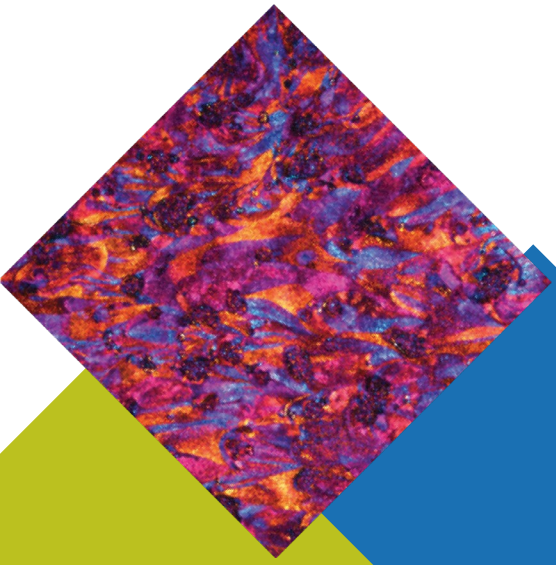
NC STATE UNIVERSITY

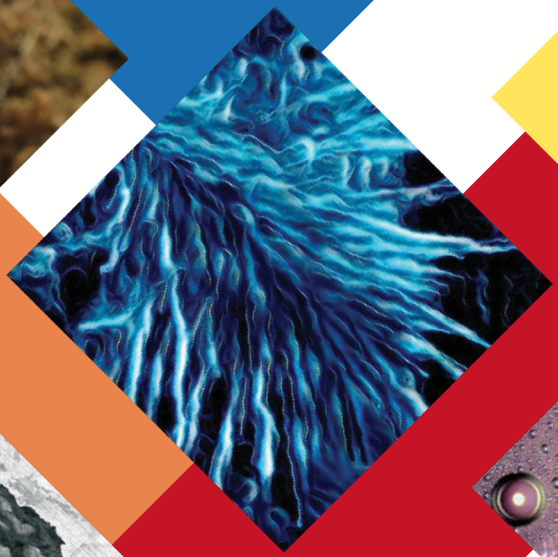
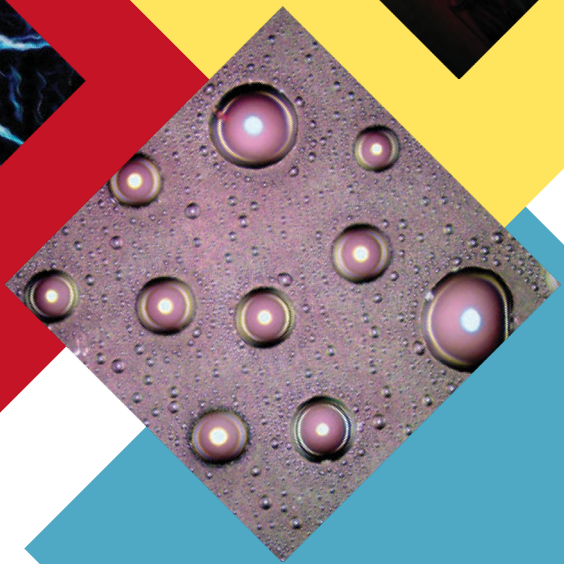
15th Annual
Graduate Student Research Symposium

ABSTRACTS

Wednesday
April 8, 2020
1:00 to 5:30 pm
McKimmon Center






Fifteenth Annual
Graduate Student Research Symposium
North Carolina State University

SYMPOSIUM ORGANIZERS

Graduate School
- Dr. David Shafer, Assistant Dean
- Bridget Foy, Administrative Assistant
- Todd Marcks, Fellowship and Grants Administrator
- Darren White, Webmaster

Graduate Student Association
- Urmila Adhikari, Plant Pathology (Co-Chair)
- Anna Rogers, Genetics (Co-Chair)
- Talha Agcayazi, Electrical and Computer Engineering
- Megan Boland, Biological and Agricultural Engineering
- Mandy Bradbury, Psychology
- Katherine L Cupo, Poultry Science
- Brian Dunn, Master of Business Administration
- Amira Hijazi, Industrial and Systems Engineering
- Sarah Karamarkovich, Teacher Education and Learning Sciences
- Drake Phelps, Veterinary Medicine
- Audrey Tribo, Communication

AGENDA

April 8, 2020

12:00 p.m. - 1:00 p.m. Poster Set Up (All set up their posters) Area1

1:15 p.m. - 1:30 p.m. Welcoming Remarks and Symposium Overview .....Room 6
Mr. James Withrow, GSA President
Dr. David Shafer, Assistant Dean of the Graduate School

1:30 p.m. - 4:00 p.m. Poster Session and Competition ..... Area 1

4:15 p.m. - 5:30 p.m. Announcements of Awards and Reception .....Room 2
Dr. Peter Harries, Dean of the Graduate School
Dr. David Shafer, Assistant Dean of the Graduate School

Table of Contents

College of Agriculture & Life Sciences

College of Design

College of Education

College of Engineering

College of Humanities & Social Sciences

College of Natural Resources

College of Sciences

College of Veterinary Medicine

Wilson College of Textiles

U Adhikari[1], C. Cowger[1,2] and P.S. Ojiambo[1]
Graduate Programs: Plant Pathology[1]; United States Department of Agriculture-Agricultural Research Service[2]
Advisors: Peter S. Ojiambo and Christina Cowger
Poster Number: 3

Effect of Host and Weather Factors on the Rate of Lesion Expansion of Septoria nodorum blotch on Winter Wheat

Septoria nodorum blotch (SNB), caused by the fungus Parastagonospora nodorum, is a yield- limiting disease of wheat that occurs frequently in the southeastern US where warm and humid conditions prevail during the growing season. Resistance to SNB in wheat is quantitative and was hypothesized to be at least partially determined by the rate of lesion expansion, which can be affected by environmental factors. Studies were conducted at three locations in North Carolina in 2018 and 2019 to quantify the effect of temperature and relative humidity on the rate of lesion expansion in three moderately resistant and three susceptible winter wheat cultivars. Disease was initiated by uniformly spreading SNB-infected wheat straw. Cohorts (i.e., groups of foliar lesions randomly selected and tagged as an observational unit) were sequentially selected and monitored throughout the season. Lesion area was measured at regular intervals, while weather data were collected using portable data loggers. Lesion area and rate of lesion expansion varied significantly (P2 on susceptible and 0.7 to 8.2 mm2 on moderately resistant cultivars, while in 2019 it ranged from 1.3 to 18.6 mm2 on susceptible and 0.3 to 8.6 mm2 on moderately resistant cultivars. The estimated rate of lesion expansion ranged from 0.19 mm2/day for susceptible to 0.05 mm2/day for moderately resistant cultivars in 2018, and 0.23 mm2/day for susceptible to 0.07 mm2/day for moderately resistant cultivars in 2019. Covariance analysis showed that temperature and relative humidity significantly (P

Benjamin Alig, Peter Ferket, Ramon Malheiros, Kenneth Anderson
Graduate Program: Poultry Science
Advisor: Peter Ferket
Poster Number: 6

The effect of housing environment on commercial white egg layer performance

Consumer demand for cage free eggs is driving the layer industry towards greater use of extensive housing systems. Unfortunately, limited research is available on how these systems affect egg production characteristics of commercial white egg layers. Four housing systems were evaluated under typical industry conditions, including caged (C), enrichable (EN), enriched (E) and cage-free (CF). Data collection for the strains began at 17 weeks of age, with a base period of 28 days for feed weigh-backs and egg quality measurements. The housing system had a significant (P

Benjamin Arends[1], Dominic Reisig[1], Shawnee Gundry[1], Kristen Hopperstad[1], Francis Reay-Jones[2], Jeremy Greene[2], Anders Huseth[1], and George Kennedy[1]
Graduate Programs: Entomology, North Carolina State University[1]; Entomology, Clemson University[2]
Advisor: Dominic Reisig
Poster Number: 11

Helicoverpa zea incidence and susceptibility to Bt corn across North Carolina and South Carolina in relation to corn and cotton production in the landscape

Characterizing Helicoverpa zea (Boddie) damage to corn in relation to the spatiotemporal composition of Bt crops is essential to understand how landscape composition affects H. zea abundance and selection for Bt resistance. To examine this relationship, paired Bt and non-Bt corn plots were sampled across locations in North and South Carolina during 2017-2019. Kernel damage and larval exit holes were measured on mature ears. To understand how corn and cotton composition surrounding sample sites related to feeding damage, data from the NASS Cropland Data Layer was used to quantify corn and cotton composition surrounding the sample sites. The vast majority of acreage of these crops are planted to Bt- varieties. Using a linear mixed-effect model, we examined the relationship between corn and cotton abundance during the preceding year in a 1 km buffer surrounding sample sites relative to H. zea damage and larval exit holes. Our results document significantly less damage in Bt corn compared to non-Bt corn. Damage in Bt corn was still substantial, indicating the presence of resistance to Bt manifest as a reduction in efficacy but not complete loss of control. They also document negative relationships between ear damage and larval exit holes in both Bt and non-Bt corn and the proportion of corn and cotton in a 1 km buffer during the previous year. The amount of damage observed in Bt corn reflects both the presence of Bt resistance in the H. zea population and the abundance of its primary hosts, corn and cotton (both largely planted to Bt varieties), grown during the previous year within a 1 km of the current year's corn planting.

Brooke Bartz, Jesse Grimes and Casey Nestor
Graduate Program: Poultry Science
Advisor: Jesse Grimes
Poster Number: 18

The identification of feeding regulatory neuropeptide, agouti-related peptide (AgRP), of two United States and two European strains of turkeys in the arcuate nucleus of the hypothalamus

Poultry feeding behaviors are influenced by various regulators which include environment factors and genetic strains. As a central hub in the regulation of several homeostatic processes, the arcuate nucleus (ARC) of the hypothalamus is an important brain region for appetite regulation. The co-expression of two opposing energy homeostatic neurons: the orexigenic agouti-related peptide (AgRP) and anorexigenic pro-opiomelanocortin (POMC) neurons are localized in the ARC. It is known in multiple species that AgRP acts as an endogenous antagonist to alpha-melanocyte stimulating hormone (a-MSH), a product of POMC neurons, promoting food seeking behavior. While administration of AgRP has been shown to stimulate food intake and increase body weight both mammals and avian species, relatively little is known about differences in the endogenous AgRP expression that exist between different strains of turkeys. The objective of this study was to examine the protein expression of AgRP in the arcuate nucleus of four different strains of commercially available turkeys using immunohistochemistry (IHC). Fertilized eggs of two United States (Strains A and B) and two European turkey strains (Strains C and D) were obtained and incubated under similar conditions. At hatch, birds were placed in pens based on strain and performance data was calculated by pen. At 5 weeks of age, birds were weighed and euthanized individually just before tissue collection. Birds were euthanized by cervical dislocation, followed by rapid decapitation and gender identification was obtained post-mortem. Whole brain tissue was excised and placed in 4% paraformaldehyde at 4°C for 48h, followed by 20% sucrose at 4°C until the time of sectioning. Tissue was cut from the caudal to rostral plane, on a freezing-stage microtome at 30µm and select sections containing the ARC were used for IHC with a primary antibody targeting AgRP. AgRP cell bodies and neuronal fibers were successfully observed in all 4 strains of birds. Feed consumption per pen positively correlated with the AgRP pixel % calculated (Strain A: 2.45kg/bd, 0.55%; B: 2.58kg/bd, 0.82%; C: 2.55kg/bd, 0.58%; and D: 2.74kg/bd, 1.39%, respectfully). Therefore, orexigenic feeding behaviors are likely increased by the AgRP neurons located in the ARC of the hypothalamus. Further research must be completed to determine the extent of these physiological implications.

T. Bhatia[1], J. Simunovic[1], K.P. Sandeep[1], M. Grace[2], M.A. Lila[2]
Graduate Program: Food Sciences[1]; North Carolina Research Campus, Kannapolis, NC[2]
Advisors: KP Sandeep[1], J. Simunovic[1]
Poster Number: 25

Microwave-Assisted Extraction of Bioactive Ingredients from Culinary and Medicinal Herbs: Dielectric Properties at 915 MHz and 2450 MHz

Culinary and medicinal herbs are being identified as valuable sources of bioactive compounds such as flavonoids shown to be efficient as anti-carcinogens, beneficial to cardiovascular, gastrointestinal, type 2 diabetes, and general health and wellbeing. Dielectric properties of different food materials play a key role in understanding the development of commercial microwave systems for heating, processing, and preservation of food materials. Microwave processing is an emerging technology gaining lot of attention due to their various positive effects on food products, one of the most important lesser degradation of bioactive compounds and nutrients present in food products resulting in high quality product. Flavoring compounds and bioactive compounds present in culinary and medicinal herbs are heat labile and hence, can degrade if processed under high time-temperature conditions. Therefore, microwave processing of these culinary herbs can result in high quality product with minimal loss of flavoring and bioactive compounds. Dielectric properties of nine types of culinary and medicinal herbs were measured at two assigned frequencies 915 MHz and 2450 MHz in the temperature range of 25 °C to 120 °C. Dielectric constants (e') for the herbs were in the range of 22.36 to 56.18 at 915 MHz and 19.21 to 52.67 at 2450 MHz. On the other hand, dielectric loss factors (e) for these herbs were in the range of 6.01 to 62.46 at 915 MHz and 4.21 to 28.91 at 2450 MHz. Polynomial correlations were developed for dielectric properties as a function of temperature. Dielectric results indicate a high potential of microwave assisted extraction for industrial applications at both examined frequencies 915 MHz and 2450 MHz ands particularly, highlight the opportunities for their sequential or concurrent combined applications.

Megan Boland
Graduate Program: Biological and Agricultural Engineering
Advisor: Jay Cheng
Poster Number: 28

Anaerobic Co-Digestion of Animal Wastewater and Agricultural Residues for Biogas Production

Anaerobic co-digestion of animal wastewater and agricultural residues for biogas production allows for the simultaneous production of renewable energy and reduction of wastes when organics in the waste are converted into methane and carbon dioxide. As process inefficiencies can limit the profitability of this technology, the addition of agricultural residues presents an opportunity to boost biogas production. In this study, we used corn stover or switchgrass as agricultural residue additives to the anaerobic digestion of swine wastewater at different organic loading rates. The digester performance and microbial communities were monitored and analyzed in thermophilic continuously stirred tank reactors (CSTRs). The CSTRs were operated under a hydraulic retention time of 10 days at 50 °C. Biogas production rate increased significantly with the addition of the agricultural residues. However, there was not a significant increase in methane yield per gram of volatile solids (VS) added in the CSTRs at 1, 2, or 3% total solids loading. CSTRs with added agricultural residues had lower conversion efficiencies in comparison to just swine wastewater. In order to address these inefficiencies, a metagenomics study using 16S and shotgun DNA sequencing is underway to identify the microorganisms responsible for degrading the lignocellulosic materials to better understand the hydrolysis of agricultural residues and optimize the digestion performance.

Molly Bradshaw
Graduate Program: Agriculture and Extension Education
Advisor: Jackie Bruce
Poster Number: 30

Career Burn Out with Females in Higher Education Administration

This research examined the lived experiences of female administrators currently working within colleges of agriculture at land-grant institutions. These experiences were specifically related to career burnout, compassion fatigue, and satisfaction. Current research indicates that women are the minority within the STEM fields and in these types of institutions. The purpose of this study was to examine what it is like to be a female in male-dominated disciplines and how the participants' experiences impacted their own personal burnout, compassion fatigue, and job satisfaction. This research study utilized a qualitative phenomenological approach through semi-structured interviews with 22 participants. Participant criteria included those who identified as female, held a position of department head or higher, and worked at a land-grant institution.

