely contribute to recurrence due to chemo- and radio-resistant nature. Recently, we identified the facilitates chromatin transcription (FACT) complex as one crucial factor involved in the maintenance of CSCs. FACT is a histone chaperone that disassembles and reassembles nucleosomes to facilitate RNA polymerase II (Pol II)-mediated transcription and elongation. Small molecule inhibitors that impact FACT function, curaxins, have been developed and are currently in clinical trials. Preliminary data from our laboratory indicates that FACT inhibition by curaxin-137 leads to the phosphorylation of H2A.X at S139 (H2A.X), an indicator of DNA damage, as well as a significant decrease in CSC viability. These findings have prompted recurrent GBM patients to be added to a phase 1 clinical trial involving curaxin-137. However, the role of FACT in the DNA damage response (DDR) and radioresistance phenotype of CSCs remains unexplored. We hypothesize that FACT inhibition via curaxin-137 in conjunction with irradiation will significantly limit the ability of the DDR to identify and repair damaged DNA leading to a reduction in CSCs radioresistance, and ultimately reduction in tumorigenesis. In exploration of this hypothesis, initial data has indicated a lack of resolved DNA damage via presence of both 53BP1 and H2A.X foci through immunofluorescence following combination treatment of curaxin-137 and irradiation. Furthermore, radiation clonogenic assays indicated decreased clonal survival in samples treated with curaxin-137 and radiation. Further research of FACT inhibition via curaxin-137 in conjunction with irradiation will be performed to elucidate the mechanistic role of FACT in GBM CSC radioresistance. We will also perform preclinical survival assays in mouse models to further validate this combinatorial approach as a treatment for GBM.
Research Project Title: Canonical and variant androgen receptor modulation as a hepatocellular carcinoma therapy

Student Presenter: Riley Mullins

Faculty Mentor: Christopher Coss

Faculty Mentor Department: Molecular Carcinogenesis and Chemoprevention

Research Abstract: Introduction:

Hepatocellular carcinoma (HCC) is the dominant form of primary liver cancer, causes the second most cancer-related deaths worldwide, and has the fastest increasing mortality rate of all cancers. Physicians have only three drug choices, each extending survival by less than three months on average, to treat advanced HCC patients. There is an urgent need for improved HCC therapies. It is thought that androgen receptors (AR-FL), androgen-dependent transcription factors that regulate gene expression, drive HCC. However, antiandrogen therapies that inhibit AR-FL proved ineffective in treating advanced HCC. In addition to AR-FL, there are androgen receptor splice variants (AR-SVs), which are constitutively-active, truncated forms of AR-FL that lack the region to which androgens and antiandrogens must bind to exert an effect.

Hypothesis: AR-SVs, not AR-FL, promote HCC cellular processes.

Methods:

In vitro HCC cell lines were treated with antiandrogens that inhibit AR-FL and AR-SVs or inhibit only AR-FL in the presence or absence of a synthetic androgen, which activates AR-FL. Following treatment, cell number was assessed using CCK-8 reagent. Cell cycle and cell viability were determined by measuring DNA content using flow cytometry.

Results:

HCC cell growth was not affected by the antiandrogens that inhibit only AR-FL. However, inhibition of AR-FL and AR-SVs by the novel antiandrogens decreased HCC cell growth.

Conclusions:

AR-SVs may promote processes associated with growth in HCC cell lines. AR-FL does not appear to modulate HCC cell growth, and this finding aligned with the failure of previous antiandrogens to treat HCC. Because inhibition of AR-FL and AR-SVs showed effectiveness in reducing HCC cell growth, these findings support that AR-SVs may explain the failure of previous antiandrogens, which inhibited only AR-FL, in HCC treatment. Use of novel antiandrogens to inhibit AR-FL and AR-SVs may be a therapeutic strategy for treatment of AR-expressing HCC tumors. Future work will substantiate that AR-SVs are important in HCC cell growth and that novel drugs are capable of inhibiting AR-SVs.
Research Project Title: Transcription factor ETS1 is required for natural killer cell development and maintenance

Student Presenter: Jessica Waibl

Faculty Mentor: Natarajan Muthusamy

Faculty Mentor Department: Internal Medicine

Research Abstract: Natural killer (NK) cells are among the first responders in any illness and serve as sentinels for malignant cells in cancer. E26 avian leukemia oncogene 1 (ETS1) is a transcription factor that is developmentally restricted and found in adult immune tissues where it is critical for the development of lymphoid cells. Our laboratory has previously determined that ETS1 is a critical factor for NK cell development and function by generating an ETS1 global knockout mouse model where we saw defects in NK cell cytotoxic function and maturation. However, the ETS1 global knockout mouse model does not assess whether ETS1 functions in a NK cell extrinsic or intrinsic manner. To elucidate this, we have developed and present here a novel NK cell specific NKp46iCre mediated conditional deletion of ETS1 in a genetically engineered floxed ETS1 mouse model NKp46iCre-ETS1fl/fl. Using a comprehensive NK cell development panel for multi-color flow cytometry, a drastic reduction of total NK cells was demonstrated in bone marrow, spleen and blood in the NKp46-ETS1fl/fl(n=8) compared to the ETS1fl/fl (n=7) and the NKp46iCre (n=5) controls. Numbers of NKp46 deficient lymphoid cells (B cells) were not affected. We further found that splenic NK cells demonstrated a developmental block affecting their transition from immature to mature NK cells. Our findings not only confirm the intrinsic role of ETS1 in early NK cell development but also introduce a new role for ETS1 in the maintenance of the NK lineage as they mature to cytotoxic NK cells able to lyse infected cells. Current studies are ongoing to dissect the mechanism by which ETS1 affects NK cell development and function in the NKp46-ETS1fl/fl mice.
Research Project Title: Identifying an AHR-dependent tumor immunity program using patient-derived glioma organoids

Student Presenter: Rahil Desai

Faculty Mentor: Jaime Imitola

Faculty Mentor Department: Department of Neuroscience and Neurology

Research Abstract: Glioblastoma multiforme (GBM) remain the most lethal type of brain tumor worldwide. Accumulating evidence indicates that mouse models using patient-derived xenografts fail to faithfully recapitulate tumorigenesis in vivo, as the genetic evolution of the injected human tumor cells are altered. Instead, three-dimensional in vitro cultures of glioma stem cells (GSCs) propagated as organoids are emerging as an alternative platform to model human cancers. To date, it is unknown whether glioma organoids recapitulate mutational and transcriptional landscape of gliomas or can be used for screening new therapeutic targets. In this study, we developed patient-derived glioma organoids from glioma stem cells cultures, and then characterized the self-organization, tissue patterning, mutational load, and transcriptome compared to non-tumoral organoids and inducible pluripotent stem cell (iPSCs) organoids. Next, we screened for potential therapeutic vulnerabilities. In the search for molecular dependencies, we performed a genome-wide microarray analysis of glioblastoma organoids (GBMO), as compared to normal and non-tumorigenic neural stem cell-derived organoids. We found that GBMO are enriched for typical genes found in glioblastomas in vivo, and that gene expression of GBMO correlate to specific areas of tumor microarchitecture in vivo. Notably, we found an increase in innate immunity genes, as opposed to normal organoids, and identified the expression aryl hydrocarbon receptor (AHR) transcription factor as a targetable molecular program. We identified the expression of AHR in GSCs and demonstrated the increase of AHR genes during GSC differentiation, notably, we showed that genetic manipulation of AHR on GSC by siRNA reduces the self-renewal of GSC in vitro and in vivo leading to increased survival in mice transplanted with GSCs. After manipulating AHR in GBMO in vitro with treatment agonist (FICZ) and antagonist (CH22131), we observed a significant increase (agonist) and decrease (antagonist) in GBM organoid size. Gene expression analysis of treated GBMO show a differential gene expression of AHR targets and cancer genes, in addition to a decrease of genes associated with immunity and stemness in GBMO. Our results indicate that organoid modeling allows for the identification of molecular vulnerabilities in a personalized manner and novel tumor-specific immune program and suggests that AHR plays a role in tumor evolution in gliomagenesis.
Research Project Title: Breast cancer survivor’s depression and heart rate variability: risks for heightened pain sensitivity

Student Presenter: Raisa Amin

Faculty Mentor: Janice Kiecolt-Glaser

Faculty Mentor Department: Psychology; Psychiatry and Behavioral Health

Research Abstract: Previous research has indicated that 25-60% of breast cancer survivors experience pain, regardless of their cancer treatment and cancer stage. The consequences of chronic pain include increased risk of mortality, impairment of sleep and memory, unemployment and lower quality of life. Breast cancer survivors are four times more likely to have depression compared to healthy populations. While the link between pain and negative mood is well documented, the current study aims to fill the gap in the literature by investigating the effects of depression and low-heart rate variability (HRV) on pain sensitivity in breast cancer survivors. HRV is the beat-to-beat variability of the heart, a good index of one’s ability to regulate emotion in the face of a challenge such as pain. It was predicted that female breast cancer survivors who are diagnosed with depression who exhibit lower HRV will be more pain sensitive than those who are not diagnosed with depression and have higher HRV. In the ongoing parent study, breast cancer survivors stages I-IIIA (N=75) provided data on depression, HRV, and pain. Pain data were collected through questionnaires and a temperature based pain task; HRV data were collected through a heart rate monitor; and depression data were acquired through clinical interviews with the survivors. In our sample, 29.9% of the survivors had a diagnosis for MDD. Preliminary analysis showed that pain sensitivity in the survivors is not significantly associated with MDD or lower HRV (ps> 0.237) controlling for age, cancer stage and cancer treatment history. However, data from self-report questionnaires suggests a marginal yet non-significant correlation between depressed mood and pain (r= 0.254, p= 0.052). A better understanding of the association between depression, HRV and pain sensitivity might ultimately help identify which cancer survivors are at a higher risk for experiencing chronic pain and its consequences.
Research Project Title: Are black women more likely than white women to use religion as a source of support when dealing with high breast cancer risk?

Student Presenter: Melissa Angeli Reyes

Faculty Mentor: Tasleem Padamsee

Faculty Mentor Department: Public Health

Research Abstract: Background:

Increasing research has shown how effective social support, including religious support, can be for health outcomes in the United States. For example, sources of support increase individuals’ likelihood of engaging in preventive screening (Kinney et al, 2005). Studies have also found that Blacks are more likely to use religion as a source of social support than Whites. In this study, I explored the role of religion in how diverse women cope with cancer risk. I hypothesized that Black women were more likely than White women to mention religion as one of their sources of support in the process of cancer prevention.