The results demonstrated that women in these male-dominated fields were indeed the minority and have not felt welcomed or valued for their work and status within their departments. The participants shared experiences that were heavily related to stereotyping, bullying, being excluded and disrespected throughout their careers. Stereotyping and perceived lack of ability has caused these women to impose harsher expectations on themselves including working longer hours, taking on additional assignments, or proving themselves in other ways. Findings indicated that experiences involving stereotyping, microaggressions, and misogyny increase the overall amount of stress felt by these women and create a perception that they have to work harder than male counterparts, thus creating more stress. The culture and climate, self-exposed expectations, and gender stereotyping also were factors that caused an increase in the stress and dissatisfaction. The high levels and additional stress resulted in participants experiencing health issues, feelings of internal misogyny, and dissatisfaction.These experiences along with the increased stress has put this group at a higher risk for career burnout, compassion fatigue, and a decrease in their job satisfaction.

Dallas Bretzman
Graduate Program: Horticultural Science
Advisor: Julieta Sherk
Poster Number: 31

Visual Preferences Identify Key Design and Management Practices for Seven University Public Open Spaces

In recent years, there has been an increasing need for University landscapes to perform sustainably and at their highest potential on many levels. However, detailed descriptions of the design process/implementation and management of campus landscapes are lacking. Since these campus landscapes need to provide aesthetic and amenity value, landscape initiatives within the administration should advocate awareness and education about the value of rich comprehensive design processesthat are linked to their management in a meaningful way.In this study, we included seven surveyed universities that helped us to explore the various methods and objectives of their design process and to describe landscape management operations used to promote high performingsustainable landscapes, which also engage a varying type and number of stakeholders. In addition, we used an image survey to identify preferred/non-preferred visual preferences for the landscape study sites of the seven universities. We compared the design processes and management strategies associated with the rated site images to establish which approaches promote the highest impact. We discovered strategies that can contribute to the efficient and robust design of University landscapes, which will increase their long-term performance.

Vashti Campbell[1], Qingyang Wang[2], Steven Hall[1], and Deepti Salvi[2]
Graduate Programs: Biological and Agricultural Engineering[1]; Department of Food, Bioprocessing and Nutrition Sciences[2]
Advisor: Steven G. Hall
Poster Number: 34

Physicochemical properties and effects of plasma activated salt water on bacterial inactivation

Plasma, the fourth state of matter, is comprised of reactive species, electrons, and ions existing in non-equilibrium. Plasma activated water (PAW) is created by discharging plasma above the surface of water. The antimicrobial properties of PAW has been investigated in the past. This study examined the physicochemical properties of plasma activated saltwater (PASW) and its efficacy on inactivation of planktonic E. coli. Eventually, we plan to use PASW in a static depuration system for oysters to improve microbiological safety. Salt water (SW), 31 ppt, was treated with an atmospheric pressure plasma jet. PASW treated for 0, 1, 2, and 5 min yielded pH values of 8.79 ± 0.01, 7.21 ± 0.02, 5.36 ± 0.03, 2.99 ± 0.02; oxidation reduction potential (ORP) values of -103 ± 0.35, -15.7 ± 0.97, 91.1 ± 1.40, 229 ± 0.95 mV; and electrical conductivity values of 35.3 ± 0.25, 35.4 ± 0.26, 36.3 ± 0.39, 40.1 ± 1.04 µS/cm, respectively. ORP and conductivity of PASW increased while pH decreased with increased treatment time. PASW samples treated for 0, 1, 2, and 5 min had nitrate concentrations of 3.48, 13.2, 18.7, 45.9 mM and nitrite concentrations of 1.21, 2.97, 3.96, and 8.90 mM, respectively. After 2 min incubation and 5 min incubation, PASW treated for 5 min applied to E. coli on TSA resulted in higher inactivation, 3.34± 2.13 log CFU/mL reduction and 5.30± 0.0 log CFU/mL reduction, respectively, compared to DI water, SW, and PASW treated for 1 and 2 min. The results of this study demonstrate the antimicrobial efficacy of PASW against E. coli in vitro. Further, efficacy of PASW will be determined for Vibrio inactivation during static depuration of oysters.

Daniel P. Collins
Graduate Program: Agricultural and Extension Education
Advisor: Jackie Bruce
Poster Number: 46

Making Meaning of Alumni Perceptions in Central Appalachian Youth-Serving Organizations through an LGBTQ

LensResearch trends show that the youth of today will be the leaders of tomorrow (Conner & Strobel, 2007). The vitality of rural areas, including Central Appalachia, and the need for youth leadership are paramount for community survival. O'Doherty et al. (2015) commented, Appalachia is facing a vacuum of new leadership to move forward (p. 2). Strategies involving youth in leadership for rural areas includes inviting youth to sit at decision making collectives and allowing them to speak about the communities they would want to remain in for their future. Yu (2017) highlighted that LGBTQ youth are currently under-represented within the Appalachian region's organizations and communities. Therefore, targeted programs for LGBTQ populations are ignored and these communities are essential to sustaining a diverse region in Central Appalachia (O'Doherty et al., 2015). Listening to concerns of LGBTQ youth in multiple localities and communities leads to understanding the needs and interventions in reducing disparities affecting LGBTQ youth in youth-serving organizations today (Lavender-Stott et. al., 2018). The purpose of this study was to understand how the culture and climate of youth serving, youth development, and youth leadership organizations in Central Appalachia affect the experiences of LGBTQ+ alumni. This study sought to gain insight into alumni experiences in hopes of creating and encouraging more inclusive and equitable practices within current Central Appalachian youth-serving organizations. Results included that LGBTQ alumni felt compelled to code-switch their lives, hiding their true selves in their interactions. Without having someone visible as a role model, the importance of visibility highlighted the difficulties in finding their place within the organization. By doing this research, the researcher is hopeful that this study, and others similar to it, will provide voice through narratives into the experiences of minoritized alumni and to help create positive change in policy and practice for future participants.

Danielle R. Cooney, Arjun Kafle, Carl Crozier, Rachel A. Vann, and Kevin Garcia
Graduate Program: Soil Science
Advisor: Kevin Garcia
Poster Number: 47

The use of arbuscular mycorrhizal fungi to improve potassium acquisition in soybean in North Carolina

Potassium (K) is an essential macronutrient for plant growth and development. Beneficial soil microbes, such as arbuscular mycorrhizal (AM) fungi, have been demonstrated to facilitate the uptake of K in model legumes. Yet, is not widely quantified among agricultural legume crops. This field-based study evaluates the effect of AM fungi on growth, nutrient acquisition, seed yield and quality of soybeans (Glycine max, L). Two K-limited and ecologically diverse field locations in North Carolina were selected to evaluate this study: Sandhill and Upper Coastal Plain Research Stations. Treatment factors include two K fertilization regimes, three soybean cultivars, and two mycorrhizal conditions. The application of K fertilizer followed recommendations for field conditions, utilizing K chloride (0-0-67 kg ha- 1) to create a high K environment, and 0 kg ha-1 for a low K environment. The soybean cultivar germplasm was comprised of three, North Carolina, untreated, commercially available cultivars representing maturity groups IV, V, and VI. Seeds were coated with MycoApply® EndoPrimeTM, a commercial mycorrhizal inoculum, or left untreated. Each plot is 4 rows wide and 12.2 meters long, and measurements and data are collected from the inner-two rows. Chlorophyll content (SPAD), shoot biomass, and root samples for AM colonization were collected at eight and thirteen weeks after planting. At eight weeks, maturity groups IV and VI from one location (Sandhill Research Station) showed significant increase in biomass when inoculated with the fungal inoculum, under low K conditions for group IV and under high K conditions for group VI. Data is currently being acquired and processed for nutrient acquisition, AM colonization, seed yield, protein and oil contents to further assess the potential effect AM fungi may have on improving soybean K nutrition in North Carolina.

Katherine L. Cupo[1], Catherine G. Fudge[2], Kelly Grace Keen and Robert B. Beckstead
Graduate Programs: Animal Science and Poultry Science[1]; Poultry Science[2]
Advisor: Robert B. Beckstead
Poster Number: 50

Investigating the transmission of Cochlosoma anatis using a novel diagnostic PCR specific to the C. anatis 28S ribosomal gene

Cochlosoma anatis is a protozoan parasite that causes enteric disease in turkeys, resulting in large economic losses to the poultry industry. Little is understood about the transmission of C. anatis, which makes reducing spread of the parasite and disease outbreaks difficult. To determine what species may act as carriers and vectors for transmitting C. anatis to turkey farms, a molecular diagnostic protocol was developed. Only a partial sequence of the mitochondrial 16S ribosomal RNA gene is available for C. anatis. Nuclear genomic sequence was obtained using Next Generation Sequence (NGS) analysis of genomic DNA isolated from C. anatis parasites. Each sequence read was compared to available sequence in GenBank to identify reads that aligned to Trichomonas vaginalis and Histomonas meleagridis, two close relatives of C. anatis for which genomic sequence information is available. One 1622 bp read shared 84% identity with the 28S rRNA gene of T. vaginalis and 80.5% identity with another partial ribosomal RNA sequence from H. meleagridis but did not align to the known turkey 28S sequence, suggesting this read is the 28S ribosomal RNA sequence for C. anatis. Two primer sets were designed from this sequence read and tested for sensitivity and specificity to C. anatis using DNA isolated from lab cultures and field isolates of C. anatis and other protozoan and helminth parasites as well as DNA isolated from turkey blood and liver tissues. Both primer sets amplified target sequence from C. anatis samples and from turkey blood and liver samples. The amplicons obtained for both primer sets from the turkey blood and liver samples were Sanger sequenced, all of which aligned to their target sequences in the 1622 bp NGS sequence. This demonstrates that the primer sets are sensitive and specific for C. anatis DNA. The primer sets are currently being used to investigate potential C. anatis vectors. Because both primer sets amplified C. anatis target in turkey blood and liver samples, future molecular and histological work will investigate the ability of C. anatis to act as a systemic pathogen in theturkey.

Kimberly N. D'Arcangelo[1], Alamgir Rahman[1,2], Timothy Miles[3] and Lina Quesada-Ocampo[1]
Graduate Program: Plant Pathology[1]; Crop Protection and Discovery, Corteva Agriscience, Zionsville, IN[2]; Department of Plant, Soil and Microbial Sciences, Michigan State University, East Lansing, MI[3]
Advisor: Lina M. Quesada-Ocampo
Poster Number: 52

Implementing a population genetics approach to enable crop-specific management of the cucurbit downy mildew pathogen Pseudoperonospora cubensis

Since a population shift in 2004, cucurbit downy mildew has become the most devastating disease of cucurbit crops in the Eastern United States. This population shift in Pseudoperonospora cubensis, the causal agent, resulted in the failure of previously effective cucumber host resistance and of some commercial fungicides. Using microsatellites (simple sequence repeats or SSRs) and isolates from a wide range of hosts, it was determined that two host-adapted clades exist in P. cubensis and a clade-specific assay was developed for differentiation. A follow-up study determined that single nucleotide polymorphisms (SNPs) known to confer resistance to FRAC 40 fungicides were more prevalent in Clade 2 isolates, with resistance mutations occurring preferentially based on clade. Therefore, to further study this phenomenon while controlling for genetic differentiation by clade, field trials were conducted in 2016 and 2017 on cucumber (Clade 2 isolates) with the objective of determining the genetic structure of P. cubensis populations immediately following single-product fungicide applications. Using SSRs, a clade-specific assay, and TaqMan qPCR assays to detect FRAC 11 and 40 fungicide resistance SNPs, 880 P. cubensis isolates were genotyped. A STRUCTURE analysis revealed the same genetic clusters present in non-treated varieties with similar sources of host resistance as well as very distinct genetic shifts following fungicide applications regardless of FRAC applied. These results provide valuable insight into how fungicides and host tolerance affect P. cubensis populations and highlight the necessity for crop-specific management strategies to allow for conservation of fungicide efficacy.

James Duduit, Paul Koentka, Dilip Panthee, Penelope Perkins-Veazie, Wusheng Liu
Graduate Programs: Horticultural Science
Advisor: Wusheng Liu
Poster Number: 58

Identification of the key carotenoid biosynthesis pathway genes impacting tomato fruit lycopene content

Tomato (Solanum lycopersicum L.) is the most economically important horticultural commodity in the U.S., and is rich in vitamins A and C, fiber, essential minerals, and several health-promoting antioxidants including lycopene, a dietary antioxidant carotenoid which contributes to tomato red color and reduces the risks of cancer, cardiovascular disease and diabetes. The lycopene content in tomatoes is largely under genetic control and varies greatly among genotypes. Analysis of gene expression levels in the carotenoid biosynthesis pathway may provide genetic information to maximize tomato fruit lycopene content. In the present study, forty-six high lycopene tomato breeding lines with different genetic backgrounds were collected worldwide, representing a wide spectrum of lycopene concentration. These lines were grown to maturity in the same greenhouse at the same time, and fruits of six different developmental stages (i.e., immature green, mature green, breaker, orange, pink, and ripe) were harvested. Real-time RT-PCR is underway to quantify the expression levels of the complete carotenoid biosynthesis pathway genes individually at different developmental stages, relative to lycopene and beta-carotene content. Our preliminary data showed that breaker and pink/red stages are critical to lycopene production. Some lines have shown unique gene expression and lycopene characteristics and will be further examined at different fruit maturity stages. Earlier maturity stages of interesting lines may provide an indication as to which genes are most critical. By linking the gene expression patterns to fruit lycopene content during ripening, we expect to identify which carotenoid biosynthesis pathway genes most impact tomato fruit lycopene content.This information will be used to improve fruit lycopene content in tomato breeding and gene editing.

Emine Fidan
Graduate Program: Biological and Agricultural Engineering
Advisor: Natalie Nelson
Poster Number: 63

Fixing those gaps in our maps: Creating a flood model using satellite imagery, geospatial data, and machine learning approaches

Flood maps are often developed using remotely sensed imagery and high-water mark data to produce static maps of flood conditions. Few approaches exist for generating time series of flood dynamics due to trade-offs in the spatial and temporal resolutions of satellite imagery, lack of hydrologic in situmeasurements, and challenges associated with modeling flood dynamics in low topography landscapes. This project addresses the existing gap in our capacity to generate flood time series using a dynamic model framework that consists of delineating flood waters from Sentinel-1 synthetic aperture radar (SAR) imagery, building a Random Forest machine learning model, and applying the model at a daily time-step. Predictors in the Random Forest model include daily precipitation observations and geospatial data that capture twelve biophysical and socioeconomic variables (e.g. flood frequency, land cover, elevation, social vulnerability, population, and distance to nearest road) at the watershed scale. The dynamic model framework was developed in the context of eastern North Carolina, which experienced severe flooding due to Hurricane Florence in September 2018. Results from this work included quantified metrics of the relative importance of individual predictor variables, as well as model accuracy and predictability. In addition, change detection analysis was applied to the daily flood maps generated from the machine learning model to allow for calculations of floodwater contact time. This additional analysis was conducted to evaluate the duration of flooding within particular land-uses in the North Carolina coastal plain.

Samuel W. Flake[1], William A. Hoffmann[1], Rodolfo Abreu[2], Giselda Durigan[3]
Graduate Program: Plant Biology[1]; Departamento de Ciências Ambientais, Universidade Federal Rural do Rio de Janeiro, Seropédica, Rio de Janeiro, Brazil[2]; Instituto Florestal, Assis, São Paulo, Brazil[3]
Advisor: William A. Hoffmann
Poster Number: 65

Leaf area and growth rates influence fire-vegetation feedbacks at a savanna-forest boundary

The distribution of savannas and forests in the tropics is thought to be largely controlled by fire. Open savannas promote frequent fires, which in turn kill trees and maintain savannas in an open state, while closed-canopy forests suppress fuels needed by fires are self-perpetuating. In this way, positive feedbacks between vegetation and fire behavior can maintain very different ecosystem states even with the same soil and climate characteristics. The effectiveness of this feedback depends on several factors, including attributes of the trees, which can vary widely between savanna specialist trees which grow in the open, and forest trees which can grow both in the open and in closed forests. We were interested in two traits in particular: growth rates and leaf area. Growth rates help determine how quickly savannas can turn into forests in the absence of fire. Differences in leaf area determine how much shade trees produce and how quickly they can outcompete grasses that fuel fires. At two sites in the Brazilian Cerrado savanna ecosystem, we found that forest species grow faster than savanna species, especially in the open. Savanna trees appear to grow at the same rate as forest trees when suppressed under dense canopies, but they suffer much greater mortality rates, explaining why forest species are able to outcompete savanna species. Forest trees also support greater amounts of leaf area, which allows them to suppress grass growth and reduce fire severity. These two results, taken together, demonstrate that the presence of forest species rapidly increases the rate of conversion of savannas to forests by quickly producing shade and outcompeting grasses. Species turnover is self-reinforcing, because shading caused by forest species causes higher mortality of savanna trees. These differences are critical to modeling stand dynamics and forecasting future conditions across the Brazilian savanna biome.