Methods:

This qualitative analysis involved face-to-face interviews conducted by Dr. Tasleem Padamsee. The total number of respondents was 49: 29 White and 20 Black. The first stage of analysis in the parent study identified all paragraphs from the transcripts that were about the themes relating to religion: lifestyle prevention, perception of risk prevention, and support structures. I tracked occurrences of the following keywords in those paragraphs through an excel spreadsheet: faith, church, prayer, Lord, God, spirituality. I then summarized the respondents’ paragraphs mentioning the keywords, and categorized each respondents’ answer based on whether any keyword denoting religion was mentioned.

Results: During their interview about breast cancer prevention decisions, 30.6% of participants (15 out of 49) mentioned religion. 20.6% of White women (6 out of 29) mentioned religion. 45% of Black women (9 out of 20) mentioned religion.

Conclusion: Almost a third of participants in general mentioned religion. Religion therefore seems to play a role in coping with breast cancer risk for a substantial minority of women. A higher percentage of Black women than White women mentioned religion. This finding supports the initial hypothesis that Black women are more likely than White women to use religion as a source of support when coping with being at high risk of breast cancer.

Keywords: religion, high-risk breast cancer, women’s health, cancer prevention, health disparities
Research Project Title: Subjective and objective cancer-related cognitive impairment in chronic lymphocytic leukemia

Student Presenter: Marcia Burns

Faculty Mentor: Barbara Andersen

Faculty Mentor Department: Psychology

Research Abstract: Introduction: The goal of this study is to further research on cognitive effects of chemotherapy, specifically in CLL patients. Chronic lymphocytic leukemia (CLL), the most common adult leukemia, is a heterogeneous diagnosis resulting from an abnormal accumulation of malignant lymphocytes. There is no cure for CLL as treatments only result in temporary remissions. Patients are at risk for potentiating adverse side effects of repeated treatment such as cancer-related cognitive impairment. These impairments include subjective, patient-reported cognitive complaints during and after treatment along with objective cognitive impairment on neuropsychological tests.

Method: Data will be analyzed from a phase II clinical trial of CLL patients undergoing combination chemotherapy (Obinutuzumab, Venetoclax, and Ibrutinib). There are two patient groups: Relapse/Refractory (R/R, at least one prior treatment, N=21) and Treatment Naïve (TN, no prior treatment, N=23). Patients will be administered the Patient-Reported Outcomes Measurement Information System: Cognitive Function (PROMIS-CF), Controlled Oral Word Association Test (COWAT), and the Rey Auditory Verbal Learning Test (AVLT) upon pretreatment, six months, and twelve months of treatment.

Results: Prospective results will determine:

1) R/R patients will experience more cognitive impairment at pretreatment assessment than TN patients.

2) Cognitive impairment will worsen from baseline assessment to twelve months across groups.

a) Exploratory analysis will test age, as a moderator, such that older age will result in more complaints and worse objective scores over the course of treatment as observed in previous cancer literature.

3) A group by time interaction such that R/R patients will have lower scores, more complaints, and show greater impairment with time compared to TN patients.

Conclusions: This study will increase information regarding cognitive dysfunction, a prevalent stressor in cancer patients’ lives that can impair daily life and autonomy. Specifically, in a vulnerable patient population, such as CLL, which has not been definitively studied in cancer control research. Furthermore, this study will increase understanding of cancer-related cognitive impairment, especially in regard to novel chemotherapeutic agents, and may result in improved care and increased services for current and future patients.
Research Project Title: Examining adherence to an online cognitive behavioral therapy for cancer patients with major depressive disorder

Student Presenter: Mary Carson

Faculty Mentor: Barbara Andersen

Faculty Mentor Department: Psychology

Research Abstract: Major depressive disorder (MDD) is the most prevalent psychiatric disorder among cancer patients and is associated with significant functional impairment including poorer physical health and poorer quality of life. There are currently no specific treatments for cancer patients with MDD and only a handful of studies have successfully adapted cognitive behavioral therapy (CBT) for the cancer population. CBT is the most empirically supported treatment for MDD and has been proven to be both efficacious and effective. However, traditional face-to-face CBT may not be ideal for patients with cancer, as many are already burdened by numerous appointments, fatigue, and/or negative associations with clinical settings. A convenient, more accessible, and self-paced treatment such as computerized cognitive behavioral therapy (cCBT), may be a suitable alternative. Although cCBT has been shown to be effective in treating depression, treatment adherence has been a major limitation. As such, it is unclear what factors influence cCBT dropout in cancer populations. Thus, the proposed study will examine treatment adherence and factors that contribute to dropout in a cCBT for cancer patients. This study’s aims are as follows: (1) To perform exploratory qualitative analysis examining reasons for not completing treatment. (2) To determine if these reasons are cancer specific. Semi-structured interviews over the phone will be conducted with participants who did not complete the 8 total weekly sessions of an ongoing randomized, waitlist controlled trial of cCBT for the treatment of MDD in cancer patients (n=28). Participants’ adherence issues related to program content, accessibility, health concerns, and mood will be assessed. Results are forthcoming. It is hypothesized that: (1) factors contributing to dropout will be varied but focus on program content (2) reasons for dropout will not be cancer related. Online interventions hold promise as a treatment modality for cancer patients. Identifying barriers to treatment adherence could help inform and optimize future online treatments for cancer patients.
Research Project Title: Predictors of sexual activity in breast and gynecologic cancer patients during adjuvant chemotherapy

Student Presenter: Katherine Conroy

Faculty Mentor: Kristen Carpenter

Faculty Mentor Department: Psychiatry

Research Abstract: Predictors of sexual activity in breast and gynecologic cancer patients during adjuvant chemotherapy

Katherine Conroy and Kristen M. Carpenter PhD

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Following treatment, approximately 30-50% of breast and gynecologic cancer survivors become sexually inactive (Grimm et al., 2015; Marino, Saunders, & Hickey, 2017; Raggio, Butryn, Arigo, Mikorski, & Palmer, 2014). Studies of long-term survivors suggest that many women may never resume sexual activity (Grimm et al., 2015; Lee et al., 2015). Sexual inactivity in survivors of cancer is associated with negative outcomes including feelings of unattractiveness, feeling unlike a woman, and depressive symptoms (Marino et al., 2017), while in studies of the general population, sexual inactivity in partnered people is associated with lower happiness in their relationship, less social support, and poorer health (Donnelly, 1993; Hess et al., 2009; Karraker & DeLamater, 2013). Despite a number of studies of sexual activity and function in survivors of cancer, little is known about the natural course of resumption of sexual activity following cancer diagnosis and treatment. While many women may take a break from sexual activity during treatment due to acute side effects, a subset of women remain sexually active during the course of chemotherapy. An understanding of these positive outcomes may shed light on the factors behind more negative outcomes. Data for this project come from an ongoing study of female patients (N=80) receiving adjuvant chemotherapy as treatment for breast or gynecologic cancer at the Ohio State University Comprehensive Cancer Center. Participants filled out questionnaires prior to and throughout chemotherapy treatment including assessments of sexual outcomes, physical and psychological health outcomes, and sociodemographics. Data from baseline (prior to first chemotherapy infusion) assessment and from brief assessments during each chemotherapy infusion thereafter are currently being analyzed to reveal possible physical, psychosocial, and demographic correlates and predictors of sexual activity. Results from this study may aid in understanding the experience of sexual issues during chemotherapy and consequentially encourage
Research Project Title: Effects of optimism on coping strategies and health outcomes in women with gynecologic and breast cancer undergoing chemotherapy

Student Presenter: Kendall Fugate-Laus

Faculty Mentor: Kristen Carpenter

Faculty Mentor Department: Psychiatry

Research Abstract: Approximately 40% of new cancer diagnoses in women are gynecologic or breast cancers (Siegel, Miller, & Jemal, 2015) which require multimodal treatment. During chemotherapy, patients are vulnerable to an onset of adverse side effects. Personality traits such as optimism may affect the coping strategies patients use to influence these adverse health outcomes (Scheier, Weintraub, & Carver, 1986; Scheier, Carver, & Bridges 1994; Segerstrom, CastaÑeda, & Spencer 2003; de Moor et al., 2006; Carver and Connor-Smith, 2010; Segerstrom and Sephton, 2010). While optimism predicts more active, approach-oriented coping strategies (Carver et al., 1993; Segerstrom et al., 2003, Carver et al., 2010) which can promote beneficial outcomes, previous research also suggests that those high in optimism may be at a higher risk for stress and impaired immune functioning if they are unsuccessful in their attempts to cope with a demanding stressor (Segerstrom, 2001). However, no researchers to our knowledge have examined how specific coping strategies affect health outcomes on a daily basis in those undergoing chemotherapy. This is a particularly important timeframe to examine given the unique and difficult challenges patients face adjusting to chemotherapy treatment. In this study, we sought to explore the daily associations between coping strategies and health outcomes among chemo-naÀ‘ve women undergoing chemotherapy for gynecologic or breast cancers. Specifically, we aimed to determine which coping strategies were more effective for women higher and lower in optimism, respectively, and whether optimism was related to the use of more strategies overall. Participants (N=80) completed an assessment prior to chemotherapy, during the first eight infusions, and following treatment that included measures of psychological and physical health. In addition, participants completed a one week diary log between the third and fourth chemotherapy infusion assessing toxicities (i.e. fatigue, nausea, distress), strategies used to cope (e.g. rest, distracting yourself, exercise), and perceived effectiveness of attempted coping strategies in the management of daily symptoms. Collected data are currently being analyzed and are part of an ongoing study. Findings from this study may aid in understanding individual experiences during chemotherapy and point towards the clinical value of encouraging certain coping strategies throughout treatment.
Research Project Title: A comparison of weight status differences in meeting AICR recommendations for dietary intake of plant and animal foods

Student Presenter: Madisyn Good

Faculty Mentor: Chris Taylor

Faculty Mentor Department: Medical Dietetics

Research Abstract: Introduction:

One in three cancers is linked to body weight, diet, and physical activity. In 2011, the American Institute for Cancer Research (AICR) published cancer prevention recommendations, which emphasized a plant-based diet. The purpose of this study is to determine the extent to which Americans meet the AICR’s recommendations regarding plant foods and animal foods, and how obesity plays a role in this relationship.

Methods:

Dietary intake data from the 2007-2014 National Health and Nutrition Examination Survey (NHANES) was used to assess the concordance of intakes with AICR’s plant-based and animal-based recommendations. Dietary intakes were assessed using a multiple pass 24-hour recall and were categorized to meet fruit, vegetable, whole grain and red meat recommendations. Weight status was classified from measured body mass index as normal weight (18.5-24.9), overweight (25-29.9) and obese (>=30). Differences in fruits, vegetables, whole grains and red meat intakes, as well as the proportion meeting AICR recommendations, were compared across weight status.

Results:

Only 36.4% of normal weight individuals, 37.2% of overweight individuals, and 31.0% of obese individuals met the recommendation of at least 2.5 cups of fruits and vegetables daily. There was also a significant difference (P <0.0001) in whole grain consumption between obese individuals compared to normal weight and overweight individuals. About one-third of normal weight individuals, 28.8% of overweight individuals, and 25.7% of obese individuals consumed at least 1 oz. of whole grain. In comparison to the AICR’s public health goal recommendation for animal foods, 50.0% of normal weight, 44.4% of overweight, and 42.7% of obese individuals consumed less than 1.57 oz. per day (11 oz. divided by 7 days), with a significant difference between normal weight compared to overweight and obese individuals.

Conclusions:

Overall, US adults are not meeting the AICR’s recommendations for cancer prevention; however, obese individuals are doing significantly worse. Excess body fat as well as poor dietary intake could put obese individuals at a greater risk for cancer. Dietary intake, specifically in regard to plant and animal foods, is a lifestyle factor that should be addressed by clinicians in the prevention of this disease.
Research Project Title: Sleep disturbance in older adult patients with advanced cancer

Student Presenter: Abigail Frooman

Faculty Mentor: Judith Tate

Faculty Mentor Department: Nursing

Research Abstract: As cancer detection and treatment improves, people with cancer diagnoses are living longer. Cancer as a chronic illness has led to new demands to manage the side effects of the disease (McCorkle et al., 2011). In cancer patients, one of the most common symptoms is sleep disturbance and fatigue. Sleep is critical for providing restorative, protective, and energy-conserving functions that are imperative for human life (Matthews et al., 2016). The purpose of this study is to be able to describe sleep trajectories and symptom burden for hospitalized patients with advanced cancer over time. This study is a secondary analysis of a multi-site, prospective, observational study of palliative care consults in hospitalized patients with advanced cancer. Participants in this study included patients 18 years or older admitted to an acute care unit with advanced cancer that did not fit any of the exclusion criteria. The Condensed Memorial Symptom Assessment Scale (CMSAS) was used to assess the presence, frequency, and amount of distress associated with sleep disturbances in study participants. Data analysis is currently incomplete, but will have results and conclusions by time of the Denman.
Research Project Title: The effect of depression and cancer treatment on physical fitness among breast cancer survivors.

Student Presenter: Siobhan McDermott

Faculty Mentor: Janice Kiecolt-Glaser

Faculty Mentor Department: Psychology

Research Abstract: Depression presents a prevalent problem to breast cancer patients and is associated with decreased physical activity during a period when exercise appears to ensure promising recurrence and mortality rates. However, it remains unknown whether depressive symptoms are related to decreases in objectively-measured physical fitness throughout survivorship. The current study assessed whether changes in depressive symptoms from pre- to post-adjuvant treatment (i.e., chemotherapy or radiation) corresponded with changes in physical fitness. Participants were breast cancer patients stages I-IIIA (N=20) who enrolled in a parent study investigating the effect of cancer treatment on heart disease risk factors. Women completed two visits, one prior to starting adjuvant therapy and a follow-up visit approximately 2 years after treatment ended. During each visit, participants completed a self-report measure assessing depressive symptoms (CES-D). A cycle ergometer exercise test assessed individuals’ VO2 max, their maximum aerobic oxygen consumption, as a measure of fitness. Exercise test duration was used as an additional measure of performance. Across visits, women reported average increases in depressive symptoms (M = 0.17, SD = 9.48), and decreases in physical fitness (M = -1.61, SD = 3.41). Changes in depressive symptoms from pre- to post-adjuvant therapy were not significantly associated with changes in physical fitness (b = 0.02, SE = 0.12, p = .848) or changes in test duration (b = -0.00, SE = 0.03, p = .977) controlling for adjuvant treatment type, BMI, education, race, surgery type, and cancer stage at visit 2. Although the current study found no association between changes in depressive symptoms and physical fitness from pre- to post- adjuvant treatment, this may be due in part to the small sample size available at the time of data analysis. Future, planned analyses with a larger sample will investigate this link further, and determine whether treatment type received (e.g., chemo, radiation, hormone, or surgery alone) moderates the relationship between depressive symptoms and fitness. A better understanding of the relationships between depression, cancer treatment, and fitness may ultimately identify patients most at risk for physical fitness declines across survivorship, and who would benefit most from interventions.
Research Project Title: Screening older women with breast cancer for depression and poor sleep

Student Presenter: Keya Patel

Faculty Mentor: Janine Overcash

Faculty Mentor Department: Nursing

Research Abstract: Background: Depression rates nearly double for older adults diagnosed with breast cancer. Depression is a serious problem which affects many aspects of life, including sleep. The symptom cluster of depression and sleep alteration should be managed as part of the breast cancer survivorship care plan. The purpose of this study is to describe the incidence and the relationship between depression and sleep alterations in older breast cancer patients.

Method: This prospective study took place at the James Cancer Center, Comprehensive Breast Center and includes people aged 70 years and over. We invited participants to consent who were diagnosed with breast cancer and receiving any type of cancer treatment (surgical, hormonal, or chemotherapeutic). Participants were asked to complete a Geriatric Depression Scale and a Pittsburgh Sleep Quality Index. Demographic characteristics were analyzed using descriptive statistics to determine the relationship between depression and sleep alternations.

Results: The mean age (N=60) was 78 years (range 69-93). Most (66%) were diagnosed with infiltrating ductal carcinoma and underwent lumpectomy (58%). Mean scores on the GDS were 2.02 (negative screen for depression). The mean score on the PSQI was 4.7 which does not indicate sleep problems. However, 38.9% of people screened positive for sleep difficulty on the PSQI (>=5). Sleep and depression were correlated (r=.52 p=0.0).

Conclusion: Sleep alterations and depression are common symptoms which are related. Understanding that both symptoms often occur together can inspire the development of an appropriate nursing care plan. A reasonable amount of older cancer patients experience sleep problems and it is important to assess for sleep alterations upon each clinic visit. Nurses must educate patients and family to report problems with depression and sleep and to provide assurance that many people experience these types of symptoms.
Research Project Title: A qualitative study of the experiences of women who test negatively for mutations, but are at high risk for breast cancer: Analysis of an online support group

Student Presenter: Emma Wauschek

Faculty Mentor: Tasleem Padamsee

Faculty Mentor Department: Health Services Management & Policy, College of Public Health

Research Abstract: Background: Little information exists about support received by women who test negatively for mutations, but are at high risk for breast cancer. One potential source is the "Mutation Negative" Forum on Facing Our Risk of Cancer Empowered, a website for women seeking support and information about their risk. Using this forum, I investigated: types of support women ask for and receive (informational, emotional, affirmational), issues they face, who they get support from (mutation positive or negative women), and how likely they are to receive support compared to women who are positive for mutations.

Methods: Analyzing all thirteen support requests made over two years on the "Mutation Negative" Forum, I determined type of support, main issue, and genetic profile of posters. First, I calculated the percentage of mutation negative women who received some sort of support (at least one responding post). After, I calculated the percentage of respondents who were either positive or negative for any mutation. Analyzing the 20 support seekers on the separate "Positive for Other Mutations" Forum, I calculated the percentage who receive support. Lastly, I compared the likelihood of receiving support between both forums.

Results: 10 mutation negative women sought informational support, and 3 emotional. Most issues involved concerns about surgery, insurance, and hearing from other women with similar issues. 81% (13) of the responses provided informational support, and 19% (3) provided emotional support. No responses provided affirmational support. Of the 16 individuals who commented, 50% (8) were negative for mutations, and only 6% (1) were positive; the rest (44%, 7) did not mention their genetic profile. Lastly, 62% (8) of the mutation negative women who started a thread received some sort of support, compared to 65% (13) women who posted in the "Positive for Other Mutations" Forum.

Conclusion: High risk but mutation negative women may have difficulty finding support. However, the majority of such women seeking support received responses from women in the same situation, and response rates were comparable to those for mutation positive women. These findings suggest that FORCE forums can be a potential source of support for mutation negative women.
Research Project Title: ASCO guidelines for anxiety and depression assessment and risk identification with chronic lymphocytic leukemia patients

Student Presenter: Abigail Robbertz

Faculty Mentor: Barbara Andersen

Faculty Mentor Department: Psychology

Research Abstract: Introduction: Psychological distress is common amongst cancer patients, with 13-40% and 10-30% experiencing symptoms of depression and anxiety, respectively. The American Society of Clinical Oncology (ASCO) has provided guidelines for screening, assessment, and treatment of anxiety and depressive disorders in cancer patients and has detailed risk factors for greater disorder severity. Patients with chronic lymphocytic leukemia (CLL) were screened and information on risk factors was obtained. This study sought to describe the anxiety and depression symptomology and its relationship with relevant risk factors in an understudied cancer population.

Methods: Patients diagnosed with CLL (N= 113) were assessed prior to start of targeted therapy. ASCO recommended measures of depressive (PHQ-9) and anxiety symptoms (GAD-7) were completed. Information on psychiatric disease characteristics and demographic risk factors were obtained. A multiple linear regression was used to predict depression and anxiety from select ASCO (income, gender and marital status) and additional risk factors (cancer-specific stress, negative life events, age and fatigue).

Results: At baseline, 29.3% of patients were experiencing symptoms of depression (18.6% mild, 6.2% moderate and 4.5% moderate to severe) and 26.8% were experiencing symptoms of anxiety (17% mild, 8% moderate and 1.8% moderate to severe). The results of the regression indicated cancer-specific stress, negative life events and fatigue explained 55% of the variance in depression scores ($R^2 = .553$, $F (3, 110) = 44.173$, $p < .000$) at baseline. Cancer-specific stress ($β = .138$, $p < .000$), negative life events ($β = 1.023$, $p = .012$), and fatigue ($β = .159$, $p < .000$) significantly predicted levels of depression. Additionally, negative life events and fatigue predicted 40% of the variance in anxiety scores ($R^2 = .399$, $F (2, 111) = 36.14$, $p < .000$) at baseline. Negative life events ($β = .193$, $p < .000$) and fatigue ($β = .080$, $p = .002$) significantly predicted levels of anxiety.