Raymond O. Garcia-Rodriguez and Lindsey D. Thiessen
Graduate Programs: Plant Pathology
Advisor: Lindsey D. Thiessen
Poster Number: 73

Determining the role of the rhizospheric microbiome composition in the Granville wilt (Ralstonia solanacearum) distribution in flue-cured tobacco (Nicotiana tabacum) fields in North Carolina

Granville wilt is a major limiting factor in flue-cured tobacco production worldwide. The disease is not evenly spread throughout flue-cured tobacco fields, but often is found affecting conglomerations of plants, known as hot-spots, that are randomly distributed across the field. To test whether these hot-spots are driven by differences in the rhizospheric bacterial composition, diseased and healthy plants along with bulk soil samples (N = 142) were sampled from inside and outside hot-spots from three fields. Bulk soil samples were sent for physiochemical analysis and DNA was extracted from the rhizosphere. Library preparation and amplification of the 16S rRNA gene hypervariable regions V4-V5 was performed using the illumina 16S Metagenomic Sequencing Library Preparation following manufacturer's instructions. Amplicons were sequenced using illumina MiSeqTM with 300 bp paired-end reads. VSEARCH was used for quality filtering, dereplication, de novo and reference-based chimera removal, and operational taxonomic units (OTUs) clustering with a 97% similarity threshold. The ribosomal database project (RDP) classifier and the SILVA database were used for taxonomic assignment of OTUs. Permutational Analysis of Variance (PERMANOVA) and beta dispersion analyses indicated that sampled sites within fields had statistically significant (p-value = 0.001) different bacterial compositions. Nonmetric multidimensional scaling (NMDS) showed that healthy plants, regardless of the location within field, had a similar bacterial composition characterized by a lower species richness when compared to diseased plants. The Phylum Proteobacteria and the Class Gammaproteobacteria were the most abundant across all samples. Diseased plants had a higher abundance of the Class Betaproteobacteria; however healthy plants had a higher abundance of the Orders Pseudomonadales and Enterobacteriales. Constrained analysis of principal coordinates (CAP) suggested that cation exchange capacity (CEC), calcium (Ca), potassium (K), phosphorous (P), and bulk soil pH were the edaphic factors that had a statistically significant (p-value = 0.001) influenced on the rhizospheric bacterial composition.

Tiera M. George[1], Joseph L. Donaldson[2], Kimberly D. Gwinn[3], Stephen Chmely[4], and Carrie Stephens[5]
Graduate Programs: Agricultural and Extension Education[1]; Agricultural and Human Sciences, North Carolina State University[2]; Entomology and Plant Pathology, University of Tennessee Knoxville[3]; Renewable Carbon, University of Tennessee Knoxville[4]; Agricultural Leadership, Education and Communications, University of Tennessee Institute of Agriculture[5]
Advisor: Joseph L. Donaldson
Poster Number: 75

Perceptions of Agricultural Careers among Minority Community College Students in a Summer Agricultural Research Program

The United States is expected to add an additional 3 billion people to the planet's population by the mid-21st century. To combat food insecurity and resource inequities, the food and agricultural workforce must be innovative and skilled. Agriculture is the nation's largest employer with over 24 million people working within the industry, yet the technical skills and knowledge needed for career success are lacking. Research has shown that this divide is especially disproportionate among minority students, and the lack of minority students represented in agriculture is a long-standing, multi-faceted issue.

To address the disparities in agricultural knowledge and perceptions, and the needs for food and agricultural workforce development among community college students, the REACH program was created. REACH is an 8-week, summer residential program at the University of Tennessee, Knoxville for undergraduates from Tennessee's 13 community colleges. Students who have completed at least two community college STEM-based classes and laboratories are recruited. Selection prioritizes students who are: (a) economically disadvantaged (based on Pell grant-eligibility); (b) represent racial and/or ethnic minority groups; and (c) first-generation college students. REACH provides participants, referred to as REACH Scholars, the opportunity to develop valuable research abilities, to gain 21st Century skills, and to learn about careers in food and agriculture. This work was supported by an Initiative Grant from the USDA National Institute of Food and Agriculture.

REACH produced considerably more positive changes in the Scholars perceptions of agricultural careers than negative changes. The results indicate that the REACH program increases undergraduates' likelihood to enter an agricultural career and contributes to more positive perceptions of both agricultural occupations and entry requirements. For the profession to recruit and maintain a diverse workforce, more classroom education, support, and hands-on research opportunities must engage minority students with the perceived benefits of working in food and agricultural careers.

James Goethe
Graduate Program: Entomology
Advisor: Anders Huseth
Poster Number: 79

Pest and beneficial insect communities in North Carolina winter small grains

Across North Carolina, small grains are grown as a full season cash crop and cover crop. Wheat and other small grains represent a unique early season habitat for many pests and beneficial insects. In favorable conditions, stink bugs, plant bugs, and thrips build their populations in wheat and move to alternative crops as the wheat senesces in May and June. Small grains are also a key habitat for important natural enemies such as lady bugs, lacewings, and predatory true bugs (e.g., Orius insidiosis). Understanding the timing and magnitude of insect dispersal from ripening grain is key to predicting local pest damage risk and biological control services. The overall goal of this project is to link insect abundance and species richness in grain to landscape composition and configuration. In 2019, arthropods were sampled at 49 spatially separated small grain fields in six eastern NC counties. We used sweep nets to measure arthropods diversity and abundance in grain. Sticky cards were placed at field interfaces to measure immigration and emigration of thrips. In the first year of this study, we collected 14 species of stink bugs, with rice stink bug (Oebalus pugnax Fabricius) being the dominant species. We collected four species of beneficial ladybeetles and tarnished plant bugs. From sticky cards, 6 species of thrips were found, with the dominant species being Frankliniella tritici followed by F. occidentalis. Results contribute towards a better understanding of grain as a key early season host patch in the landscape for pests and beneficial insects.

Jamora Hamilton, Ayako Wada-Katsumata and Coby Schal
Graduate Program: Entomology
Advisor: Coby Schal
Poster Number: 87

Pick Your Poison: Effects of a Chitin Synthesis Inhibitor on German Cockroach (Blattella germanica) Survivorship and Reproduction

German cockroaches are indoor pests that can reach large infestation sizes, produce potent allergens, and can mechanically transmit pathogens to surfaces and food. Their control can be difficult because they have evolved high levels of resistance to many insecticides. Insect growth regulators (IGRs) are chemicals that interfere with growth, development and reproduction. Chitin synthesis inhibitors (CSIs), a class of IGRs, interfere with the formation of chitin, resulting in failure of insects to molt, mortality, and they can kill embryos by disrupting their normal development. In this study, we investigated whether ingestion of the CSI novaluron affected survivorship and reproduction in the German cockroach and evaluated its potential use in cockroach baits. The objectives for this study were to 1) determine the effect of a novaluron-supplemented diet on mixed German cockroach populations, 2) determine the effects of novaluron ingestion by gravid females on their offspring, and 3) determine the effects of novaluron on mating success and fertility of males. We compared the effects of varying concentrations of novaluron on mixed cockroach populations by performing no-choice and 2-choice behavior tests and recording mortality weekly. Novaluron, at 100 ppm and higher concentrations, was effective at preventing nymphs from molting and suppressing reproduction in females. Gravid females exposed to novaluron for five-day periods during their 20-day gestation were able to produce viable egg cases. Adult males were fed novaluron and allowed to mate with normal untreated females. The females were then monitored to determine if they would produce viable eggs. We found that treated males mated successfully, and novaluron did not affect egg viability in females. Overall, the results suggest that novaluron is effective on German cockroach populations and has the potential to be incorporated into cockroach baits as an additional active ingredient to delay insecticide resistance.

Zahra Hanafy[1], Jonathan Olson[2] and Sophia Kathariou[1]
Graduate Programs: Food Science[1]; Biological Sciences[2]
Advisor: Sophia Kathariou
Poster Number: 88

Transformation-mediated dissemination of antimicrobial resistance in Campylobacter jejuni

Campylobacter jejuni is a leading zoonotic pathogen, colonizing a broad range of animals and infecting humans primarily through exposure to animal feces and contaminated food or water. Currently, the drugs of choice to treat human campylobacteriosis are macrolides such as erythromycin and fluoroquinolones. Competence of C. jejuni mediates horizontal gene transfer through natural transformation via the uptake of naked DNA. The aim of this study was to determine the variance in transformation frequency for genes mediating resistance to different antibiotics, i.e., nalidixic acid (a quinolone), gentamicin, erythromycin and tetracycline. We used a chloramphenicol-resistant derivative of C. jejuni 11168 as recipient to assess the uptake of antibiotic resistance genes from a panel of C. jejuni or C. coli DNA donors. The recipient cells were incubated with donor DNA, then plated on antibiotic-containing media for calculation of transformation frequencies. The results suggest that transformation frequency for nalidixic acid resistance ranked consistently higher (~1.4x10-3) than for resistance to gentamicin (~9.8x10-5), tetracycline (~7.6x10-7) and erythromycin (=4.7x10-8). We also noticed more frequent intraspecies gene transfer than interspecies gene transfer events. Findings from this experimental model provide insights on transformation-mediated transfer of antimicrobial resistance that may occur in food, animals and/or the environment, leading to dissemination of antibiotic resistance in the agricultural ecosystem.

Brock Kamrath
Graduate Program: Biological and Agricultural Engineering
Advisor: Michael R. Burchell II
Poster Number: 133

Improving nitrogen treatment through rejuvenation techniques on an aging tertiary constructed wetland

Constructed wetlands provide an effective method for small communities to upgrade their wastewater treatment facilities to include biological nutrient removal. Gravity driven hydraulics and self-sustaining removal pathways limit energy inputs and operating costs for these systems. Studies documenting the success of young (3-N, NH4-N, org-N, and TN) indicated that performance was substandard, likely due to unfavorable inlet nitrogen speciation and insufficient O&M practices. With the aim to improve treatment at the site, accumulated detritus was removed from cell 1 in spring 2019, while cell 2 was left in its initial condition to serve as a control. After detritus removal, improved hydraulic and N treatment performance has been observed in the rejuvenated wetland cell 1. Ongoing analyses include hydraulic tracer tests, seasonal N load reductions, and monthly removal rate estimates to quantify the impact of wetland rejuvenation. Additional analyses will attempt to quantify the potential nitrogen reduction benefit of widespread constructed wetland implementation in NC.

Christina N. Kranz, Erin Rivers, Joshua L. Heitman, and Richard A. McLaughlin
Graduate Programs: Soil Science
Advisor: Joshua L. Heitman
Poster Number: 120

Linking Nutrient and Metal Leaching Losses to Infiltration Rates in Compost-soil Blends

Urban soils suffer drastic manipulation during construction, which results in degraded physical and chemical properties. Lack of organic matter and compaction are common characteristics of these soils. A new upper horizon can be created by incorporating compost into these soils in order to improve stormwater management. There has been a widespread interest in using compost to manage stormwater on roadsides, yet little research has addressed the appropriate rate of compost incorporation in urban soil to improve soil physical and chemical properties for stormwater management. The objective of this study is to determine the effects of compost amendment rates on nutrient and metal leaching in order to identify target compost rates for stormwater management on roadsides. Soil cores were prepared in the laboratory using a sandy loam soil mixed with certified yard waste compost at 0, 10, 20, 30, 40, and 50% by volume. Columns were leached with deionized water or simulated stormwater for several pore volumes to construct breakthrough curves for nutrients (nitrate, ammonium, and ortho-phosphate) and metals (copper, lead, and zinc). Results will allow us to determine nutrient and metal contributions from the compost as well as the potential for the compost-soil blends to improve stormwater quality during flow through. Ideally, we aim to identify compost rates, which improve soil physical properties substantially without creating a potential source of water pollution.

Roger D. Lawrie[1,3], Jean Marcel Deguenon[3], Robert D. Mitchell III[2], Loganathan Ponnusamy[3], Dominic Reisig[3], Alejandro Del Pozo-Valdivia[3] and R. Michael Roe[3]
Graduate Program: Toxicology[1]; USDA Agricultural Research Service[2]; Entomology and Plant Pathology[3]
Advisor: R Michael Roe
Poster Number: 124

Understanding evolved resistance to GMO-crops in insects using transcriptomics

Evolved resistance to genetically modified crops including economically important products such as cotton, corn, soybeans and many others has become rapidly and globally widespread over the last 20 years. Numerous economically important agricultural pests of crops expressing Bt (Bacillus thuringiensis) bacterial proteins (Cry1Ac, Cry1F, Cry2Ac) have evolved resistance to these Bt-toxins. Exponential increases in resistance have been reported with each field season, recent data (2019) has shown up to 1000-fold (susceptible vs. resistant) resistance to protein Cry1Ac (1 of the major active components of Bt-crops) in the Cotton Bollworm (Helicoverpa zea). RNA-seq is a method to quantitatively measure total gene expression in an organism. This method was used to measure differences in global gene expression between a Bt-susceptible and a Bt-resistant strain of the Cotton Bollworm, where the differences in susceptibility to Cry1Ac +Cry1F toxin was 100-fold (2018). We found gene expression differences that would be expected based on our current understanding of Bt mode of action and resistance including increased expression of proteases and reduced expression of Bt-interacting receptors in Bt-resistant bollworms. We have also found additional expression differences between the two strains of bollworm in genes that have not previously been thoroughly investigated. This suggests that there are multiple different mechanisms influencing the development of Bt-resistance in addition to potential previously unrecognized pathways of resistance in this agricultural pest species. Also important to consider is how investigation into the genetic mechanisms of Bt-resistance will aide in the understanding of how resistance in insects develops. Ideally this knowledge can then be applied to reduce the vulnerability of novel and next-generation integrated pest management technologies to evolved resistance in agricultural pest species.

Imani Madison, Maria Angels de Luis Balaguar, Rosangela Sozzani, Terri Long
Graduate Program: Plant Biology
Advisor: Terri Long
Poster Number: 134

The genetic programs regulating phloem cell differentiation are perturbed by iron deficiency

Plant cell differentiation is tightly regulated under both unstressed and stressed environmental conditions. Iron deficiency inhibits chlorophyll synthesis and photosynthesis, effectively inhibiting synthesis of sugars that plants need to grow, mature, and reproduce. Phloem is a tissue within the plant vasculature that transports sugars, signals, and nutrients between organs. In Arabidopsis thaliana, phloem is a model for understanding cell differentiation because it completely differentiates within a vertical file of approximately 20-25 cells that can be easily studied. In the root tip, undifferentiated stem cells divide to produce a phloem precursor cell which divides to create a slightly more differentiated phloem cell. These divisions continue until sieve elements, fully differentiated and functional phloem cells, form. After extracting RNA from this gradient of phloem cells from both iron sufficient (+Fe) and iron deficient (-Fe) roots, we inferred Gene Regulatory Networks (GRN) to infer the regulatory relationships between the genes expressed in the range of differentiating phloem cells. COGWHEEL 1 (COG1) is a master regulator of phloem differentiation in both the +Fe and -Fe GRNs. Analysis showed that COG1 likely negatively regulates phloem differentiation in 3 main ways. In a COG1 overexpressor, the major known genes controlling enucleation, a required process of sieve element differentiation in which the nucleus is removed, are repressed. In the knockout mutant, cog1-1, sieve element differentiation and phloem transport are both promoted in +Fe while in the COG1 overexpressor, sieve element differentiation and phloem transport are both delayed in +Fe. Moreover, cog1-1 exhibits impaired iron homeostasis while COG1 overexpressors exhibit enhanced iron homeostasis, suggesting that the perturbation of iron homeostasis is linked to the misregulation of phloem differentiation. Thus, examining cell differentiation at the tissue level will improve the understanding of developmental regulatory mechanisms, their interaction with stress, and the resulting consequences to tissue function and plant development.

Reny Mathew
Graduate Program: Plant Pathology
Advisor: Charles H. Opperman
Poster Number: 137

Whole Metagenome Sequencing and Analysis of the Root Microbial Community associated with the Plant-Parasitic Nematode, Radopholus similis

Plant-parasitic nematodes (PPNs) cause an estimated $157 billion in crop losses annually worldwide. The migratory PPN, burrowing nematode (Radopholus similis) is an important pest of numerous economically important crops including banana/plantain (Musa spp.) and Citrus spp. Multiple management strategies, including application of nematicides, are widely employed. However, some nematicides pose substantial risks to the environment, humans and non-target organisms. Our project involves analyzing the banana rhizosphere microbial community (microbiome), as a potential tool to manage R. similis. Currently, research on microbiomes has gained momentum across a variety of biological systems. For this project, nematodes were collected from three different zones (Lake, Northern and Southern) in Tanzania, which is one of the major world producers of bananas. By analyzing the associated microbiome with whole metagenome sequencing techniques, we identified diverse species of organisms inhabiting the rhizosphere during a R. similis infection. Examination of trends across the three sampled zones indicated a significant percentage of proteobacteria in all three zones. The reported nematode-antagonistic bacterium Serratia marcescens appeared prominently in the Northern and the Southern zones. In contrast, we found a higher percentage of a different antagonistic soil-borne bacteria, Variovorax paradoxus in the Lake zone samples. Intriguingly, R. similis was less prevalent in Lake zone samples collected from banana, indicating a potential antagonistic interaction. A functional potential analysis of the microbial community as a whole was also conducted. Although core microbial communities and similar metabolic pathways were observed from the Northern and Southern zones, notable differences in the microbial communities were observed from the Lake zone.

Eric Moorman
Graduate Program: Food Science
Advisor: Lee-Ann Jaykus
Poster Number: 144

Impact of sanitizer rotation on population dynamics and sanitizer tolerance in Pseudomonas aeruginosa and Listeria monocytogenes co-culture biofilms

The foodborne pathogen Listeria monocytogenes (Lm) and spoilage organism Pseudomonas aeruginosa (Pa) are often isolated from the same biofilm contaminated surfaces in food processing facilities. Biofilms increase the survival of microorganisms in food environments thereby increasing their potential for cross-contamination into the food supply. Our laboratory shows that when Pa is allowed to form a biofilm on stainless steel in the presence of Lm, Pa populations become significantly less susceptible to inactivation by quaternary ammonium compound (QAC) sanitizers after successive exposures (pPa populations in biofilms develop a QAC-tolerance phenotype, but they also provide a protective effect on Lm allowing the pathogen to survive treatment with QAC sanitizer at a concentrations five times the legal limit regulated by the United States Food and Drug Administration (FDA). In this work we investigate an industrial sanitation practice under review by the FDA called sanitizer rotation. In theory, biofilms with built up tolerance to a chemical sanitizer would be further inactivated by rotating to a different sanitizer with a new mode of action. The objective of this work was to investigate if Pa in biofilms with a selected QAC-tolerance phenotype can be inactivated using sodium hypochlorite (SH). As QAC and SH utilize different modes of action, we hypothesized that Pa biofilm populations with built up QAC-tolerance will not display cross-tolerance to SH. We also show that rotating from QAC to SH sanitizers increases the relative ratio of Lm to Pa populations in co-culture biofilms, a finding with potential food safety and public health implications. Although further research is needed, preliminary findings indicate that there may be value in sanitizer rotation for enhanced biofilm prevention and control in food processing facilities.

Hossam Moursi, Mohamed Youssef, and Chad Poole
Graduate Program: Biological and Agricultural Engineering
Advisor: Mohamed Youssef
Poster Number: 145

Water Quality Benefits of Drainage Water Recycling at a Tile-Drained Site in Eastern North Carolina

Drainage water recycling is an emerging practice for capturing and storing drainage water in small ponds and using this water for supplemental irrigation during dry periods. In addition to crop yield benefits, this practice also minimizes the net export of nutrients and sediment from agricultural fields to downstream surface water. Additionally, the on-farm ponds can potentially be managed for flood mitigation.

We are conducting a field study on a 22-ha farm near Bath, NC to investigate the crop yield, water quality, and flood mitigation benefits of drainage water recycling. The field is equipped with a smart water management system that regulates subsurface drainage and subirrigation. A 0.60-ha pond is used to collect surface runoff and subsurface drainage water from the farm and upstream-forested land. Rainfall, water table, surface runoff, subsurface drainage, and irrigation quantity and quality are monitored. Flow proportional composite water samples are collected.

Results of 8 months-long monitoring (May 2019 - January 2020) showed that the pond captured 36% of total runoff and drainage water, with an average load reduction of 83% for nitrate-N, 59% for soluble reactive phosphorus and 91% for sediment. During Hurricane Dorian, the field received 150 mm of rain over 5 days generating 9600 m3 of surface runoff and the pond was able to store 46% of the generated runoff. This reduces peak flows in streams following extreme events; thereby reducing the risk of flooding. If these preliminary results hold over a longer monitoring period, the water quality benefits of drainage water recycling systems would be unprecedented.

Debora Muratori Holanda and Sung Woo Kim
Graduate Programs: Animal Science & Poultry Science
Advisor: Sung Woo Kim
Poster Number: 95

Effects of multimycotoxin challenge on growth and health of weanling pigs with different weaning weights

A worldwide concern is how to mitigate the effects of fungal toxins (mycotoxins) contaminating feedstuffs that pose risks to livestock animals. The objective was investigating the effects of dietary multimycotoxin challenge on growth and health of nursery pigs with different weaning weight (WW). Weanling pigs (n = 106) were assigned following a RCBD in a 2x2 factorial arrangement on day 0. Factors were: WW, light (6.9 kg) or heavy (9.8 kg); and dietary multimycotoxin challenge, low or high (additional: 0.2 mg/kg aflatoxins, 1.8 mg/kg deoxynivalenol, and 1.8 mg/kg fumonisins). Before allotting 16 replicates/factor and 3 pigs/pen, 10 pigs from light and heavy WW were euthanized to collect gut tissue. Fecal score (days 0, 3, 5, 7, 10, 15, and 20) and growth performance (weekly) were recorded. Six lightest, intermediary, and heaviest pens among treatments had 1 pig (20 kg) per pen euthanized to collect ileal digesta and gut tissue. Data were analyzed using SAS mixed procedure. On day 0, pigs with heavy WW presented lower oxidative stress (malondialdehydes and protein carbonyl), lower inflammation (TNF-a), and increased local immune activation (IL-8 and IgA), whereas presenting decreased systemic immune activation (IgG) in the gut. During the study, pigs with heavy WW presented increased growth performance (weight, gain, and feed intake), whereas mycotoxins reduced growth performance. Pigs with heavy WW presented less diarrheal stools on days 0, 10, and 20. Mycotoxins reduced nutrient digestibility. At the end, pigs with heavy WW showed lower oxidative stress (malondialdehydes and protein carbonyl) and decreased local immune activation (IL-8 and IgA) in the gut. Mycotoxins increased oxidative stress (protein carbonyl) and inflammation (TNF-a) in the gut. Pigs with heavy WW showed pre-existing differences that may justify their lower mycotoxin susceptibility. In conclusion, weaning heavier pigs can be a strategy to reduce mycotoxin deleterious effects in nursery pigs.

Jennifer A. Myers, Dilip R. Panthee
Graduate Program: Horticultural Science
Advisor: Dilip Panthee
Poster Number: 174

Understanding Genetic Resistance to Bacterial Wilt in Tomatoes

Resistance to bacterial wilt caused by Ralstonia solanacearum in certain tomato lines used today is a very desirable trait with several unknowns. As a soil borne bacterial disease, there are not many consistently effective methods for controlling and managing this disease in the field. This issue makes developing a good resistant tomato line the most ideal solution. Although bacterial wilt resistance has been identified, this resistance can vary widely across field locations, temperatures, and bacterial strains. Combined with the less desirable horticultural traits that are usually linked with bacterial wilt resistance, there is a great interest for better understanding how genetic resistance works, and how to improve not only for resistance, but for fruit quality as well. In this study, RNA-Seq analysis provided a comprehensive look at changing gene expression in the resistant HI 7998 line compared to the susceptible NC359 line. These changes in gene expression levels give a more detailed look at what genes and gene types play an important role in conferring resistance. Comparing these genes to previously identified regions found to be highly linked to bacterial wilt resistance further validify the role some of these genes might play in conveying bacterial wilt resistance. A better understanding of how tomato lines covey resistance in the U.S. will help in breeding better bacterial wilt resistant tomato lines that are more suited for U.S. tomato production quicker and more effectively.

Jace Natzke and Jose Bruno-Barcena
Graduate Program: Microbiology
Advisor: Jose Bruno-Barcena
Poster Number: 148

Development of Azotobacter vinelandii as a microbial factory: Continuous conversion of carbon monoxide to ethylene gas

Ethylene is an essential commodity feedstock used for the generation of a variety of consumer products, but its generation demands energy intensive processes and nonrenewable substrates (such as crude oil and natural gas). Azotobacter vinelandii is an obligate aerobic diazotroph that has the proven transient capability, in closed systems, to reduce and couple molecules of carbon monoxide into ethylene using its vanadium nitrogenase. During this reaction, carbon monoxide demonstrates reversible competition with dinitrogen for the active site of the vanadium nitrogenase which limits nitrogen fixation, oxygen availability, and redox generation; leading to a complete cessation of cell proliferation in hermetically-sealed batch cultures. In this study, we customized and tested a continuous two-stage stirred-tank system, which mitigates the negative effects of inhibitory compounds on microbial growth, in order to continuously culture A. vinelandii under controlled exposure to carbon monoxide. Using this system, we were able to achieve a culture capable of dynamic growth while exposed to a constant flow of 5% carbon monoxide-enriched air; producing ethylene at a yield of 302 µg ethylene g-1 glucose consumed. Furthermore, we identified carbon monoxide mass transfer and in vivo nitrogenase activity as central reaction-limiting factors. If eventually adopted at industrial production scale this technology has the potential to significantly lower the total energy and recovery costs, along with greenhouse gas emissions, associated with current ethylene production strategies while simultaneously lowering dependence on petroleum crude oils.

Cassondra S. Newman[1], Brian E. Scheffler[2], Ramey C. Youngblood[3], Ryan J. Andres[1], Amanda M. Hulse-Kemp[2], Jeffrey C. Dunne[1]
Graduate Programs: Crop and Soil Sciences, North Carolina State University[1]; Genomics and Bioinformatics Research Unit, USDA-ARS[2]; Institute for Genomics, Biocomputing, and Biotechnology, Mississippi State University[3]
Advisors: Jeffrey C. Dunne and Amanda M. Hulse-Kemp
Poster Number: 149

Tailoring a Genotyping-by-Sequencing (GBS) Approach to Virginia-type Peanut to Facilitate Economical High-Density Genotyping

The objective of this research is to develop a high-throughput genotyping pipeline specifically for the improvement of peanut cultivars for the Virginia-Carolinas (VC) production region. Integrating genotyping into the peanut breeding program is imperative to increasing existing, beneficial allele frequency and tracking the introgression of novel alleles in future cultivars. Antecedently, this requires improved marker discovery and development of a genotyping approach that is both efficient and economical. To accomplish this objective, a three-step approach was carried out that consisted of: 1) Development of a Virginia-type peanut reference genome, 2) Alignment of whole-genome sequencing data from 48 diverse peanut varieties to this reference genome for single nucleotide polymorphism (SNP) discovery, and 3) In silico digestion of the reference genome to determine an optimal pair of restriction enzymes for genotyping-by-sequencing (GBS) that would capture the highest number of SNPs. This genotyping pipeline will allow the implementation of genomic selection, enabling the rapid development of improved cultivars for the VC region. Furthermore, on a per sample basis, genotyping costs will be reduced 75% compared currently available alternatives.

Janel L. Ohletz and Jeffrey G. White
Graduate Program: Soil Science
Advisor: Jeffrey G. White
Poster Number: 154

LASSO or DRIS: Understanding the nutrient balances of NC corn growers

Currently ranked 18th in grain corn production, N.C. had 840,000 production planted to corn in 2017. Despite harvesting two and a half times more grain corn (119 mil. bu.) than other southeastern states, N.C. has one of the lowest yields per acre (142 bu ac-1). The traditional approach for nutrient management decisions has been to use sufficiency ranges to determine crop macro- and micronutrients needs and the rate. The objective was to compare two multivariate techniques for nutrient analysis, the diagnosis and recommendation integrated system (DRIS) a system for finding the most limiting nutrient using tissue samples, and least absolute shrinkage and selection operator (LASSO) a generalized regression method that performs variable selection and regularization. The goal was to access which system most accurately determined nutrients most correlated with yield outcomes. In 2017 and 2018, we evaluated the nutrient status of soil and plant tissue samples across the growing season from high yielding growers across NC. Linear and multivariate regression were performed relating yield to plant tissue and soil samples at four growth stages. Most individual variables between plant tissue and soil nutrients were not highly correlated to yield except for Mg (R2=0.21). Using DRIS, the nutrient balance index for macronutrients had a higher correlation to yield (R2=0.3), but only for the sample taken at tasseling. Conversely, the LASSO regression model resulted in a much higher correlation to yield (R2=0.87) using both tissue and soil samples from the vegetative growth stage. Detecting a nutrient imbalance earlier will enable enough time to affect a change in corn yield. The soil-plant interface is a complex system and using LASSO enabled a better understanding of the covariates in the complex soil-plant interface that most likely affected yield.

Aleah Querns
Graduate Program: Plant Biology
Advisor: Seema Sheth
Poster Number: 166

The Role of Thermal Tolerance and Plasticity in the Invasive Capabilities of Mimulus guttatus

The Role of Thermal Tolerance and Plasticity in the Invasive Capabilities of Mimulus guttatusThe rise of globalization has expedited the spread of organisms beyond their natural range, in turn allowing further opportunity for species introduced to novel habitats to outcompete native inhabitants. These instances of invasion constitute unique events that allow us to study fundamental ecological and evolutionary processes. Many questions remain about how invasive species persist and outcompete native species. Two separate hypotheses are that invasive plants evolve 1) a greater ability to alter their phenotype in response to changes in the environment (i.e. plasticity) and 2) the ability to perform well across a broad range of environments (i.e. environmental tolerance). Invasive populations may show higher phenotypic plasticity compared to their native counterparts as novel conditions may select for genotypes most responsive to environmental change. Additionally, invasive populations may show a greater thermal breadth and altered thermal optima compared to native counterparts as a result of strong selection from novel temperature regimes. We tested these predictions in native and invasive populations of the perennial seep monkeyflower, Mimulus guttatus (Phrymaceae). We grew multiple genotypes from 18 native (United States) and 13 invasive (United Kingdom) populations and exposed clonal replicates of these individuals to a range of temperatures. We then constructed thermal performance curves and estimated phenotypic plasticity for each population. Examination of the ecological and evolutionary processes that facilitate invasions will have wide-reaching insights for both fundamental biology and applied management.