Discussion: Screening all cancer patients for distress is an important criterion to provide innovative treatment for cancer patients. Determining which factors are correlated with depression and anxiety will improve preventative measures and enable the use of supportive care for cancer patients with greatest risk.
Research Project Title: Factors that influence whether or not posts in breast cancer related message boards will receive responses

Student Presenter: Theresa Tran

Faculty Mentor: Tasleem Padamsee

Faculty Mentor Department: College of Public Health

Research Abstract: Background: Facing Our Risk of Cancer Empowered (FORCE) is a website that provides message boards for women with high risk of breast cancer to discuss questions with others who have similar concerns. This research aims to understand why certain posts receive responses while others receive none.

Methods: In the parent project, researchers qualitatively coded two years’ worth of “Main” forum threads into categories including type of support requested and whether women received that support. In this specific project, I separated threads by whether or not they received a response and conducted several coding stages. Of 110 “no response” posts (NRPs), I selected every other post for a sample of 55. Of 342 posts with at least one response (AORPs), I selected every 6th post for a comparison sample of 57. Then, I coded each for categories including type of support requested, number of views, number of paragraphs, tone, and inclusion of phrases denoting generality. I reviewed my coding multiple times to distinguish any differences between samples.

Results: Among the NRPs, 34 contained phrases denoting generality e.g. “any” or “anyone”. 36 AORPs also contained those phrases. However, NRPs were brief and open-ended. AORPs had multi-paragraphed and specific questions. Additionally, NRPs had lower numbers of views than AORPs. Furthermore, 51 of the NRPs requested strictly informational support and only 3 requested emotional support along with informational, while 30 AORPs requested only informational support and 23 requested a mixture of informational along with either emotional or affirmational support.

Discussion/Conclusion: My initial hypothesis was that vague posts received no responses due to the phenomenon “Diffusion of Responsibility”. This is the idea that the more people present, the less responsible someone feels for their actions. My results did not support this hypothesis. Posts that received responses contained emotional information, which may have made people feel more inclined to answer. Additionally, posts that received responses garnered more views than those that did not. Certain posts may have gone unanswered simply because people did not see them. Subsequent research should explore larger sample sizes, time-zones, and high-traffic times on the website.
Research Project Title: The association of clinical trial comprehension on the likelihood to enroll in a randomized clinical trial for cancer treatment

Student Presenter: Danielle Townsend

Faculty Mentor: Jessica Krok

Faculty Mentor Department: Health and Rehabilitation Sciences

Research Abstract: Introduction/Background: While it is generally understood that randomized clinical trials (CTs) are essential to cancer research, there is not much emphasis placed on the patient-level factors that influence decisions to enroll in a CT. Furthermore, patients are not always confident and knowledgeable about what is being asked of them when given the opportunity for cancer CT enrollment. A lack of understanding of the concepts of randomization and chance may alter a patient's willingness to enroll in a cancer CT. Thus, this study sought to understand the association of patient demographic factors, patient comprehension of CTs, randomization, chance, and CT enrollment.

Method: An online survey using Qualtrix was conducted to examine cancer CT enrollment among adult cancer survivors based on participants' knowledge of important cancer CT concepts, such as randomization and chance. Chi square, t-test, univariate, and multivariate analyses were conducted to study the effect of cancer CT comprehension on the enrollment of those patients who were offered the opportunity to enroll in a cancer CT.

Results: Of the 123 survey participants that were offered cancer CT enrollment, the majority were non-Hispanic white (71.5%), and female (67.5%), with an average age of 47 years. Results indicated that participants who were female (OR=5.14, 95% CI=1.17-22.71), and single or never married (OR=6.16, 95% CI=1.46-26.03) were significantly more likely to enroll in a cancer CT. However, the results for comprehension of cancer CTs, randomization, and chance and had varied effects (positive and negative) on cancer CT enrollment.

Conclusions: The varied effects of cancer CT comprehension on cancer CT enrollment suggest that chance and randomization, with respect to cancer CTs, are not well understood by cancer patients. Clinical professionals need to be aware of this comprehension uncertainty among patients in order to improve cancer CT introductory approaches, enhance cancer CT comprehension, and subsequent enrollment among cancer patients.
Research Project Title: The efficacy of pulsed electric field to reduce antimicrobial resistant bacteria in wastewater

Student Presenter: Amy Albers

Faculty Mentor: Thomas Wittum

Faculty Mentor Department: Veterinary Preventive Medicine

Research Abstract: Antimicrobial resistant bacteria are of concern in both human and veterinary medicine. Pulsed Electric Field uses an electric current to lyse bacterial cells and is currently used to reduce wastewater coliform counts in several wastewater treatment plants. Our objectives were to determine the efficacy of Pulsed Electric Field (PEF) as an intervention to be used in high risk environments to reduce the amount of viable carbapenemase-producing bacteria in raw influent before entering the wastewater treatment plant. Untreated influent samples were collected from a wastewater treatment plant serving Columbus, Ohio twice weekly for 24 weeks. The samples were strained to remove any large particles prior to treatment. A small aliquot of sample was assessed for conductivity, pH, and turbidity. After treatment with PEF, a 100 Âµl aliquot from both influent and treated samples was spreadplated onto both CHROMagar, and petrifilms to quantify the reduction of E. coli, coliforms, Pseudomonas sp., and Acinetobacter sp. The results indicate approximately a one log reduction of both coliforms and carbapenemase-producing bacteria following treatment. We observed an additional reduction of coliforms and carbapenemase-producing bacteria by using a longer treatment time. These results suggest the potential for PEF treatment to reduce the discharge of carbapenemase-producing bacteria from high risk environments such as hospital ICUs into wastewater flows and ultimately into the environment.
Research Project Title: Does feeding and reduced light mitigate elevated temperature stress in coral?

Student Presenter: John Armstrong

Faculty Mentor: Andréa Grottoli

Faculty Mentor Department: School of Earth Sciences

Research Abstract: Corals are living closer to their upper thermal tolerance limits due to increasing sea surface temperatures, a result of anthropogenic climate change. This alters the symbiotic relationship between the coral host and its endosymbiotic algae, causing coral bleaching, which decreases coral health and increases mortality. However, evidence suggests that increased heterotrophy and/or slight decreases in light levels may mitigate the deleterious effects of elevated temperature stress on corals. Despite this, it is unknown if these conditions could act synergistically to protect corals from elevated sea surface temperatures and provide a refuge.

To test this, three coral species, Stylophora pistillata, Turbinaria reniformis, and Pocillopora damicornis, were exposed to one of eight treatments of a fully factorial experimental design, including: ambient temperature (27Â°C), high temperature (31Â°C), optimal light (300 Î¼mol photons m-2 s-1), low light (150 Î¼mol photons m-2 s-1), unfed, and fed (with brine shrimp). CZAR, CHAR, and CTAR are percentile measurements of the relative contribution of carbon to coral daily metabolic demand met by photosynthesis, heterotrophy, and the total contribution, respectively. These values were calculated to evaluate the relationship between metabolic demand and environmental conditions.

All three coral species could not meet metabolic demand when unfed at elevated temperature, irrespective of light level, indicating that photosynthesis alone could not provide enough carbon to meet coral energy requirements under elevated temperature stress. However, fed T. reniformis were able to significantly increase CHAR at elevated temperature, enabling metabolic demand to be met under optimal light. Fed S. pistillata were also able to significantly increase CHAR at elevated temperature, irrespective of light, but were still unable to meet metabolic demand. Fed P. damicornis were unable to increase CHAR to aid in stress mitigation at elevated temperature, irrespective of light, and therefore were unable to meet metabolic demand as CZAR was also significantly depressed. Overall, our results suggest that increased heterotrophy may help to compensate for decreased photosynthesis in some coral species experiencing elevated temperature stress. However, slight decreases in light do not mitigate the deleterious effects of increased temperature stress.
Research Abstract: Taiwan is considered a High Standing Island (HSI) because its streams have their headwaters are at or above 1000 meters of elevation. Through the combination of high uplift rates, direct exposure to open ocean, and an average of four typhoons a year, Taiwan’s physical and chemical weathering rates are very high. Estimates indicate that globally up to 33% of total sediment transport to oceans can be linked to HSIs. The focus of this research project is to determine the source material for weathering on Taiwan in order to gain a better understanding of both chemical and physical weathering patterns at this particular geologic location. Studying weathering on HSIs is globally important because chemical weathering of silica minerals is a carbon sink over geologic time, exporting carbon dioxide from the atmosphere. I have performed petrographic analysis on bedrock samples from the Choshui River basin, the largest watershed in Taiwan. After cutting the rocks into thin sections, I used a petrographic microscope to identify the mineralogical makeup of the rocks. The region that the rocks were taken from is dominated by Miocene-Eocene aged meta-sedimentary rocks, and my findings match this description. Quartz is the dominant mineral in the Choshui River watershed bedrock, with phyllosilicates being second most abundant. It was apparent from looking at these rocks that hydrothermal alteration occurs frequently in this region, supported by the common alteration product of sericite and iron oxides/hydroxides. The evidence of hydrothermal alteration suggests that sources other than bedrock may have heavier influence on weathering patterns than previously predicted.
Research Project Title: Stress response of a common fish to changing urban steam temperatures

Student Presenter: Levon Bajakian

Faculty Mentor: Mažeika Sullivan

Faculty Mentor Department: SENR

Research Abstract: Urban streams often have higher average and more variable temperatures than forested streams. However, the effects of anthropogenically influenced water temperatures on fish condition are not well understood. We propose to quantify the impacts of urbanized stream temperatures on the physiological stress response of Creek Chubs. We will use growth rates and blood-glucose levels to measure stress responses in a 6-week laboratory experiment. The treatment group will be subjected to a diurnal temperature profile that simulates urban stream temperatures of Columbus, Ohio and the control group will be subjected to a constant 21 °C, the optimal growth temperature for Creek Chubs. Results from a preliminary trial (with the control group held at a constant 14°C) suggested that increased temperature variability was related to increased growth rates, but blood-glucose levels showed no significant changes. We anticipate that subjecting fish to a temperature regime that mimics an urban stream during summer, rather than spring, will likely prompt decreased growth rates and elevated blood-glucose levels. Relationships between urban temperature profiles and Creek Chub would indicate that less thermally tolerant species may be at high risk from shifting temperature regimes in urban streams.
Research Project Title: The use of magnetotactic bacteria to remove phosphorus from eutrophic conditions