Ourania Raftopoulou[1], Elliot Ryser[2], Cameron Parsons[3], Driss Elhanafi[4], Sophia Kathariou[1]
Graduate Program: Microbiology[1]; Food Science & Human Nutrition, Michigan State University[2]; Genetics, North Carolina State University[3]; Biomanufacturing, North Carolina State University[4]
Advisor: Sophia Kathariou
Poster Number: 168

Sequence Genetic barcoding of Listeria monocytogenes Strains and Potential Phenotypic Impacts

Listeria monocytogenes is a foodborne pathogen that is notorious for causing severe, invasive disease and multistate outbreaks via a wide range of food products, including fresh produce. Sequence tagging of foodborne pathogens, such as Listeria, can be employed for functional assessments of the ability of different strains to colonize and survive food products and abiotic surfaces. By assigning a unique barcode to each strain, monitoring of the relative abundance of the strains at different time points can be enabled through next generation sequencing of total DNA extracted from inoculated products. Listeria monocytogenes strains with diverse serotypes, genotypes and sources were tagged with unique barcodes of approx. 30 nt cloned into the barcoding integration vector pTZ200.mix, which was then inserted in the same chromosomal locus in each strain. A panel of 8 different strains, representing different serotypes were each barcoded with unique sequence tags. The parental strains and their barcoded derivatives were assessed for growth, motility, biofilm formation, hemolysis and virulence in the Galleria mellonella insect model. Biofilm formation was evaluated in polystyrene microwells with the crystal violet assay. Hemolytic activity was determined at 37°C on blood agar plates. Motility was assessed at 25oC with 10-µl spot inoculations on soft agar. Growth at 4- 37oC was assessed on agar plates. For virulence assessments, Galleria larvae were injected with 105 and 106 CFU, incubated at 37°C and monitored for survival over 7 days. No significant (p0.05) differences were observed in biofilm formation, growth and virulence between barcoded and parental strains. However, certain barcoded derivatives were impacted in hemolytic activity and motility, with the direction of the change being strain-dependent, and only 4 of the 8 barcoded strains were not impacted. The findings suggest that barcoded derivatives should be used with caution due to potential effects on certain phenotypic traits.

Wendy Rivero, Elizabeth Shin, Qingyang Wang, Deepti Salvi
Graduate Program: Food Science
Advisor: Deepti Salvi
Poster Number: 176

Effect of Plasma-activated Nutrient Solution on the Growth and Quality of Hydroponic Sweet Basil

Hydroponic farming utilizes a water solution enriched with nutrients (NS), instead of soil, to optimize yield. Plasma, the fourth state of matter, generates reactive oxygen and nitrogen species when exposed to water, known as plasma-activated water (PAW). Similar to PAW, Plasma-activated nutrient solution (PANS) has increased plant growth in hydroponics systems, but its effect on food quality is unexplored. The objective of this study was to compare the yield, morphology, and quality of sweet basil plants grown hydroponically in an ebb-and-flow system with either PANS or NS. Chemical characterization of PANS involved quantification of oxidation-reduction potential (ORP), electrical conductivity (EC), pH, the concentration of reactive species: nitrate and nitrite, and plant nutrients concentration. Yield (fresh and dry weight, and moisture content), morphology (nodes and branches, plant height and width, node appearance rate, and leaf index) and quality (color, texture, and mineral composition) were analyzed. Despite no significant difference in EC, ORP rose significantly from 46.0 ± 1.46 mV to 152.0 ± 19.9 mV, suggesting that reactive species were generated from the acidification process. Nitrate concentration in PANS was not significantly different from NS, while nitrite increased significantly from negligible levels to 33.9 ± 2.6 ppm. Although the composition of PANS showed higher concentrations of nitrate, total nitrogen, zinc, and copper, there was no significant difference in terms of yield, quality, or leaf mineral content (p

David Felipe Rodriguez-Mora
Graduate Program: Plant Biology
Advisor: Jillian De Gezelle
Poster Number: 177

Integrating morphology and ethnoecology to test the classification of the Yage (a.k.a. Ayahuasca) vine among the Cofan indigenous people of southwestern Colombia

Yage (a.k.a. Ayahuasca) is an ancient medicinal and psychoactive vine used in ritual by Amazonian cultures since pre-Columbian times. Growing awareness about this ritual in the XX century led to the proliferation in the number of studies that endorse Yage's medicinal value, mainly for psychological disorders. Despite the rising importance of this plant, science to date only recognizes Banisteriopsis caapi as the Yage vine, considering minor the variations of the leaves, flowers, and fruits among their cultivars. Yet indigenous people recognize other traits to tell meaningful variation among wild Yage vines, especially differences in the stems.

This work assesses the diversity and classification of the wild Yage vines among the Cofan indigenous people of southwestern Colombia, emphasizing stem variation. At least thirty specimens per vine will be collected and examined. The vine diversity will be determined through a statistical analysis of A. The relationships between four elder shamans (traditional healers) in the Cofan community of Jardines de Sucumbios with their wild Yage vines (including the characters used to recognize each vine); B. Each vine's physical form; and C. Each vine's ecology. The correlation between the Cofan classification concepts and the results of the proposed analyses will be tested, to identify meaningful variation among the vines. Furthermore, the Cofan classification of the vines will be assessed through a double-blind experiment in which the four elder shamans, in addition to five younger shamans and six shaman apprentices, will be asked to name from photographs and dry plants previously recognized Yage vines by the elder shamans. Currently, this work has found three new Yage species, raising awareness for the conservation of Yage to face current risks derived from the widespread clonal propagation of B. caapi via stem cuttings, along with the destructive overharvesting of wild populations, and the degradation of their native habitat.

Tsharre Sanders
Graduate Program: Youth, Family, and Community Sciences
Advisor: Annie Hardison-Moody
Poster Number: 183

I Won't Let Go: Holding on to Faith as a Black LGB Christian

Although there seems to be a growing acceptance for lesbian, gay, bisexual (LGB), or same-gender-loving (SGL) identities within some Christian denominations, many Black LGB/SGL Christians are still receiving messages condemning their identities through involvement in more conservative Christian communities. For many, this is a source of discomfort and tension which can force them to engage differently with their faith practices. Through 11 in-depth interviews with Black LGB Christians analyzed using an interpretative phenomenological approach, I will explore how they make sense of faith and the impact that has on their sense of self. The paper also explores the effects of this intersection of identity on self-esteem and levels of faith. Among those who have somehow been able to reconcile their faith and sexual orientation, there tends to be deeply personal understanding of God. Among those who do not currently have an affirming faith stance, there are pervasive feelings of inadequacy and a lot of tension. Some of the thematic elements across the interviews include shame, secrecy, and hiding, non-desirable effects on mental health, performative aspects in churches, and avoidance of sexuality and sexual ethics within their church communities. The findings suggest a need for a shift in Black Christian families and networks to offer more social support for their LGB congregants/members.

Xiaonan Shi, Ricardo Hernández, Mark Hoffmann
Graduate Programs: Horticultural Science
Advisor: Mark Hoffmann
Poster Number: 193

The impact of stolon removal frequency on asexual reproduction of day-neutral strawberries (Fragaria x ananassa cv. 'Albion')

Strawberry plants are commercially propagated by asexual reproduction. After California, North Carolina has the second largest strawberry nursery industry in the United States. However, the strawberry cultivars with perpetual flowering traits produce daughter plants and flowers simultaneously, resulting in cost-inducing factors of manual flower removal and sub-optimal daughter plant production rates. 'Albion' is a day-neutral strawberry cultivar, commercially used in North Carolina, South Carolina and Georgia, mostly for extended season production. However, the low availability of 'Albion' plants, ready to be planted in time, is a limiting factor for strawberry growers in the Southeast. We hypothesize that daughter plant harvesting techniques will impact daughter plant production, and therefore can be used as a tool to optimize strawberry nursery production methods. Here we investigated the influence of stolon removal frequency on daughter plant production of strawberries. Strawberry (cv. 'Albion') plants were grown under controlled environment (26?, 507 µmol m-2 s-1 PPFD, 14h/10h D/N cycle) in soilless media (coconut coir : perlite, 50% : 50%) fertilized by customized nutrient solution. Stolons with daughter plants attached were harvested at one-week and three-week intervals, and once after twelve weeks. All strawberry plants in the growth chamber exhibited no inflorescence. The plants harvested after twelve weeks produced significantly more daughter plants per plant (102 per plant), compared to 33 daughter plants in three-weekly harvest.

Sydney L. Shuping, Allison N. Renwick, KaLynn Harlow, Jeffrey R. Sommer, Christina M. Merkley, and Casey C Nestor
Graduate Program: Animal Science
Advisor: Casey Nestor
Poster Number: 195

Undernutrition reduces mRNA abundance of kisspeptin and neurokinin B in young male sheep

Proper energy balance is important to ensure reproductive success. Chronic nutrient restriction is known to suppress hypothalamic-pituitary function, but the central mechanisms whereby undernutrition inhibits GnRH/LH secretion remain largely unknown. KNDy neurons, which co-express kisspeptin, neurokinin B (NKB), and dynorphin, form a unique population of cells in the arcuate nucleus (ARC) of the hypothalamus and play a critical role in GnRH/LH pulse generation. Based on our recent evidence that chronic feed restriction reduces kisspeptin and NKB protein expression in young male sheep, we hypothesized that nutrient restriction would inhibit mRNA abundance for kisspeptin and NKB. Fourteen wethers were placed into a fed to maintain body weight group (n=6; Fed) or a feed-restricted to lose 15-20% of pre-study body weight group. (FR; n=8). Weekly blood samples were taken via jugular venipuncture and plasma was stored at -20°C. At Week 13, animals were euthanized following blood collection, brain tissue was perfused with 4% paraformaldehyde, and tissue containing the hypothalamus was collected. Following submersion in 20% sucrose, hypothalamic blocks were sectioned at 50 µm on a freezing microtome, and stored in a cryopreservative solution. To assess changes in mRNA abundance, we used a relatively new in situ hybridization technique, RNAscope, to quantify mRNA for kisspeptin and NKB in the ARC with probes that were ovine-specific. Results showed that feed restriction reduced the number of kisspeptin mRNA-expressing cells (Fed, 231.2 + 14.4 vs FR, 100.3 + 35.9) and NKB mRNA-expressing cells (Fed, 192.7 + 18.4 vs FR, 97.3 + 21.7). Furthermore, analysis of kisspeptin and NKB co-expressing cells (30 cells/animal) revealed that feed restriction significantly reduced the average mRNA integrated density for NKB, but not kisspeptin, compared to Fed controls. Together, these findings further support a role for kisspeptin and NKB in the central mechanism governing GnRH/LH secretion during undernutrition in male sheep.

Qing Xia, Joshua Heitman, Wei Shi
Graduate Program: Soil Science
Advisor: Wei Shi
Poster Number: 216

Investigation into Soil Microbiota Structure and Activity under Different Soil Texture and Pore Size Distribution

Soil texture is one of the most important edaphic factors influencing soil nutrient cycling, ecological processes, and agricultural productivity. However, its impact on the soil microbial community, the vital biological component driving biogeochemical element cycling, has received little attention. In this work, we examined how bacterial and fungal communities varied with soil texture through modulating sand/clay content, bulk density, and moisture. Both bacterial and fungal rRNA genes and rRNA-derived cDNAs were high-throughput sequenced, and then sequences were analyzed for estimating microbial diversity and structure. The outcomes of this work help answer the question: how can sand/clay content be translated into estimates of more laborious and expensively determined microbial diversity and structure. Therefore, this work contributes to the development of pedotransfer functions in soil microbiology.

Saeed Ahmadi Oloonabadi
Graduate Program: Design
Advisor: Perver Baran
Poster Number: 4

Mobile Augmented Reality, Inclusive Community Engagement, and Healthier Neighborhoods

Research shows that improving built environment features, such as sidewalks or trees, may enhance health and physical activity. Many racial/ethnic and low-socioeconomic communities, however, have inequitable access to environments that promote wellbeing. The emergence of digital technologies has created new opportunities to advance community engagement efforts that have been carried out to address these disparities. Digital engagement methods foster active citizen-government communications and mitigate the costs, time, and resources of participation. The integration of smartphones in creating and sharing information and benefitting from their situating and sensing capabilities is one promising area of digital engagement.

The purpose of this research is two-folded: to develop a participatory mobile augmented reality platform to assess street features that are believed to improve walkability in disadvantaged communities, and to evaluate this platform in terms of its user experience satisfaction and participation improvements. Augmented reality or AR is an interactive technology that blends digital information into the real-world experience of users. To this end, a mobile AR app has been developed that provides an AR experience of walking-related street features as well as the entire neighborhood design. This study is guided by a hybrid approach that intersects community-based participatory research and mixed-method research.

As part of the research, the usability of the app is being evaluated with several Graduate students in the College of Design at NCSU and experts in the New Jersey Institute of Technology. Moreover, three community meetings are being coordinated in Charlotte, NC, to collect data with community-specific street features in a real-world context. Through these activities, we will assess how AR platform may improve the process of community engagement. Master of Urban Design students at UNC Charlotte and urban planners from the City of Charlotte will also contribute to this interdisciplinary research by creating walkable design scenarios for the AR platform.

Ashley Anderson
Graduate Program: Graphic Design
Advisor: Matthew Peterson
Poster Number: 9

Working with Imagery: Mediating Image Rescripting for Anxiety with Multimodal Digital Storytelling

An estimated 32% of adults in the United States experience an anxiety disorder at some point in their lives according to the National Institute of Mental Health. Even though a large segment of the population is affected by anxiety, many people still lack access to treatment and coping resources. Cognitive behavioral therapy is a type of psychotherapy aimed at helping people develop skills needed to challenge unhelpful patterns of thought and behavior. However, traditional treatments for anxiety and other common psychological disorders can be costly and time-consuming. Beyond these logistical barriers lies an enduring stigma of mental illness that discourages people from seeking treatment.

Health and wellness applications like Sanvello and MindShift are bringing well established mental health practices and coping strategies to people directly. While efforts to expand such resources into a digital space have made them available to more people, many of these apps fail to take full advantage of the affordances of mobile digital devices. Such devices make it easy to create and manipulate multiple forms of media, including text, audio, still images and video suggesting opportunities beyond converting existing therapy interventions to a static device screen.

Leveraging the affordances of mobile digital devices, this investigation explores how a mobile therapy application might be designed to help challenge negative automatic thoughts related to planning and goal setting. Drawing from imagery-based interventions used in cognitive behavioral therapy, this study combines imagery change techniques with multimodal digital storytelling to design a system to assist people in representing and manipulating their mental images. This research employs making as an investigative tool in developing visual strategy for eliciting, reframing and transforming mental imagery.

Ezgi Balkanay
Graduate Program: Design
Advisor: Burak Erdim
Poster Number: 17

Housing and Citizenship: Politics of Urbanization in Neoliberal Economies

Just a few gecekondu or squatter settlements have remained in Modern Turkey. Gecekondu was the first place where the rural migrants stayed when they come to the city. Perceived "informality" has been contributed to global discussions: spatial justice, housing problem, and gentrification.

"Gecekondu" has been extensively examined and portrayed in various forms of public discourse and cultural production since its first appearance in the 1950s. After the 1980s, the former gecekondu become established neighborhoods. Even the ones who have a long resistance history, like Dikmen in Ankara, have been demolished. A few remaining neighborhoods, such as Küçük Armutlu in Istanbul, have been highly marginalized.
The shifting role of gecekondu in Turkey's modernization/urbanization highlights changing perceptions by its residents and outside groups, governmental agencies and experts. Several different agents and agencies are involved in the urban renewal and the preservation of these districts while simultaneously redefining their roles as well as the identity of the neighborhoods.

This project examines the politics of space production in neoliberal economies through the analysis of the transformation of two gecekondu in Turkey, namely, Küçük Armutlu and Dikmen. It examines the politics of the transformation of these districts, from gecekondu to apartment blocks, through an examination of the shifting roles of each of the agents. It analyzes the representation of the subjectivities of these agents and the neighborhoods involved through various forms of public discourse and cultural production. Utilizing and interrogating news media, documentaries, movies, novels, political satire, art exhibitions, postcards, photographs, and short essays; this project studies how these sources represented and constructed the distinct identities of these agents, as well as the built environment.

This project claims that well-established dichotomies of informal and formal lands can be challenged through the overlooked similarities in the narratives of the gecekondu and apartment blocks.

Ashley Beatty
Graduate Program: Art and Design
Advisor: JMark Scearce
Poster Number: 20

The Female Umwelt: Ethics, Technology and Critical Design

Across the menstrual cycle there are distinct and predictable shifts in sex hormones, particularly estrogen and progesterone, which occur at both ovulation and menstruation. These sex hormones are potent neuromodulators with opposing effects. From the 1930's through today, studies across the fields of behavioral, evolutionary, cognitive and social psychology, medicine and modern neuroscience have characterized this duality yet this information is not common knowledge. Drawing from feminist philosopher Luce Irigaray's theories of sex difference and the umwelt of biologist Jacob von Uexkull, this project aims to pool transdisciplinary knowledge into an accessible format in order to educate and promote awareness of the perceptual effects of sex hormones while provoking ethical considerations over the application of this knowledge. Critical Design, which borrows from both industrial design and conceptual art, was identified as the ideal medium for this project. Satirical near-future consumer products are presented as a tangible form of social critique. This project proposes the next generation of menstrual cycle tracking apps, an automatic in vivo system that accurately identifies and publicly displays menstrual cycle phase. Framed as a design team's internal product pitch within a large tech company, two divergent value narratives are outlined: One, a marketing strategy for the end user in which the system is a tool for self-knowing and also, through public spectacle, a social empathy generator. Two, a framework of cycle phase reaction patterns for the company's data analytics and advertising sales department in which the system is a surveillance tool with unrivaled access to lucrative behavioral data. The consumer product satirizes the increasingly intimate and invasive aspects of our technology while the value structures satirize the slippage of privacy and human rights in our current data economy. Together they elucidate the topic while weaving a cautionary tale about behavioral inference and commodified categories.

Joshua E. De Jesús Cruz
Graduate Program: Industrial Design
Advisor: Timothy Buie
Poster Number: 54

Redefining Virtual Reality Devices: Industrial Design + VR Education

The potential of virtual reality has been explored thoroughly for the last 5 years with companies like Oculus and HTC pushing the boundaries of VR devices further than we expected. The problem is that the fast development of the virtual reality industry has driven the creation of its devices to address the entertainment and gaming market and user needs, but What if we wanted to use virtual reality for creative purposes? Current gaming-based virtual reality devices lack intuitive and ergonomic control when used with virtual sketching applications, such as Google's Tilt Brush or Gravity Sketch. Consequently, companies aiming to use virtual reality for creative purposes have been forced to adapt their user interfaces to these devices, creating a gap between the tool the users have at their disposal and task they want to achieve. This study aims to redefine the virtual reality devices we know and explore the possibilities of new devices that can offer users an improved experience of freehand gesture control interfaces basing user needs and design criteria on a virtual reality sketching and concept development class for industrial design college students.

Sara Fisher
Graduate Program: Art & Design
Advisors: Todd Berreth, Patrick Fitzgerald, Tania Allen
Poster Number: 64

Other as Spectacle: Women, Queerness, and the Male Gaze

TheMale Gaze was first termed in Laura Mulvey's 1975 article Visual Pleasure and Narrative Cinema, where it was defined as the visual language that frames women as an erotic object to be displayed for the purpose of pleasing an assumed male audience. Within this framework, women are valued primarily as sex objects and limited to a specific gender role, while queer individuals are treated as objects to be feared or ignored. This project, Other as Spectacle, aims to make the audience aware of their own relationship with the male gaze, and the ways in which individuals can perpetuate the social expectations of heterosexuality and the objectification of women. The theme of the work surrounds the concept of a masquerade. As the user steps in front of an interactive projection, they will find themselves in the role of an 'outsider' or, in this case, 'the monster.' The viewer will face their own reflection in a mirror, and witness as their image is distorted and augmented within the projection. Their monstrous reflection will be contrasted with the figures of the masquerade, each adhering to their respective roles under the male gaze. In this installation, the viewer will play the role of the spectacle; their reflection on the screen slowly morphing into the figure of a monster as the characters on the screen observe and react to their presence. Other as Spectacle builds on precedents of feminist theory, queer theory, and interpretations of Gothic Horror. The installation uses the combined technology of the Xbox Kinect, a projector, and a one-way mirror. TouchDesigner, a design and programming tool that allows for real time interactions, was used to create the projected visuals.

Katie Frohbose
Graduate Program: Graphic Design
Advisor: Deborah Littlejohn
Poster Number: 69

Data Sense: Facilitating Citizen Sensemaking of Smart Environments through Augmented Urban Experiences

A smart city is an urban area that uses sensors and smart agents in the Internet of Things (IoT) to manage resources and services efficiently. It functions through the generation and translation of data among humans and technological “smart objects.” While these affordances aim to make life easier, seamless, and better for its citizens, humans are nevertheless implicated by its inherent structure that relies on human data. As such, informing citizens of the mechanics of smart infrastructure is important. Building transparency into smart designs is difficult when embedded sensors, data, and algorithms are hard for non-expert citizens to conceptualize. A re-imagining of how data can be experienced in ways that go beyond flat visualizations can be useful to help bridge the cyber-physical-digital worlds the IoT transgresses.

The affordances of Augmented Reality and GIS technologies present opportunities to “keep the human in the loop” by facilitating embodied, multi-sensory, and contextual interactions with sensors and data in smart environments. When combined, these technologies present a space for non-experts citizens to “make sense” of data in a cyber-physical-digital way. The objective of this investigation is to explore modes of interaction between citizens, data and embedded environmental sensors to aid in citizen sensemaking of smart environments. This research is situated within a More-than-Human and New Materialist framework that understands the smart city as a relational ecosystem of human and nonhuman actors that co-mingle and co-constitute space with varying degrees of affect and agency. Studies are derived from two semesters of design inquiry that utilizes a combination of user-centered, speculative, participatory, and research-through-design methods. The result will be a taxonomy of approaches in which users can engage with digital data materiality in new forms

Randa Hadi
Graduate Program: Graphic Design
Advisor: Denise Gonzales Crisp
Poster Number: 85

A State of (Betweenness): Narrating Transnational Family Histories Through a Dynamic Digital Archive

Transnational families are characterized by their geographical dispersion. These families become fragmented and scattered due to social, economic, and political reasons but often continue to keep close relationships across borders. Transnational families lack a concrete connection to their families and home. This study proposes a dynamic, digital family archive that provides a space for transnational families to share, annotate, experience, explore, connect, and promote representation through family histories. Rather than attempting to draw out the truth, this study exploits family narratives to create a sense of connection. This research combines family narrative characteristics and multimodal digital storytelling to inform the design of an interface that provides a space for individuals to feel connected through stories giving transnationals a space to weave together seemingly disparate past events into a story about where they have been, where they are, and where they are going. The research proposes multiple options to suggest how such a system might function.

Kahren Kersten
Graduate Program: Industrial Design
Advisor: Kelly Umstead
Poster Number: 116

Reforming the Fridge to Reduce Household Food Waste

The topic of food waste is becoming increasingly important on a global scale. Food waste negatively impacts the environment, economy and quality of life of developing countries. Notably, half of all edible food waste in the developed world occurs in the household, and as such, this is an important setting where an intervention can make an impact. To that end, this research investigates how the household fridge can be redesigned to aid households in lowering their food waste. A mixed method study is underway to guide the development of a new fridge concept. The research began with a series of Fridge Studies investigating fridge storage strategies and how fridge design elements contribute to or reduce food waste. Household compositions of singles/ house sharers; couples; and families were targeted for participation. Thirteen separate households were recruited, including eighteen total active participants. Each household engaged in one or more stages, including a video recorded grocery shop unload into the fridge; fridge storage and food waste documentation; followed by semi-structured interview to discuss fridge usage observations in some cases. The data collected supports secondary research findings and highlights key food waste contributors to be a lack of accessibility and visibility as food items get pushed to the back of the fridge or buried at the bottom of drawers. A series of new fridge concepts are being developed to address these problems. A predictive markets methodology will be used to evaluate the appeal of these concepts in an online survey among a broad demographic sample of US residents aged 18+. The results of this test will direct concept development which will subsequently be reviewed in a focus group including some previous Fridge Studies participants. Reviews from two refrigerator design experts will also inform the direction of the final design.

Hossein Saedi
Graduate Program: Design
Advisor: Arthur Rice
Poster Number: 181

Go Green – Go Healthy The Impact of Using Natural Green Elements in Residential Building Lobbies on the Attention Restoration of Residents

This study aimed to explore the potential impact of micro-interactions with natural green elements on attention restoration as a component of mental health. Today, 55% of the world's population lives in urban areas, a proportion that is expected to increase to 68% by 2050. One way of responding to this population`s accommodation need is high-density developments. Densification usually means no front or back yards and limited access to a natural environment. Also, studies on average hours per day spent in primary activities for the urban population suggests that most time is spent at home, at work, and commuting between these two locations.

Access to natural environments provides people with numerous health benefits. Research has determined that green landscapes can promote cognitive functioning and recovering from attentional fatigue. However, population growth, densification, and the new lifestyle of urban residents have limited the citizens` interactions with green environments. So it is essential to maximize the benefits that citizens can receive during their limited interaction with natural elements.

Attention Restoration Theory indicates that sustained attention is one of the critical factors for successful cognitive functioning. This experimental study compared the results from a Sustained Attention to Response Task for 38 residents of a high-rise residential building. Participants were randomly assigned to experience one of two versions of a building`s threshold modeled in a 3D virtual environment. One model included natural green elements, and the other did not. Participants completed the SART twice. Once before experiencing the threshold, as the baseline of their attention level, and once after. The results indicated that those who interacted with natural green elements in the building threshold for 50 seconds obtained demonstrably higher SART score and expressed less cognitive errors. This research outcome supports the potential positive effect of micro-interaction with naturalgreen elements on health and well-being.

Helia Taheri
Graduate Program: Design
Adviser: Traci Rose Rider
Poster Number: 201

Factors of Using Operable Windows and their Relationship with Thermal and Indoor Air Quality Condition in K-12 Classrooms in Raleigh and Denver

Schools are the second most important environment in children's lives after their homes (Mendell et al., 2013), supporting the importance of school environments in students' learning performance, health, and comfort (Annesi-Maesano et al, 2013). Ventilation is one of the factors impacting student learning performance (Gao et al., 2014); appropriate ventilation can be provided through operable windows, exhaust fans, or mechanical ventilation systems, or a mix of these strategies (Gao et al., 2014). Additionally, different building elements can impact ventilation quality such as air ventilation systems, HVAC systems, and building envelopes, including windows (Catalina and Iordache, 2012). Ventilation also impacts thermal comfort and indoor air quality, which are viewed as the most important comfort conditions in improving occupant health and productivity (Pan et al., 2018). A literature review of thirty-one articles - which has been narrowed down from 136 papers found from Web of Science, Google Scholar, and ScienceDirect by searching keywords such as operable window, natural ventilation, open/close window, temperature, thermal comfort, CO2, indoor air quality and IAQ - showed that most research in this topic has been conducted through quantitative methods including environmental monitoring, survey, and simulation. Among the papers found, only one paper was located in the United States and most of them were located in Europe and Asia. Also, 54% of total papers focused on thermal comfort and 25% focused on indoor air quality and only 21% of total papers focused on both thermal comfort and indoor air quality in classrooms.

The proposed comparative case study seeks to contribute to the gap in literature to better understand thermal condition and indoor air quality in K-12 classrooms with operable windows. RATIO Architects has agreed to be a partner in this research, providing access to K-12 schools in Raleigh, North Carolina, and Denver, Colorado. Two main goals of this study are to better understand (i) the relationships between thermal comfort, indoor air quality, and window open/closed condition in the classrooms, and (ii) the decision-making factors around using/not using operable windows from both the teachers and school administrator side. The goals of this research are to increase awareness aroung operable windows among teachers, school administrators and architects, and to improve students' comfort and learning outcome.

Darshan Veershetty
Graduate Program: Industrial Design
Advisor: Kelly Umstead
Poster Number: 208

Reduction of Food Waste at Grocery Retail Stores

Annually 40% of the food that is produced in the United States goes to waste. Amongst 50% of food waste is still edible which is concerning when 1 in 7 US families are food insecure. The retail sector wastes about 133 billion pounds of food. When dumped in landfills food waste contributes 11% of greenhouse gas emissions that causes climate change. Majority of the grocery retail brands score poorly in managing food waste due to lack of accountability, prevention, recovery and recycling practices. Environmental Protection Agency shows that prevention at source is the top priority in hierarchy for reducing food waste. Current solutions include developing accurate and automated replenishment of stock based on analytics and forecast of consumer behavior, donation to food insecure populations, repurposing for energy production through methane in biorefineries or other industrial uses, feeding animals, and composting. However, there are too little design solutions for a grocery store to help benefit the users including the employees, and customers in significantly reducing the food waste.

The primary reasons for food to go to waste through the supply chain of a grocery retail chain are lack of consumer education on food waste, lack of standardized date labelling, challenging to handle delicate produce, consumers buying food in excess due to poor planning, consumer's attitudes and perceptions on imperfect yet edible produce, etc., The study will focus on food that includes produce and meats as they form the highest chunk of the food waste.

Primary source research methods will include interviews and observations involving grocery store employees and customers. These methods are useful in finding pain-points or discover opportunity areas for reducing food waste which may have been overlooked by users who are habituated to the activity of grocery shopping. The research insights will be useful in finding potential solutions.

Sara Weir
Graduate Program: Industrial Design
Advisors: Kelly Umstead and Tim Buie
Poster Number: 211

Resettling in the United States: Finding Place and Purpose Through Design

As war, crime, and violence escalate around the world, large numbers of individuals and families are forced to leave their homes and resettle in a foreign country. The resettlement process is stressful, overwhelming and full of uncertainty. Throughout resettlement, many refugees experience lack of employment, denial of education, poor living conditions, and limited access to technology. Technology empowers refugees to build connections and relationships, without access to technology refugees' information and social networks are drastically restricted. Beyond policy change, little has been done to mitigate these issues. Policy change addresses the process of resettlement but neglects the individual going through the process. The failure to address these issues not only affects the resettlement process for refugees but also their success at integrating into a new host country.

Using human-centered design methodologies in partnership with refugees, non-profit organizations, volunteers, and industry experts, this work aims to explore the impact of technology on the resettlement process from multiple perspectives. The purpose of this project is to determine how newly designed, technology-based products and services may increase refugees' access to resources throughout the resettlement process. Specifically, the work will investigate how technology and physical artifacts can be combined to increase refugees' access to resources, how technology can connect refuges and host country natives for a shared purpose, and how immediate access to technology may alleviate the complexity of the resettlement process.

Darren Woodland Jr.
Graduate Program: Art and Design
Advisor: Tania Allen
Poster Number: 214

On Soundscape: Towards the Development of a Conceptual Framework for Utilizing Sound in Extended Reality Platforms

Sound plays an integral role in what we perceive and how we perceive it; that includes not only our environment, but ourselves. Sound is a powerful and often underutilized force, it has the ability to influence cognition, create sensation, and facilitate interaction. In preparation for undertaking this research and project, I began by asking a question. What can sound tell us about how we interact with our technology, the spaces we inhabit, and how we create new realms of interaction and engagement, both virtual and real? In order to answer this question the focus of my efforts have been in multiple areas of research pertaining to not only the physical nature of sound, but also how sound insidiously influences whatever it comes into contact with. Those areas of research are: 1) Sound as a Form of Interaction, 2) The Nature of Sound in Digital Media, 3) An Ecological Approach to Sound and Listening, 4) Cognition, Perception, and Sensation through Aural Stimuli, and 5) Engagement and Presence though Audition and Embodiment. In investigating this question it became glaringly obvious that there is a lack of understanding, focus, and cohesive integration of sonic elements into the development and design processes of many new emerging technologies, particularly extended reality. On Soundscape is a research project that aims to create a conceptual framework for approaching sound as a dynamic form for creating engagement in extended reality platforms. This project will take the form of a series of design experiments within the three different forms of extended reality technology; virtual reality, augmented reality, and mixed reality.