Student Presenter: Ashlee Balcerzak

Faculty Mentor: Steven Lower

Faculty Mentor Department: Environment and Natural Resources, Earth Science

Research Abstract: Eutrophication or excess nutrients in rivers and lakes is a problem in the Midwest commonly caused by high levels of phosphorus in runoff from agricultural land. Magnetotactic bacteria (MTB), a magnetite-containing microorganism found in aquatic ecosystems, may contain intracellular inclusions of phosphorus. This study will test how effective MTB is at removing high concentrations of phosphorus from eutrophic conditions. The hypothesis for this project is that MTB will have some capability to remove phosphorus from their water environments, offering a microbiological solution in places where eutrophication occurs. Methods include growing the type strain of MTB, Magnetospirillum magneticum, AMB-1, in media spiked with concentrations of phosphorus at 0.01 mg/L, 0.025 mg/L, and 0.06 mg/L. These concentrations were selected to mimic, respectively, Canada’s target level of phosphorus for Lake Erie, the US Environmental Protection Agency’s target level of phosphorus in lakes, and the peak phosphorus levels found in the western Lake Erie basin in 2010. A colorimetric analysis was used to measure phosphorus in solution at different time points. A centrifuge was used to separate the cells from the media. Results indicate that when phosphorus-containing media is inoculated, concentrations of phosphorus decrease in the media after two days. Samples with higher concentrations of phosphorus experience more rapid decreases in solution phase phosphorus. Phosphorus was recovered from the cell pellet, indicating phosphorus was removed and stored in AMB-1 cells. Results indicate this technology may hold some promise for limiting eutrophic conditions such as those that occur in northwest Ohio and Lake Erie.
Research Project Title: Determination of oxygen fugacity using olivine-melt equilibrium: implications for the redox states of volcanic arc basalt mantle source regions

Student Presenter: Seth Bryson

Faculty Mentor: Michael Barton

Faculty Mentor Department: Earth Science

Research Abstract: In order to connect volcanic rocks to their mantle sources, it is essential to consider redox equilibria and their dependence on temperature, pressure, chemical composition, and oxygen fugacity. Oxygen fugacity (fO2) is an intensive variable that strongly affects the behavior of those elements in magmas that are sensitive to changes in redox state, such as Fe, and therefore Mg-Fe silicates, such as olivine. Since fO2 plays an important role in fractional crystallization, in principle it is possible to estimate fO2 from analyses of olivine in equilibrium with the melt. This research describes a new method based on this principle called the Olivine-Melt Equilibrium Method. The Fe3+ and Fe2+ contents of melt in equilibrium with olivine are calculated from the relationship of Gee and Sack (1988) that describes the partitioning of Mg and Fe2+ between olivine and melt. The Fe3+ and Fe2+ contents of the melt are then used to calculate the fO2 at which olivine and melt are in equilibrium using the model of Kress and Carmichael (1991) for the relationship between Fe3+/Fe2+, fO2, T, P, and melt composition. We have calculated oxygen fugacities from published analyses of coexisting glass and olivine pairs in volcanic arc settings. We obtain ΔFMO = +1.03 ± 0.52 for olivine-melt pairs from Sunda arc basalts and ΔFMO = +1.50 ± 0.70 for olivine-melt pairs from Mariana arc basalts. The results for these arcs are within the range of those obtained using other methods to constrain the oxygen fugacity’s of volcanic arc basalts. The latter have higher water contents than mid-ocean ridge basalts, and are derived from compositionally distinct (hydrated) mantle source regions. The results obtained in this study indicate that these source regions are also characterized by higher redox states than those of mid ocean ridge basalts, presumably reflecting recycling of crust into the mantle via subduction processes.
Research Project Title: Estimating seasonal avian diversity in an urban wetland in Columbus, Ohio.

Student Presenter: Kaitlin Carr

Faculty Mentor: Christopher Tonra

Faculty Mentor Department: School of Environment and Natural Resources

Research Abstract: Biodiversity can be a useful measure of overall health of an ecosystem. Despite seasonal changes in avian communities, diversity is often measured only during the breeding season. Monitoring avian species over seasonal variations has the potential to indicate the condition of the ecosystem and inform management decisions. In a 52-acre urban wetland, avian species were captured using mist netting over a period of two years. This method allowed for sampling of secretive species that standard audio-visual surveys often fail to detect. Plumage characteristics were used in identifying species. We calculated diversity using Simpson’s index and standardized effort using net hours to compare diversity among seasons. Using capture effort, we also estimated relative abundance of species and analyzed the effect of temperature on diversity. This study provides a measure of diversity for the site during under-sampled times of the year with different communities.
Research Project Title: Serendipity in events leading to groundwater contamination in Elkhart, IN

Student Presenter: Allyson Brady

Faculty Mentor: Frank Schwartz

Faculty Mentor Department: Earth Science

Research Abstract: Unregulated disposal of industrial chemicals commonly results in groundwater contamination, with the development of plumes of these hazardous constituents. The development and size of plumes are dependent upon geologic and hydrogeologic settings. This study investigates multiple plumes of chlorinated solvents in groundwater at Elkhart, Indiana in relation to the subsurface lithology, and the geologic history of the area, as well as key factors controlling the migration of contaminants. The aim of this study is to understand seminal events promoting the development of these extensive contamination plumes within the study region. My approach involved literature surveys along with the examination and interpretation of a collection of gamma-ray logs available from Indiana Geological Survey. The logs covered much of the area impacted by the variety of significant contaminant plumes. The shallow geology proved to be a complex mosaic of glacial outwash and other interbedded glacial deposits. Across the study area, little to no distinct pattern of layering was indicated by the gamma-ray logs. The unconfined, permeable aquifer beneath Elkhart connected the near-surface chemical disposal sites and promoted the rapid infiltration of precipitation and the growth of contaminant plumes in the groundwater. The St. Joseph River close in proximity to the disposal sites attributed a steep hydraulic gradient, which propagated this rapid expansion. The porous, permeable, and varied subsurface setting, coupled with the previous lack in disposal regulations advanced the development of significant contaminant plumes. The most seriously contaminated sites are currently being remediated. The glacial geologic setting provides a high risk for contamination, and industries and members of the communities must be vigilant for potential problems. The findings here will further enhance the understanding of contamination and prevent future problems in regions with similar hydrogeologic settings.
Research Project Title: Promoting cover crop adoption to improve water quality in agricultural landscapes

Student Presenter: Olivia Carros

Faculty Mentor: Robyn Wilson

Faculty Mentor Department: School of Environment and Natural Resources

Research Abstract: Nutrient loading and associated algal blooms resulting from agricultural runoff are a pressing environmental concern for the Great Lakes. Cover crops are an important Best Management Practice (BMP) useful for reducing nutrient runoff while providing a wide variety of other on-farm benefits. 22 semi-structured interviews were conducted to learn more about the motivations, benefits, and constraints associated with cover crop adoption among different types of farmers. Three distinct groups of farmers were identified within the sample, sharing certain characteristics: enthusiastic (or early) adopters, new (or middle) adopters, and tentative (or late) and non-adopters. Middle and non-adopters lack awareness of the diverse potential benefits of cover crops relative to enthusiastic or early adopters. As a result, emphasizing these benefits may be critical to decreasing skepticism toward cover crops as an effective and economic management tool and promoting future adoption. Demonstration farms are a popular outreach tool used to provide such information about BMPs. Pre- and post-surveys were conducted at the Blanchard Valley Demonstration Farms to determine the impact of the event on farmer knowledge, beliefs and concerns. Preliminary results indicate that the demonstration farms significantly improved the participants’ confidence in their ability to implement cover crops but had no significant impact on farmer knowledge. These results provide evidence that current outreach and communication efforts are having a positive effect, but must continue to focus on concrete examples of long-term economic benefits and diverse on-farm benefits, such as resiliency and livestock opportunities, in order to be effective.
Research Project Title: Evaluating whether there are trade-offs between plant diversity and ecosystem functions in restored and unrestored Lake Erie coastal wetlands

Student Presenter: Alan Coburn

Faculty Mentor: Lauren Pinto

Faculty Mentor Department: School of Environment and Natural Resources

Research Abstract: Coastal wetlands along Lake Erie have been dramatically altered by humans, disrupting important natural ecosystem functions including habitat provision, flood mitigation, and nutrient retention. Restoration actions, such as the removal of dikes, aim to restore these natural processes. While the goal of dike removal is to restore long-term ecosystem functioning, there may be short-term trade-offs between restoring particular ecosystem functions and maintaining biodiversity. For example, higher-than-optimal water levels and longer inundation periods following hydrological reconnection may increase nutrient retention, but decrease wetland plant diversity. This could affect primary productivity and nutrient uptake by wetland plant communities, thus affecting higher trophic levels in the wetland ecosystem and water quality in Lake Erie (e.g. higher levels of nitrogen and phosphorus). The goal of this study was to compare wetland inundation, nutrient levels, primary productivity, and plant diversity in restored and unrestored coastal wetlands over the course of a growing season. We hypothesized that the restored wetlands would have higher water levels, longer inundation time, and higher levels of nitrogen and phosphorus, but lower primary productivity, and lower plant diversity than the unrestored wetlands. Twelve coastal marsh sites – 6 restored and 6 unrestored – were sampled in the Ottawa National Wildlife Refuge wetland complex in Oak Harbor, Ohio. We measured water level and collected water samples biweekly between May-August, 2017. Water samples were analyzed for total nitrogen and phosphorus concentrations. Plant diversity surveys were conducted in June and July, and peak, above-ground biomass of emergent plants was measured in mid-August. Preliminary results suggest that mean water depth and its relative changes did not differ between restoration status, and that total nitrogen and phosphorus levels were lower in restored sites than in unrestored sites. Emergent wetland plant biomass was also lower in restored sites than in unrestored sites. Lower nutrient levels and biomass in restored sites may indicate a lower rate of overall wetland nutrient retention following hydrological reconnection. Further analysis of plant diversity data will examine whether diversity differs between restoration status, and whether it is associated with nutrient levels and biomass.
Research Project Title: Measurement of anthropogenic micropollutants in the Scioto and Olentangy River water systems using single particle and conventional inductively coupled plasma mass spectrometry (ICP-MS)