Michael Belcher
Graduate Program: Learning and Teaching in STEM
Advisors: Jere Confrey and Erin Krupa
Poster Number: 24

Examining students' experiences with a STEM entrepreneurial-based curriculum and its impact on mathematics learning: A design study

To increase interest and engagement in STEM, researchers have begun building curricula that situate STEM learning within entrepreneurial pitch competitions (see e.g. Newton et al., 2017). However, little is known about how these types of entrepreneurial-based STEM challenges support students' engagement or STEM learning, especially with respect to mathematics. This study sought to explore and understand the processes by which an entrepreneurial-based STEM challenge can support students' engagement and mathematics learning. A design research methodology (Cobb, Confrey, et al., 2003) was used to explore students' experiences with the Design & Pitch (D&P) Challenges in STEM, a curricular framework that situates STEM learning within entrepreneurial pitch competitions, and the Building Algorithms challenge. Twenty-one students, grades 6 through 8, participated across two iterations of the study: the first iteration (n=6) was conducted at the team's research office, and the second (n=15) was conducted in a suburban charter school. Qualitative data (video of students' daily work, team interviews, post-challenge focus groups, task-based interviews, and daily work samples) were collected and analyzed using a combination of a priori and open coding to identify themes explaining students' cognitive engagement and math learning. The results of the study showed that the D&P challenge framework and the Building Algorithms challenge supported engagement by empowering students to choose authentic and relevant contexts and through the appeal and pressure of pitching to external judges. Additionally, through entrepreneurial processes (e.g. iterating and prototyping) and features unique to the challenge (e.g. the use of spreadsheets), students were supported to reason flexibly with algebraic expressions and functions. This study demonstrated how entrepreneurship and entrepreneurial-based STEM challenges can support engagement and STEM learning, especially mathematics.

Danielle Boulden
Graduate Program: Curriculum and Instruction
Advisor: Kevin M. Oliver
Poster Number: 29

Building Teacher Capacity to Integrate Computational Thinking and Computer Science Through a Distributed Leadership Approach

The purpose of this study was to investigate how a cohort of educators at one middle school collectively enacted new leadership roles to promote the school-wide integration of computational thinking (CT) and computer science (CS). Using an instrumental case study approach, this investigation examines how a distributed leadership model helps explain how these educators worked to promote these new innovative pedagogical practices throughout the school. Distributed leadership was utilized as a guiding theoretical lens and activity theory as an evaluative lens to determine how these educators coordinated internal and external resources, collegial relationships, and their own professional capabilities to build a collaborative and professional learning environment focused on CT/CS integration across the school curriculum. Data were collected through school observations and interviews with members of the teacher leadership cohort and other faculty and staff. Findings suggest that by working together collectively through a distributed approach to leadership, these educators were able to effectively pool resources and build expertise that cultivated buy-in by students, teachers, and parents and support for this important school-wide initiative. This research has implications for CT and CS integration strategies in the K-12 curriculum as other states begin to adopt CT/CS education standards and develop integration plans at the school and district levels.

Teena Coats
Graduate Program: Learning and Teaching in STEM
Advisor: Aaron Clark
Poster Number: 43

Staying Afloat: The First Year of Teaching as a Technology Education Teacher

The first year of teaching can be challenging. Many describe the experience as though they are merely trying to stay afloat. To gain better insight on how to best support beginning technology education teachers, the author has conducted a phenomenological study of the experiences and supports utilized by two first-year technology education and drafting teachers. Observations, interviews and a survey were used to gather information about the experience of the participants. Three central themes of support were found: verbal communication, material resources, and skill-based development. The experiences of these teachers are discussed through the lens of social cognitive career theory.

Bayley Garbutt
Graduate Program: Curriculum and Instruction
Advisor: Jessica DeCuir-Gunby
Poster Number: 72

Understanding Factors Related to Preservice Teachers' Attitudes and Perceptions Regarding African American Language

In the coming years, more culturally and linguistically diverse (CLD) students will encounter teachers that do not look or sound like them. With the demographics of students in teacher education programs unlikely to change much during this time, this diversity gap is likely to continue. The present study examined relationships between preservice teachers' (PSTs) characteristics along with various aspects of their background, and their attitudes and perceptions regarding a specific variety of English, namely African American Language (AAL). The relationship between PSTs' dispositions for culturally responsive pedagogy and their attitudes toward AAL was also assessed. Hierarchical regression analysis indicated no significant relationships between the characteristics of PSTs and attitudes toward AAL. In model 2 a significant relationship was observed between PSTs' disposition for praxis and attitudes; the final model revealed that PSTs' disposition for social justice was the most significant predictor of attitudes toward AAL. A higher disposition for social justice was associated with more positive attitudes toward AAL. Cluster analysis revealed three clusters of PSTs with varied and increasing levels of dispositions for praxis, community, and social justice. Analysis of variance indicated that the cluster of PSTs with the highest disposition for social justice, possessed significantly higher attitudes towards AAL than the other two clusters. Altogether, these findings suggest that PSTs' dispositions for culturally responsive pedagogy mattered more than their background characteristics in predicting their attitudes toward AAL. The grouping of PSTs into clusters presents a novel approach to preparing teachers to have fair and equitable mindsets for teaching AAL-speaking students. Teacher education programs can capitalize on this understanding of PSTs through more precise applications of culturally responsive pedagogy that take into account the dispositions PSTs have for engaging in culturally responsive praxis, being open to community and diversity as well as showing a commitment to social justice.

Taylor Harrison
Graduate Program: Learning and Teaching in STEM
Advisor: Hollylynne Lee
Poster Number: 91

Instructional Decision-Making of High School Statistics Teachers

Seven high school teachers were interviewed regarding factors that impacted their approach for teaching statistics and their process of planning a statistics lesson. They were then followed into the classroom over a series of lessons to examine how these plans unfolded in the classroom, and how these teachers responded to events that may not have been accounted for in their planning. Results about the rationale for instructional decisions and experiences, and beliefs and statistics understanding that may be influencing those decisions will be shared.

Dorothy Holley
Graduate Program: Learning and Teaching in STEM
Advisor: Soonhye Park
Poster Number: 96

Integration of Science Disciplinary Core Ideas and Environmental Themes through Constructivist Teaching Practices

A descriptive, mixed methods study investigated learning outcomes and processes of integrating environmental education (EE) and science education (SE). Specifically, this study examined the impact of EE-based constructivist science teaching approach on students' science achievement scores, environmental self-efficacy, course completion rate, and perceptions of their learning experiences. Participants of the study (N=46) included students in a Physical Science course at one public high school in a southeastern state of the United States. Data sources included the students' final exam scores, standardized unit test scores, self-efficacy measurements, course completion data, and student written reflections. Data analysis indicated that students with an EE-based constructivist science teaching approach (N=23) performed higher on science achievement tests and developed statistically higher environmental self-efficacy than those in a traditional teaching classroom (N=23). More students passed the final exam (96%) and the mean final exam score was four points higher (82) in EE-based constructivist teaching approach classes. Students who were in the EE-based constructivist science teaching approach classroom tended to perceive their learning experiences in more positive ways.

Lindsey Hubbard and Stella Jackman-Ryan
Graduate Program: Teacher Education and Learning Sciences
Advisor: Margareta Thomson
Poster Number: 99

Examining Factors of Professional Development that Influence Classroom Practices for High School Science Teachers

The push for inquiry-based learning in science classrooms has been met with low self-efficacy among science teachers. Professional development offers an opportunity for teachers to gain confidence through experiencing a real research lab. This study investigates the outcomes of an extensive 8-week professional development program on teachers' classroom instruction and explores the influential factors in instructional change. The paper reports on a single instrumental case study with eight high school science teachers from a larger mixed methods longitudinal study. Focus groups and individual interviews were conducted to understand the experiences of the teachers in this cohort of participants. Two major themes emerged in teachers' instructional changes: an increase in hands-on approach and an increase in patience toward students' learning. Four themes emerged as influential factors toward instructional change: change in teaching philosophy, having something to take back, having relationships as a resource, and feelings of confidence. The immersive nature of the research PD experience is a key feature in allowing for these results. Professional development opportunities including an immersive lab experience, opportunities to build a learning community, and opportunities to feel like the student are influential to changes towards are more inquiry-based learning approach in the classroom. When seeking opportunities for professional development for high school science teachers, school leaders and science teachers should search for key features that promote changes in the classroom leading to more inquiry-based learning.

Deidre Kelly
Graduate Program: Technology Education
Advisor: Aaron C. Clark
Poster Number: 115

Major Influences: First-Generation College Students' Perceptions of Influences When Selecting a Technology and Engineering Education Major

Deciding what college major is the right fit is a complex process even for the most confident and self-aware adolescents. This undertaking is particularly heavy on first-generation college students (FGCS) as their parents have not successfully completed a four-year degree. Previous research shows parents have a significant influence on continuing college students' perceptions about college and major choice. In the absence of parental experience at a four-year college, FGCS often turn to others for assistance and advice. Understanding who FGCS seek out for guidance and how the students respond to the counsel they receive is critical to identifying patterns in how FGCS make these decisions. This research uses a phenomenological approach to examine the perceptions of 12 FGCS majoring in technology and engineering education (TEE) as to who was persuasive in their college preparation and major selection processes. The results show that despite their lack of a degree, parents are still by far the leading source of encouragement in both negative and positive manners. Interestingly, the participants saw their own enjoyment in activities related to the major as the second most influential factor, followed by other family, college peers, college advisors, high school teachers, and college professors. This suggests the TEE FGCS are motivated to seek out majors that satisfy their intrinsic needs (personal interests and what makes them happy) over more extrinsic reasons (pleasing others, money, or status). This research can assist university and high school TEE faculty and staff, researchers, and high school and college academic advisors in enhancing the influencers' effectiveness in guiding future students directly to the TEE major and reducing unnecessary courses while increasing student satisfaction, retention, and graduation rates.

Vance Kite
Graduate Program: Learning and Teaching in STEM
Advisor: Soonhye Park
Poster Number: 119

Computational Thinking Unplugged for Science (CTUPS): A Program of Professional Development for Inservice Science Teachers

Computational thinking (CT) is defined as a set of practices for conceptualizing problems and preparing solutions such that they can be executed by a computer. Recently, CT has been advanced as part of the 21st century skills required for ALL students to be successful in this digital era. Historically, CT has been taught in computer science classes through computer programming. This approach has restricted marginalized communities' access to these valuable skills. Growing recognition of the importance of CT for all students has motivated stakeholders to explore integrating CT into K-12 curricula. These efforts have encountered barriers including: insufficient technology, overfilled curricula, and, most importantly, under-prepared teachers who fear technology and lack CT-integration confidence. Unfortunately, research on CT professional development (CT-PD) for teachers is in its infancy and little has been done to understand how unplugged (non-programming) CT strategies can address the barriers of technology access and teachers' technology discomfort. My research consists of three studies that focus on the development, implementation, and impact of an intensive weeklong CT-PD to support inservice science teachers in using unplugged strategies to integrating CT into their science curriculum. Study one employs a state-wide survey of inservice science teachers to understand teachers' perceptions of CT and CT-PD needs. Findings from this survey were used to design the weeklong CT-PD that is the foundation of Study two. Study three consists of a multiple case study that follows four teachers from the CT-PD into their classrooms to investigate their CT/science content integration. In this presentation I discuss 1) findings from study one that informed the design of the CT-PD; 2) the effects of the CT-PD on teachers' CT understanding, CT integration self-efficacy, and implementation of CT in their classrooms; and 3) preliminary findings from data collected from the four case study teachers.

Laura G. Maldonado
Graduate Program: Educational Leadership, Policy, and Human Development
Advisor: Audrey J. Jaeger
Poster Number: 135

Connecting to Campus and the Workforce: A Case Study of Community College Students Participating in SkillsUSA

Employers in every state face a shortage of workers to fill jobs that require education beyond high school but less than a 4-year degree. Community colleges train individuals through career and technical education (CTE) to meet these local, state, and national needs. Many CTE programs offer career and technical student organizations known as CTSOs. Studies have investigated CTSOs at the secondary level, but the value of CTSOs is unknown at the postsecondary level. This poster presents the findings from a qualitative case study exploring how SkillsUSA participation influences community college students' preparedness for the workforce. SkillsUSA is one of 11 CTSOs funded by the U.S. Department of Education. Data was gathered from students, alumni, and advisors through interest questionnaires, semi-structured interviews, observations, and documents at two community colleges in North Carolina. Eclectic coding was used during first cycle coding and pattern coding was used during second cycle coding to generate codes, themes, and findings. Using the Psychology of Working Theory (PWT) to frame the study, preliminary findings reveal that while hometowns impacted access to job opportunities and industries, SkillsUSA participation influenced alumni and students' choice of work and confidence in overcoming obstacles. Participants also reported institutional social support, especially from advisors and peers, as influential in reaching future goals. The study provides an extension of the PWT to community college and CTE populations, addresses the void in the practical understanding of SkillsUSA members at community colleges, and informs policymakers about how CTSO participation can contribute to national and state economic and postsecondary attainment goals.

Kristi Martin
Graduate Program: Learning and Teaching in STEM
Advisor: Karen Hollebrands
Poster Number: 136

Pre-service Teachers' Problem-Solving In Trigonometry

Research shows trigonometry is difficult for pre-service teachers. This research used task-based interviews to examine how seven pre-service secondary mathematics teachers (PSMT) solved a single open-ended trigonometry problem. The PSMT were presented with a diagram showing three trigonometric expressions and asked to add a fourth expression so that each group of three expressions excludes the fourth expression. The PSMT each considered different characteristics or possible solutions before determining their solution and all found a different solution. Common reasoning about why one value was excluded included the quadrant the angle was located in, the evaluated value of the expression, and which trigonometric function was involved.

Whitney N. McCoy
Graduate Program: Teacher Education and Learning Sciences
Advisor: Jessica T. DeCuir-Gunby
Poster Number: 138

Black Girls Accepting the Grand Challenge: A Qualitative Exploration of a Summer Engineering Program's Influence on Black Girls' Racial Identity, Engineering Identity, and STEM Self-Efficacy

Research shows that only 7% of women in collegiate settings graduate with a STEM degree and only 28% of the science and engineering workforce are women. Moreover, only a stifling 2% of women scientists and engineers in the field are Black. A girl's race and gender can influence her identity as well as how she perceives herself and her ability to achieve. Therefore, the intersections of these social dimensions can be critical for girls, especially for Black girls. Thus, this mini-ethnographic case study design investigated the informal learning experiences of Black adolescent girls in engineering. By utilizing a Critical Race Theory framework and Black Feminist Thought with an intersectionality lens, this study investigated (1) How do Black adolescent girls describe and navigate their multiple identities while participating in a summer engineering camp; (2) How do Black adolescent girls view themselves in the context of a summer engineering camp; and (3) What are camp leaders perspectives regarding their role in the summer engineering camp on Black adolescent girls' multiple identities? Findings elicited how Black girls' racial identity, engineering identity, and STEM self-efficacy in a predominately White environment influences their attitudes towards achievement, perception of engineering, and understanding of how double-bind identities contribute to success for Black women and girls in STEM fields. Resiliency, racial pride, and working harder were utilized to succeed in the camp environment. Implications will help expand or improve informal engineering experiences for Black girls in order to build bridges to barriers that may prevent them from viewing themselves as engineers as it pertains to their individual identities as Black females.

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Graduate Programs: Learning and Teaching in STEM[1], Department of Psychology[2]
Advisor: Eric Wiebe
Poster Number: 167

Middle school students' monitoring accuracy and computer programming performance: Effects of scaffolding, previous experience, and gender

Metacognition refers to the knowledge of one's own cognition and is the means through which an individual regulates and controls his or her own cognitive processes. Self-monitoring ability is part of metacognitive skills that learning scientists now put emphasis on given the shift of definition of what learning is, in which learning takes place when learners advance their abilities to monitor their own understanding of concepts being learned. Scaffolding is a method for teaching and learning that promotes learners' active reflection on their prior knowledge as well as on their current state of understanding. This study investigated middle school students' performance and monitoring accuracy by examining the impact of scaffolding on computer programming learning. This study also examined whether prior experience and gender interact with scaffolding to influence students' performance, confidence judgment, and monitoring accuracy. The total samples in the current study were 260 middle school students. A pretest-posttest design was used, and the data were analyzed using repeated-measure analysis of variance and regression tests. The results showed that all study variables were significantly impacted by the scaffolded intervention. Interaction effects between scaffolding and gender were found on performance and global confidence judgment, and interaction effects between scaffolding and previous experience were found on global confidence judgment and discrimination index. Students' final performance was significantly predicted by their pretest score, and changes in both monitoring accuracy scores (absolute accuracy index and discrimination index). The results are discussed in terms of the impact of scaffolding and individual differences on monitoring accuracy.

Matt Reynolds
Graduate Program: Science Education
Advisor: Soonhye Park
Poster Number: 175

Examining the Relationship Between the edTPA and Preservice Science Teachers' Pedagogical Content Knowledge

This study examined how the most widely implemented preservice teacher performance assessment in the U.S., the edTPA, relates to the specialized type of teacher knowledge necessary for effective teaching, known as pedagogical content knowledge (PCK). Thirty-six preservice teachers' PCK levels were determined by PCK Mapping, an enumerative analytical approach capable of quantifying participants' PCK evidenced by their edTPA materials. Participants' edTPA performance was scored by Pearson, a for-profit testing company. Data analysis indicates there was a significant positive correlation between participants' edTPA scores and PCK levels ($r_s(36) = .949$, p

Frederique Yova[1], Temple Walkowiak[1], Vicki Jacobs[2]
Graduate Program: Teacher Education and Learning Sciences[1]; University of North Carolina at Greensboro[2]
Advisors: Temple Walkowiak; Jonee Wilson
Poster Number: 218

Parents' beliefs, attitudes and expectations towards early mathematics: Effect of a brief exposure to their own young child's mathematical thinking

The study is positioned in the field of mathematics education and relates to beliefs, attitudes and expectations parents of young children may have regarding early mathematics.

Early mathematical skills have been empirically linked to later success in school (Duncan et al., 2007). However, mathematics experiences vary considerably among young children as mandatory school starts once a child is five years old. Previous studies have reported numerous factors that may affect early numeracy such as parents' expectations in numeracy (e.g. Kleemans et al., 2012), parent-child discussions about numbers (e.g. Levine et al., 2010), or parents' anxiety about mathematics (e.g. Maloney et al., 2015). Nevertheless, little is known about how these factors may evolve once parents better understand how their child approaches mathematics. The purpose of the study was to examine attitudes, beliefs and expectations parents may have about early mathematics and how those may change after being exposed to their own young child's mathematical thinking.

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Graduate Programs: Electrical Engineering[1]; Materials Science and Engineering[2]
Advisor: Salah M. Bedair
Poster Number: 1

Development of InGaN/GaN LEDs grown on InGaN Semibulk templates in the green gap spectral range

Nitride based Light Emitting Diodes (LEDs) with InyGa1-yN/GaN multiple Quantum wells (MQWs) show a deterioration in Quantum efficiency as the emission wavelength is shifted from Blue towards Green or longer wavelength emission. This is referred to as the green gap and it originates from the large lattice mismatch between the InyGa1-yN well and the underlying GaN template specifically for high indium content required for long wavelength emission and the accompanied piezoelectric field in the strained wells. A good quality relaxed InxGa1-xN template can address this issue by reducing the mismatch between the InyGa1-yN MQWs and the underlying InxGa1-xN template.

In this work, device quality InxGa1-xN templates were grown by Metal Organic Chemical Vapor Deposition (MOCVD) using the semibulk (SB) approach and characterized for use as templates for MQWs. These templates were characterized using Photoluminescence (PL), Atomic Force microscopy (AFM), High-resolution X-ray diffraction (HRXRD), Secondary Ion mass spectrometry (SIMS), and High-resolution High-angle annular dark-field scanning transmission electron microscopy (HAADF-STEM) to develop an understanding of the relaxation mechanism and to optimize the growth conditions to achieve device quality templates. Several test structures of InyGa1-yN MQWs were then grown under the same conditions on GaN and on the InxGa1-xN templates to investigate the effect of the underlying template on the MQW emission. A consistent red shift in PL emission has been observed for MQWs grown on the templates as compared to identical MQWs grown on GaN. This red shift can be attributed to the reduced compressive strain in the MQWs which results in a decrease in band gap and an increase in indium content. Electroluminescence of fabricated LEDs on the SB template show a red shift of 100 nm as compared to an identical LED grown on GaN. This shows the potential of using relaxed InxGa1-xN SB templates for green wavelength LEDs.

Fatma Abdelrahman
Graduate Program: Nuclear Engineering
Advisors: Robert B. Hayes
Poster Number: 2

EPR Study of Sugar and Artificial Sweeteners

Electron paramagnetic resonance (EPR) was used to study the dosimetric properties and post-irradiation signal stability of sugar and artificial sweeteners. EPR is a non-destructive spectroscopic technique used to study organic materials by assaying trapped charge due to ionizing radiation exposures. Previous studies have shown that EPR is a powerful dosimetry tool for study teeth, nails, and bones. The dose response of sugar was investigated by performing measurements and spectral manipulations to samples that have been exposed to various doses. Results showed strong linearity between doses and signal intensities, which supports that sugar is a sensitive material that can be used as a dosimeter for various applications like radiological emergency response and nuclear forensics since it is a commonly found material and easy to retrieve. The signal stability of sugar and sweeteners were studied by exposing them to high dose and observing the signal intensities after different storage durations. Although the intensity varied among sample types, all samples experienced the same behavior of a sharp increase in intensity shortly after irradiation, followed by an overall stable trend. The results concluded long-term stability of the signal for long storage durations. The work and measurement protocol presented here could also be applied to other commonly found organic materials such as plastics and clothing materials.

Parvez Ahmmed[1], James Reynolds[1], Prafulla Regmi[2], Alper Bozkurt[1]
Graduate Programs: Electrical Engineering[1]; Poultry Science[2]
Advisor: Alper Bozkurt
Poster Number: 5

An Injectable System for Subcutaneous Physiological Monitoring in Small Animals

Livestock industry practices in recent years have largely been driven by consumer concerns for welfare-friendly husbandry systems. One such example is the on-going transition from conventional cages to cage-free housing systems for egg-laying hens. This change results in larger spaces and bigger colonies for the birds. These non-cage housing systems have complex designs with enrichments for birds but are also associated with different health and welfare challenges. Major welfare challenges of the modern poultry management systems include aggressive pecking and cannibalism (up to 1/4th of total cumulative mortality in laying hens and turkeys), high prevalence of keel bone fractures and footpad disorders. Similarly, health challenges include pathogenic infections of different viral, bacterial and protozoal diseases. Measuring the dynamics of bird behavior and physiology could provide clues to effectively monitor the flock's well-being as well as aid early diagnosis of disease processes in these production systems. The aim of this project was to develop a minimally-invasive implantable sensor system for small animals to wirelessly monitor and collect behavioral and physiological data. The designed injectable system is capable of subcutaneous measurement of photoplethysmography, electrocardiography, bioimpedance, accelerometry, magnetometry, and thermometry. All these integrated sensors, along with a processing unit, a Bluetooth radio, and a battery, are coated with biocompatible materials and packaged into a 4mm x 50mm capsule-shaped form-factor. Several in vivo experiments have ensured the functionality, usability, and reliability of the sensor system. With a 3-meter wireless range from a central data aggregator, the capsule can continuously transmit data from all the sensors for 24 hours. However, depending on the application's need, this system can support 2-3 months of intermittent recording of these physiological parameters. This novel system can and will generate new research scopes for animal scientists and help veterinarians to maintain animal health and welfare.

Mahnaz Behroozi
Graduate Program: Computer Science
Advisor: Chris Parnin
Poster Number: 23

Towards Scientific Study of Technical Interviews Using Eye Tracking

Software developers often face a critical test before landing any job---passing a technical interview. A technical interview is a specialized form of an interview, where candidates engage in one-on-one problem-solving sessions. During these sessions, candidates will be asked to code on a whiteboard or using a simple text editor on a computer in the presence of the interviewer. Candidates are asked to think-aloud and perform a problem-solving walk-through in order to assess their explanation and problem-solving ability. Candidates can be expected to engage in a series of 4--8 technical interviews (each 45 minutes to an hour) with developers or managers. Critics have argued that these types of interviews unnecessarily stress and filter out otherwise qualified candidates, yet there is no scientific study on possible negative effects of these interviews on candidates. In my work, I first study software engineers' concerns about technical interviews. Then, I propose a framework to study whiteboard interviews in particular and investigate the factors that introduce extraneous challenges for software engineers. My thesis proposes studying each technical interview style and finding out the factors that negatively affect software engineers' performance. This may help in propounding interventions and enhancing technical interviews.

Zexi Chen
Graduate Program: Computer Science
Advisor: Ranga Raju Vatsavai
Poster Number: 37

Relational Long Short-Term Memory for Video Action Recognition

Spatial and temporal relationships, both short-range and long-range, between objects in videos are key cues for recognizing actions. It is a challenging problem to model them jointly. In this work, we first present a new variant of Long Short-Term Memory, namely Relational LSTM to address the challenge for relation reasoning across space and time between objects. In our Relational LSTM module, we utilize a non-local operation similar in spirit to the recently proposed non-local network to substitute the fully connected operation in the vanilla LSTM. By doing this, our Relational LSTM is capable of capturing long and short-range spatio-temporal relations between objects in videos in a principled way. Then, we propose a two-branch neural architecture consisting of the Relational LSTM module as the non-local branch and a spatio-temporal pooling based local branch. The local branch is introduced for capturing local spatial appearance and/or short-term motion features. The two-branch modules are concatenated to learn video-level features from snippet-level ones which are then used for classification. Experimental results on UCF-101 and HMDB-51 datasets show that our model achieves state-of-the-art results among LSTM-based methods, while obtaining comparable performance with other state-of- the-art methods.

Qiwen Cheng, Juan Fausto Ortiz Medina and Douglas F. Call
Graduate Program: Civil Engineering
Advisor: Douglas F. Call
Poster Number: 38

Microbial Communities Derived from a Full-Scale Drinking Water Treatment Plant That Can Exchange Electrons with Activated Carbon

Pyrogenic carbonaceous materials (PCMs), such as biochar and activated carbon, are widely used to improve soil fertility, sequester carbon and remove contaminants from gas and water. Traditionally, PCMs are viewed as non-reactive sorbents of chemical and biological contaminants. Recent research suggests that they can also be reactive redox mediators that drive many environmentally relevant reactions (e.g., dehalogenation, denitrification and methanogenesis). Defined culture studies indicate that PCMs can serve as electron acceptors/donors for Geobacter and Shewanella species. However, little is known about whether or not microorganisms present in environmental systems, especially where PCMs have been already applied, can reduce/oxidize PCMs. These microorganisms may utilize PCM's reactivity for contaminant degradation, which extends the benefits of PCM amendments. The objective of this study was to identify microorganisms from a PCM-amended system that exchange electrons with PCMs, and to explore possible electron exchange mechanisms. We sampled a native microbial community from a biological activated carbon (BAC) filter, and provided granular activated carbon (GAC) as the electron acceptor and ozonation by-products (acetate, formate) as the electron donor. Our results indicated that the BAC community could oxidize acetate (but not formate) by reducing GAC. After three transfers, the acetate oxidation rates increased 4.3-fold, and microbial morphologies and GAC surface coverage became homogenous, indicating culture adaptation. Geobacter species were specifically enriched, with a relative abundance of up to 96% on the GAC surface and 93% in suspension. The electron-accepting functional groups on GAC could be responsible for acetate oxidation, and long-range electron transfer from microorganisms to the electron-accepting moieties might occur. Our work suggests that providing GAC as the electron acceptor might enhance PCM-mediated contaminant degradation pathways in full-scale water treatment systems.

Sanghyun Choo
Graduate Program: Industrial Engineering
Advisor: Chang S. Nam
Poster Number: 40

Augmenting EEG Data for Classifying Human Cognitive States: Wasserstein Generative Adversarial Network Approach

Deep Learning (DL) has been widely used in many areas to extract essential features and classify diverse data types successfully. However, the underfitting problem occurs frequently when DL-based classifiers were used for classifying human cognitive states using electroencephalogram (EEG) data due to a deficient amount of training datasets for EEG. Also, the existing data augmentation methods (e.g., noise addition and sliding time windows) can lead overfitting to training data and loss of time information for the EEG datasets. Wasserstein Generative Adversarial Network (WGAN) can be a tool for augmenting EEG data to overcome the limitations of the existing EEG data augmentation method and improve the performance of the classifier (e.g., the classification accuracy of cognitive states). The WGAN has proven its effectiveness in terms of its robustness and stability when generating artificial data than a general GAN model. With the effectiveness of the WGAN, we propose a novel EEG data augmentation method for improving the performance of a CNN-based classifier based on WGAN. The proposed framework augments image-based EEG features as an input for the classifier by Continuous Wavelet Transform (CWT), which is used for time-frequency decomposition of EEG signals. To validate the proposed model, we compared the performance of the CNN classifier between EEG data augmentation methods (the proposed method, noise addition, and a general GAN-based method) with different amount of data augmentation (0%, 50%, 100%, 150%, 200%) using publicly available data sets (e.g., BCI competition dataset). The results showed that the classifier using an augmented training dataset by the proposed WGAN-based model had a higher classification accuracy than the other two methods. This finding indicates that the proposed WGAN-based EEG data augmentation could improve the performance of the CNN classifier for classifying various human cognitive states.

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Graduate Programs: Chemical Engineering[1]; Chemistry and Biochemistry, North Carolina Central University[2]; Biological and Biomedical Sciences, North Carolina Central University[3]; Obstetrics and Gynecology, Duke University[4]
Advisor: Saad A. Khan
Poster Number: 49

Using Rheology to Quantify the Effects of Collagenase Treatments on Tumor Digestion

Biological tissues are complex composite materials whose mechanical properties are often difficult to measure by traditional techniques. Quantification of bulk tissue properties, such as modulus and viscoelasticity, can be used to aid in disease diagnosis and design of novel therapies. We demonstrate the ability to measure multiple types of mammalian tissues, with elastic moduli ranging from 100-10,000 Pa, by dynamic oscillatory rheology on a commercially-available rheometer. We then present results from two case studies involving tumor digestion by injected collagenase enzymes and illustrate how rheology can be used to quantify treatment efficacy. In the first, we quantified the degree of in-vivo digestion of human uterine fibroid tissue (benign tumors) by a single injection of collagenase Clostridium histolyticum. In the second, we measured digestion of xenograft human breast cancer (malignant) tumors grown in mice by repeat injections of liberase (blend of collagenase isoforms.) In both studies, we co-injected Liquogel (LQG), a thermoresponsive polymer that transitions upon heating from an injectable solution to a gel, to reduce diffusion of collagenase from the injection site. All tissues exhibited gel-like rheological behavior, and the average tissue moduli was calculated for each treatment group. We observed that co-injection of LQG and collagenase significantly reduced the modulus of uterine fibroids compared to both buffer controls and free collagenase injections. Histological staining confirmed that bulk softening resulted from localized collagen digestion. The impact of collagenase injections on breast cancer tumors was less intuitive; co-injection of LQG and collagenase led to the formation of smaller and stiffer tumors. We hypothesize that this observation is due to collagenase softening the local microenvironment and discouraging outward tumor growth.

R.W. Epps[1], M.S. Bowen[1], A.A. Volk[1], K. Abdel-Latif[1], S. Han[1], K.G. Reyes[2], A. Amassian[3], and M. Abolhasani[1]
Graduate Programs: Chemical Engineering[1]; Dept. of Materials Design and Innovation, University at Buffalo, Buffalo, NY[2]; Dept. of Material Science and Engineering, Organic and Carbon Electronics Laboratories (ORaCEL), North Carolina State University, Raleigh, NC[3]
Advisor: Milad Abolhasani
Poster Number: 61

Convergence of Microfluidics, Colloidal Synthesis, and Machine Learning

In the development of next-generation photovoltaics and light-emitting diodes, colloidal inorganic perovskite quantum dots (PQDs) have drawn notable attention for their highly tunable bandgap properties, high-charge carrier mobility and defect tolerance, and adaptability towards solution phase processing. However, studies of this material group and other colloidal semiconductor nanocrystals requires extensive exploration of their massive reaction parameter space within highly controlled environments. The high sampling rate, low chemical consumption, and precise process control of microscale flow reactors greatly reduces the challenges in exploring complex reaction spaces; however, these screening technologies alone are likely not able to make significant breakthroughs, due to the massive scope of relevant colloidal synthesis conditions.

In this work, we present a modular microfluidic platform integrated with a machine learning-enhanced reaction optimization algorithm for on-demand synthesis of high-quality PQDs with desired optical properties. With this strategy, we have autonomously optimized reactant compositions for the simultaneous improvement of photoluminescence quantum yield