Student Presenter: Bradley Cole

Faculty Mentor: John Olesik

Faculty Mentor Department: Earth Sciences

Research Abstract: Gadolinium (Gd) is commonly used as a Magnetic Resonance Imaging (MRI) contrast agent, while engineered Silver (Ag) nanoparticles are used in consumer products for their anti-bacterial properties. Dissolved Gd and Ag nanoparticles ultimately become waste as micropollutants into our natural water systems. The transport and eventual fate of these micropollutants is not well understood. Our goal is to determine if these micropollutants exist in Columbus’ rivers. Gadolinium concentrations will be measured by time integrated ICP-MS, while Ag nanoparticle concentrations and diameters will be determined using single particle ICP-MS. Gadolinium, a rare earth element, exists naturally in known abundance ratios to other rare earth elements in rivers. When anthropogenic Gd is present, the ratio of the Gd concentration to the concentrations of other rare earth elements will be anomalously high. In single particle ICP-MS, each nanoparticle produces a burst of signal that lasts for only 200 to 500 μs. The number of signal bursts is proportional to the number of nanoparticles per milliliter in the sample. By calibrating the number of signal counts per femtogram (10^-15g) of Ag and then measuring the signal from nanoparticles in the sample, the mass of Ag in each nanoparticle can be determined. If the nanoparticles are spherical, then the diameter of each nanoparticle can be calculated from the mass of Ag in each nanoparticle. River water samples have been collected from thirteen separate locations within the major Scioto river system and its large tributary, the Olentangy River. Both rivers flow from northern Ohio, south, passing through many urban and industrialized areas such as the Ohio State University’s campus and medical facilities. After the rivers converge, the Scioto then continues southward along the western edge of the City of Columbus, eventually passing the waste treatment plant near Commercial Point. The analyses, results and conclusions are still to be conducted and discussed.
Research Project Title: Effect of pH and temperature on the metabolic physiology of the Hawaiian coral Porites compressa

Student Presenter: Katherine Giesy

Faculty Mentor: Andrea Grottoli

Faculty Mentor Department: Earth Sciences

Research Abstract: Coral reefs are among the most diverse ecosystems on the planet. However, their survival is threatened due to anthropogenic effects and climate change. The reefs of O‘ahu, Hawaii are naturally exposed to a range of temperature and pCO2 regimes, with some sites experiencing conditions not expected on most reefs until mid-century. By measuring metabolic physiology traits, such as photosynthesis and respiration, one can better understand how Hawaiian corals might respond and possibly persist in the rapidly changing ocean. I investigated the experimental effects of elevated pCO2 (i.e., reduced pH) and temperature on the coral Porites compressa’s metabolic physiology over a five-month period. I show that metabolic physiological responses to the stress treatments varied depending upon the site of origin. Photosynthesis rates in corals that originated from reefs surrounding the Hawaii Institute of Marine Biology (HIMB) and from Haleiwa were unaffected by temperature and acidity stress. In contrast, photosynthesis rates from corals that originated from Sampan reefs initially were stimulated by the elevated pCO2, but had acclimated to the pCO2 conditions after five months. Respirations rates in corals that originated from both HIMB and Sampan increased in response to elevated temperature and/or pCO2. While acidity had a greater influence on metabolic physiology overall, temperature affected respiration rates particularly in corals that originated from Sampan. Future scheduled analyses (feeding rate, energy reserves, etc.) will facilitate a more comprehensive assessment of the physiological variation across these treatments and sites. By understanding the extent to which coral can acclimate to their changing environment, one can better predict how reefs might fare under future ocean conditions.
Research Project Title: Establishing a long term avian survey to monitor restoration succession

Student Presenter: Katherine Denune

Faculty Mentor: Chris Tonra

Faculty Mentor Department: Environment and Natural Resources

Research Abstract: Ohio has lost over 90% of its original wetlands, resulting in the loss of key ecosystem services such as water purification, flood prevention and critical wildlife habitat. Successful wetland restoration is critical for the reestablishment of well-functioning habitats. Due to the diversity of species and niches, birds are highly useful and common indicators of progress of ecosystem recovery after restoration. The objective of this study was to establish a long-term point count survey in a large restored marsh and wet prairie to monitor bird species richness and diversity. Continued monitoring will document any changes in bird species presence relative to ongoing habitat succession. The survey was located in a roughly 650 acre restored marsh and prairie at Battelle-Darby Metro Park, west of Columbus, OH. Franklin County Metro Parks expressed special interest in the status of Ohio species that are threatened or of concern, such as Henslow’s Sparrow (Ammodramus henslowii) and Marsh Wren (Cistothorus palustris). Therefore, I established a network of survey points, with 27 count stations spaced 250 meters apart. Three surveys were completed in May and early June of 2017 using avian point count methods. During the five minutes spent at each station I detected species presence within a 50-meter radius using direct visual sightings, calls and songs. I will present results on species richness and diversity as well as abundance and occupancy data on particular species of interest. Bird estimates will be compared to habitat coverage. My results will provide information on both bird species diversity and habitat usage to aid in management regarding the succession of the restored wetland and prairie.
Research Project Title: Behavioral differences between populations of African cichlid fish from divergent habitats

Student Presenter: Nicole Episcopo

Faculty Mentor: Suzanne Gray

Faculty Mentor Department: SENR

Research Abstract: Reproductive behavior is a crucial, yet unique process that ensures the survival and overall success of many animal species. With all of the different environmental shifts occurring in ecosystems across the globe due to anthropogenic activities, it is not hard to imagine that in order for a species to survive, it needs to adjust to environmental changes. In aquatic systems, a number of environmental changes are known to affect the survival of fish, including low dissolved oxygen (hypoxia) and increased suspended sediments (turbidity). Pseudocrenilabrus multicolor, a species of African cichlid fish, is a widespread species found in freshwater rivers and swamps in East Africa. They are a sexually dimorphic species, where the male is larger and brighter in color in comparison to small, grey females. Differences in reproductive behavior have been observed between males of different color due to oxygen levels, and more aggressive behaviors have been observed in fish that court in turbid waters. Rivers (Bunoga and Ndyabusole populations) are a high turbidity, high oxygen environment that are strongly influenced by deforestation and agriculture near the rivers. The swamp environments (Bwera and Lwamunda populations) are clearer waters and naturally lower in oxygen concentration, making the water hypoxic. Differences between the behaviors of fish from different habitats could be explained by the problems associated with seeing other fish, whether potential mates or predators, in highly turbid water. It is possible that evolutionary (i.e. genetic) changes in color and behavioral interactions of the fish have occurred between populations experiencing different stressors. However, the question of persistent differences between populations from different conditions when reared under similar conditions of clear water and high oxygen (i.e. with no stressors), has yet to be answered. My study will test the hypothesis that there are persistent differences in reproductive behavior across populations due to the environmental differences the fish experience in their natural habitats. To test this, I will make repeated observations of F1 fish from four populations reared in the lab. There will be five tanks for each of the four populations, for a total of 20 tanks. There will be one male and two to three females in each tank. Each tank will be observed for ten minutes during which I will record any courting or reproductive behavior demonstrated by the fish. The behaviors will be divided into two categories, reproductive behaviors and aggressive behaviors. The aggressive behaviors will include chasing and biting, and the reproductive behaviors will consist of lateral displays, frontal displays, leads and quivers. A minimum of three observations per tank, separated by at least one week, will be completed and the mean number of reproductive and aggressive displays averaged for each tank. Data analysis will be completed on the totaled cataloged behaviors across each tank and a ratio of reproductive over aggressive behaviors will be calculated. The ratios of tanks will be combined across populations, and a one-way ANOVA will be run on all of the ratios. This work could indicate a genetic component in reproductive behaviors in species of Cichlids, and could imply adaptation amongst the different populations over time. This similarity could be between all four populations, or between the two different conditions of rivers versus swamps.
Research Project Title: Estimating relative surface ages and wetting histories of ice-free antarctic regions using geochemical analysis of soils

Student Presenter: Daniel Gilbert

Faculty Mentor: Berry Lyons

Faculty Mentor Department: School of Earth Science

Research Abstract: Introduction

The ice-free regions of Antarctica are polar deserts where atmospheric aerosols are deposited and can accumulate over time in the surface soils. The McMurdo Dry Valleys (MDV) are the largest ice-free area on the continent and contain soils ranging in age for a few 1000's of years to as old as 14 million years. Soils in the Transantarctic Mountains to the south of MDV have similar ages. These ages relate to the waxing and waning of both the West and the East Antarctic Ice Sheets as the climate has changed. For this reason, types and concentrations of water soluble salts found in these soils can be used as a relative surface age dating parameter.

Methods

I have measured the elemental composition of soils from several, ice-free locations in Antarctica. They range from coastal sites a few 10s of meters above sea level, to sites 800 kilometers inland and elevations of 2500m. Soils samples were leached with deionized water, dissolving water soluble ions, then filtered through 0.4μm filters. The leachate was then analyzed using ion chromatography to determine concentrations of the anions Cl-, F-, NO3-, SO42-, and PO43-. The leachate was also analyzed by an inductively coupled plasma optical emission spectrometer to measure the concentrations of Li and B.

Results

Locations further inland and at higher elevations tend to have higher concentrations of NO3-, Cl-, SO42-, and F-. Most coastal sites at high elevations generally had higher Cl- values. Cl- and NO3- are clearly atmospherically derived, suggesting that if deposition fluxes are known, their concentrations may be good indicators of relative time since the soil was last wetted.

Conclusions

In general the water soluble salt concentrations correlate to the estimated surface ages of the soils measured either by exposure age dating or known relationships to glacier advances and retreats.
Research Project Title: Recovery and lithologic analysis of sediment from Hole UT-GOM2-1-H002 and H005, Green Canyon 955, northern Gulf of Mexico

Student Presenter: Nikki Kinash

Faculty Mentor: Ann Cook

Faculty Mentor Department: School of Earth Sciences

Research Abstract:

In May 2017, the University of Texas led a drilling and pressure coring expedition in the northern Gulf of Mexico, UT-GOM2-01. The holes were located in Green Canyon Block 955, where the Gulf of Mexico Joint Industry Project Leg II identified an approximately 100-meter thick hydrate-filled course-grained levee unit in 2009. Two separate wells were drilled into this unit: Holes H002 and H005. In Hole H002, a cutting shoe drill bit was used to collect the pressure cores, and only one of the eight cores collected was pressurized during recovery. The core recovery in Hole H002 was generally poor, about 34%, while the only pressurized core had 45% recovery. In Hole H005, a face bit was used during pressure coring where thirteen cores were collected and nine cores remained pressurized. Core recovery in Hole H005 was much higher, at about 75%.

Herein, we focus on lithologic analysis of Hole H002, with the goal of documenting and understanding core recovery in Hole H002 to compare with Hole H005. X-ray Computed Tomography (XCT) images were collected by Geotek on pressurized cores, mostly from Hole H005, and at Ohio State on unpressurized cores, mostly from Hole H002. The XCT images of unpressurized cores show minimal sedimentary structures and layering, unlike the XCT images acquired on the pressurized, hydrate-bearing cores. Only small sections of the unpressurized cores remained intact. The unpressurized cores appear to have two prominent facies: 1) silt that did not retain original sedimentary fabric and often was loose within the core barrel, and 2) dense mud sections with some sedimentary structures and layering present. On the XCT images, drilling mud appears to be concentrated on the sides of cores, but also appears in layers and fractures within intact core sections. On microscope images, the drilling mud also appears to saturate the pores in some silt intervals.

Further analysis of the unpressurized cores is planned, including X-ray diffraction, grain size analysis and porosity measurements. These results will be compared to the pressurized cores to understand if further lithologic factors could have affected core recovery.
Research Project Title: Dissolution kinetics of volcanic ash in seawater

Student Presenter: Lillian Kleban

Faculty Mentor: Sue Welch

Faculty Mentor Department: Earth Science

Research Abstract: Dissolution Kinetics of Volcanic Ash in Seawater

The amount of CO2 in the atmosphere over geologic timescales is greatly affected by the weathering of silicate and phosphate rocks. Weathering of Ca-Mg phases is significant because it results in precipitation of Ca Mg carbonate which affects long term CO2 uptake. Weathering of iron or phosphate phases is important because these reactions release nutrients that promote plant growth and take up CO2 as organic Carbon in the short term. My project investigates the dissolution kinetics of volcanic ash from five different volcanic eruptions (1980 Mount St. Helens, USA eruption, 1991 Mt. Pinatubo, Philippines eruption, and 2010 Eyjafjallajökull, Iceland, Mt. Pacaya, Guatemala, and Tungurahua, Ecuador eruptions) in synthetic sea water. Mineral reaction experiments were set up by adding 1 +/- 0.05 grams of ash to 0.5 liter Nalgene bottles filled with 500 +/- 3 grams of synthetic sea water. The solutions were sampled periodically via syringe, filtered, and then analyzed with a Skalar San++ nutrient analyzer to test for the concentrations of silica and phosphate. The samples were also analyzed for iron by use of the ferrozine method; however, the concentrations of iron were too low to be detected. The phosphate concentrations were close to the detection limit and varied over time. The silica concentrations increased gradually over time and dissolution rates were estimated from a linear fit of the data. The highest release rate was 23 ppb Si/day from Icelandic ash sample. The slowest release rate was 1.5 ppb Si/day from the Tungurahua ash sample. The differences in dissolution rate of the ash sample were related to the differences in surface area and particle size of the ash. Faster dissolution rates are associated with greater surface area and smaller particle size. These results are consistent with the results of a similar experiment in which ash from the same eruptions was dissolved in deionized water at varying acidity.
Research Project Title: The role of taxonomic verses functional macroinvertebrate diversity as indicators of nutrient pollution in Ohio streams

Student Presenter: Krystal Pocock

Faculty Mentor: Lauren Pintor

Faculty Mentor Department: School of Environment and Natural Resources

Research Abstract: Nutrient enrichment is a key driver of harmful algal blooms in many United States surface waters and has a degrading impact on aquatic ecosystems. Aquatic macroinvertebrates have been historical indicators of impairments in rivers and lakes due to differences in the relative sensitivity of different species to stressors, such as excess nutrients. Taxonomic diversity indices are commonly used to represent macroinvertebrate diversity, however, the use of functional traits has become increasingly utilized due to their ability to mechanistically link macroinvertebrate communities to environmental stressors. The objectives of this in-progress research project are to determine whether taxonomic or functional indices of macroinvertebrate diversity are better indicators of nutrient pollution in impacted Ohio watersheds. Based on previous studies, I predict that sites which have a high amount of nutrient pollution will have low functional and taxonomical diversity while sites that have a low to moderate amount of nutrient pollution will have high functional and taxonomical diversity. Furthermore, I hypothesize that functional diversity indicators will explain more variation in nutrients than taxonomical indicators of nutrient enrichment. Macroinvertebrate and water samples were collected from multiple sites within three watersheds in Ohio that differ in levels land use: Burr Oak (n=6), Hoover Reservoir (n=11), Indian Lake (n=11). Water samples were analyzed for total nitrogen (TN), nitrate-nitrogen (NO3-N), ammonia-nitrogen (NH4-N), total phosphorus (TP), and phosphate-phosphorus (PO4-P). Preliminary results indicate that nitrogen and phosphorus concentrations are higher in in Indian Lake (agricultural) and Hoover (mixed use) watersheds than in Burr Oak (forested). Taxonomic diversity does not appear to vary considerably across all three watersheds. Interestingly, opposite our predictions a higher percentage of sensitive taxa (mayflies, stoneflies, caddisflies) were present in Hoover Reservoir and the lowest in Burr Oak. However, there was a higher percentage of predator taxa in Burr Oak in contrast to the other two watersheds.
Research Project Title: Annual surface elevation change of the Lehman Rock Glacier in Great Basin National Park, Nevada, USA

Student Presenter: John-Morgan Manos

Faculty Mentor: Bryan Mark

Faculty Mentor Department: Geography

Research Abstract: Mid latitude, mountain glaciers are a critical reserve of fresh water for local populations and are threatened by a rapidly changing climate. Specifically, the Lehman Rock Glacier in Great Basin National Park in western Nevada has little perennial, exposed ice left with the rock glacier being the predominant extant ice feature. In order to determine how dynamic the rock glacier is and better understand its geomorphology, we performed annual surveys of the surface beginning in 2015. Using balloon-borne photogrammetry, >600 images spanning a study area of ~ .1 km² were taken at an elevation of roughly 500 feet above the surface. We used a surface from motion (SfM) technique where we could determine change in the surface of the glacier by identifying points in incident in aerial photos. Ground control points (GCPs), 5 used in the 2015 model and 15 used in the 2016 model, allowed us to reconstruct the surface from the aerial photographs. Accuracy points, 18 points in 2015 and 17 points in 2016, were used to assess errors in model reconstruction. Real-time kinematic (RTK) points were post-processed and differential corrected allowed for ~ .001 meter vertical resolution measurements. We developed our 3-dimensional models of the rock glacier using Agisoft Photoscan. A digital elevation model (DEM) of the glacier in both 2015 and 2016 was obtained using the models generated by Photoscan. Using ArcMap, the 2015 DEM model raster was subtracted from the 2016 DEM model raster. Results indicate that annual surveys using RTK and differential GPS produce high quality DEMs with an average elevation offset of ~ 0.30 m. Comparing DEMs showed elevation varies spatially ranging from +1.5 m to −1.0 m. The future of glacier morphology research will benefit greatly from drone technologies which will enhance photo quality and allow for higher resolution DEMs.
Research Project Title: Coal mining: a potential threat to human health

Student Presenter: Claire Metka

Faculty Mentor: Motomu Ibaraki

Faculty Mentor Department: Earth Sciences

Research Abstract: Category: Mathematical and Physical Sciences

Title: Coal mining: A potential threat to human health

Student Presenter: Claire Metka

Faculty Advisor: Ibaraki, Motomu

Abstract: Coal mining continues to play an important role in the U.S. energy supply making up 16% of the total U.S. energy sources in 2016. However, active and abandoned coal mines can contaminate surface water and groundwater creating a potential threat to the public health. Acid mine drainage (AMD) occurs when rocks associated with coal mining, such as pyrite, react with oxygen and water to form sulfuric acid. This strong acid can leach into groundwater and surface water damaging the surrounding ecosystem and contaminating drinking water. The New Lexington Pit in Perry County, Ohio, where groundwater is vital source of municipal and private drinking water sources, has been coal mined for decades. During the most recent mining periods, the Oxford Mining Company that operates the mines had numerous permit violations discharging acidic water into the surrounding surface waters. The interaction between groundwater and surface water has potential to expand areas of contamination. Although there are numerous studies that focus on AMD, most of the AMD studies today focus on contaminant migration in surface waters. The purpose of this study is to shed light on the potential risks of AMD on groundwater quality and public health. To understand the groundwater flow system, a numerical modeling approach is used. Unlike groundwater field sampling and observation, the numerical modeling approach allows us to understand the physical processes that control the groundwater flow system. A conceptual model was created from mining permit data using RockWorks software. This conceptual model was imported into MODFLOW for numerical investigations. MODFLOW is USGS’s numerical model that can simulate groundwater flow as well as surface and groundwater interactions. The preliminary results of this study suggest that AMD in groundwater has potential to further contaminate surrounding areas. The results of this study should promote further research in AMD contaminant migration in groundwater at other mining sites.
Research Project Title: Magma plumbing system beneath Herðubreið, Northern Rift Zone, Iceland

Student Presenter: Collin Oborn

Faculty Mentor: Michael Barton

Faculty Mentor Department: School of Earth Sciences

Research Abstract: Iceland is the most volcanically diverse location on the planet as nearly every type of volcano can be found on this island. Volcanoes are an existential and powerful threat to the modern world on both short and long time scales, and understanding their inner workings is paramount to protecting society from one of nature's deadliest and most destructive activities. Given that gathering and analyzing information about every type of volcanic activity on Iceland is a daunting task, this study focuses on a specific locality in Iceland's Northern Volcanic Zone, the volcano known as Herðubreið (Herdubreid). The purpose of this research was to determine the depth of crustal magma bodies that feed Herðubreið. The methods of this project involved using the analyzed weight percent of major oxides in samples of glass collected from the volcano over the last few years to calculate the pressure at which the magmas partially crystalized. From this pressure, we established the relative depth of the magma chamber or chambers located in the underlying crust. The results reveal the presence of two main magma bodies located at 11 and 17 km below the surface. These depths were expected as they agree with the results of seismic studies for this area and are consistent with results obtained using identical petrologic methods for other volcanic plumbing systems in Iceland. This work provides part of the bigger picture of Icelandic volcanism, as Herðubreið is only one of about thirty active volcanoes on Iceland. However, while the results of this work constitute a necessary first step for improving warning systems and updating evacuation procedures for people who live or work near similar types of volcanoes, more work is needed to gain a complete picture of the magma plumbing systems in the crust beneath Iceland. Additional research is underway to collect and study samples from these volcanic systems with the objective of understanding how these different types of volcanoes work, how the different plumbing systems interact with each other, and how to place the results obtained for Iceland into a global context.
Research Project Title: The effects of natural capital investment on coastal communities’ resilience to natural hazards

Student Presenter: Andrew Shea

Faculty Mentor: Sathya Gopalakrishnan

Faculty Mentor Department: AEDE in CFAES

Research Abstract: Background:

Over half of the world’s population lives and works near the coast. Climate change poses an increasing inherent risk to coastal communities. Rising sea level and increased frequency and intensity of natural disasters have the ability to decimate coastal infrastructure and economies. Human impacts have changed and caused loss of ecosystem services that serve as natural coastal protections such as mangroves, coral and oyster reefs, and marshes. The loss of these protections results in increased environmental risks. To enhance or replace these ecosystem services, investments in coastal protection, in the form of green or gray infrastructure, can be made. Investment in this infrastructure has been shown to yield economic returns in the form of property values. While coastal adaptations clearly increase property values, it is not entirely sure to what extent coastal adaptation investments affect the economic resilience of a community after a natural hazard, such as a hurricane or flood.

Methods:

Communities that have invested in coastal protections are compared to communities that have not invested in coastal protections with regards to their resilience. This is analyzed by studying how long it takes for coastal property values to recover following a natural hazard. Using a hedonic pricing method which looks at property values, this study aimed to show to what extent coastal adaptation investments affect the economic resilience of a community following a natural hazard.

Results and Conclusions:

While the data from Dare County, NC showed that beach nourishment increases property values, the results were inconclusive on the affect that Hurricane Arthur had on home sales. Resilience was unable to be analyzed since the hurricane did not have a statistically significant impact on home prices.
Research Project Title: Distribution and mapping of high-Mg calcite vs. aragonite in stromatolites of Storr’s Lake, San Salvador, Bahamas

Student Presenter: Qingting Wu

Faculty Mentor: Elizabeth Griffith

Faculty Mentor Department: School of Earth Sciences

Research Abstract: Some well-developed microbial mats have calcified structures in Storr’s Lake, a hypersaline lake on the east coast of San Salvador Island, Bahamas. Many of these microbialite structures are laminated, and therefore classified as stromatolites. This study focuses on small stromatolitic knobs collected from the bottom of Storr’s Lake, whose mineralogy is dominated by aragonite and high-Mg calcite. These two minerals appear to dominate different layers that are classified by the depth below the top surface of samples. Mapping and finding the distribution of these two minerals could achieve the association between mineralogical weight percent and spatial arrangement in stromatolites. A precise trend of aragonite and high-Mg calcite distribution could be accomplished. This project can be used to inform future studies of fine-grained stromatolites in the fossil record, and discussion of controls on the mineralogical compositions.
Research Project Title: Natural variability in the contribution of heterotrophic carbon to tissues of Montipora capitata

Student Presenter: Alexandra Smith

Faculty Mentor: Andréa Grottoli

Faculty Mentor Department: Earth Science

Research Abstract: Coral reefs are threatened by rising temperatures and ocean acidification. However, evidence suggests that some populations of coral can cope with high temperature and pCO2 conditions through physiological adaptations that confer resilience. Coral host and endosymbiotic algal \( \delta^{13}C \) and \( \delta^{13}N \) values reflect underlying coral biology. We measured \( \delta^{13}C \) and \( \delta^{13}N \) values in Montipora capitata corals from two sites around Oahu, HI to determine the proportionate contribution of photoautotrophic and heterotrophic carbon to coral tissues, to assess the relative contribution of nitrate and plankton to the same tissues, and to evaluate the relationship between their biology and environmental conditions. Haleiwa is a site with mean summer seawater temperature (26.8°C) and pCO2 levels (390 µatm) that reflect those presently observed on most tropical reefs. Kaneohe Bay is a semi-enclosed bay with elevated summer mean seawater temperature (28.5°C) and pCO2 levels (500 µatm) representative of predicted mid-century reef conditions. We found that \( \delta^{13}C \) of the coral host and the endosymbiotic algae, as well as the difference between \( \delta^{13}C \) of the host and \( \delta^{13}C \) of the algal fraction, was higher in corals from Kaneohe Bay than those from Haleiwa. This is likely because Kaneohe Bay corals are compensating for more stressful conditions by increasing the proportionate contribution of heterotrophically derived C to their tissues, or because there is a greater abundance of zooplankton providing greater opportunity for feeding. In addition, we found that \( \delta^{13}N \) of the algal fraction was higher in Kaneohe Bay corals, suggesting that these corals are incorporating more nitrate and/or heterotrophically derived nitrogen into their tissues to compensate for more stressful conditions. These results support our hypothesis that corals can cope with higher temperature and pCO2 conditions through adaptations that confer resilience. The adaptation appears to be linked with heterotrophic plasticity or increased incorporation of heterotrophic food sources into tissues.
Research Project Title: Coral lipid class composition following repeat bleaching

Student Presenter: Sarah Solomon

Faculty Mentor: Andrea Grottoli

Faculty Mentor Department: School of Earth Sciences

Research Abstract: Increasing sea surface temperatures, a result of anthropogenic global change, is causing an increase in the frequency and severity of mass coral bleaching events. When heat stressed, corals expel their photosynthetic algal endosymbionts that provide them with fixed carbon to meet metabolic energy requirements. In the absence of endosymbionts, corals with high levels of stored energy reserves (lipids, carbohydrates, and protein) and corals that acquire energy through heterotrophy are known to have increased survival and resilience potential. To evaluate how lipid management can infer resilience, I measured changes in lipid class composition in repeatedly bleached and non-bleached corals of three species across several recovery time points over two years. Phospholipid concentrations in Orbicella faveolata decreased by about half, which might correspond to cell loss associated with severe bleaching in this species following single bleaching. However, this response was mitigated in the second year and cholesterol concentrations increased, which could be a response to increased incorporation of heterotrophic food into tissue building. Porites astreoides maintained low concentrations of cholesterol across both years. These initial findings suggest that these two species manage their lipid reserves differently under heat stress. The effects of single bleaching events were not indicative of lipid class composition following repeat bleaching. I am measuring more lipid classes (tri- di- & mono- acylglyceride, free fatty acid, and wax ester) to have a comprehensive record of coral lipid management. Further investigation of structural and storage lipid management will reveal resilient strategies and improve our knowledge of how corals recover following annual bleaching events.
Research Project Title: The Pure Water Access Project: demonstrating the unique ability of undergraduates in the global water sector

Student Presenter: Aman Prasad

Faculty Mentor: Roy No

Faculty Mentor Department: Shuvro

Research Abstract: Introduction:

Founded in 2010, the 501(c)(3) The Pure Water Access Project (PWAP) is an innovative non-profit based in Columbus, Ohio. PWAP was designed for two reasons: to (1) support non-profits in the water sector establish research-based interventions to improve water sources around the world and (2) to provide an opportunity for undergraduate students to practice data analytics and research methodology. This presentation aims to evaluate the strengths and weaknesses of PWAP’s model by analyzing the successfulness of two ongoing projects in Ghana and Nicaragua.

Methods:

PWAP’s current methodology involves partnering with local nonprofits that are based in target regions where the water quality interventions take place. Then, PWAP’s undergraduate fellows, all students at Ohio State, use existing resources at the university to design or assist the creation of water quality interventions.

Using a mixed methods approach, we analyze the effectiveness of PWAP interventions to improve water sources in Ghana and Nicaragua. Additionally, we used qualitative survey data to evaluate the experience of a variety of actors in the partnerships cultivated by PWAP: the undergraduate fellows’, nonprofit partner organizations, and community members impacted by the developed water, sanitation, and hygiene (WASH) interventions.

Results:

Following PWAP’s intervention in Penim, Ghana, all water samples taken from the implemented water solution showed no bacterial growth in culture, with pH, nitrate, and hardness levels all within the normal parameters for suitable drinking water. Furthermore, 3-month follow-up surveys showed high community acceptance. Selected data show that 100% of respondents (n=42 households) indicate a perceived improvement in clean water access in the community and 98% of participants being in favor of additional supplementary interventions in the future. Qualitative evaluation interviews conducted in Ghana, Nicaragua, and Columbus were overwhelmingly positive, indicating both qualitative and quantitative project success.

Conclusion:

We present a novel non-profit organizational structure that is proven to be able to effectively implement and improve WASH interventions that are highly evaluated by both partner nonprofit organizations and the local community members in which the interventions took place.
Research Project Title: Antarctic iceberg research: census, environmental trends, and global implications

Student Presenter: Karina Peggau

Faculty Mentor: Krissek No

Faculty Mentor Department: Larry

Research Abstract: This research explores data collected through the Drake Passage and around the Antarctic Peninsula, regarding icebergs and relevant environmental data to better understand the state of icebergs in Antarctica. The data was then analyzed to determine the environmental implications surrounding the collected information. First, a schedule was created for group members to be responsible for observing and describing the iceberg conditions during four designated times each day. Icebergs were observed, within a 3 mile distance, for size and shape as designated by MANICE specifications. According to the geographical distribution analysis that was conducted, the number of large icebergs increased farther south, particularly with more tabular-shaped icebergs closer to the ice shelves. Additionally, there was no significant correlation between ice concentration and latitude, longitude, and air temperature, although due to potential limitations on data, such as locations visited and the avoidance of high ice concentrations by a tourist vessel, concrete environmental conclusions cannot be made from the data collected. Finally, research was done to look into potential effects of iceberg melt on oceanographic processes and the Antarctic marine biosphere. Although further research needs to be completed to improve data significance, icebergs and sea ice concentration are both known to play a role in sea level, Antarctic marine biosphere, and the thermohaline circulation.
Research Project Title:
Student Presenter:
Faculty Mentor:
Faculty Mentor Department:
Research Abstract:
Research Project Title:
Student Presenter:
Faculty Mentor:
Faculty Mentor Department:
Research Abstract: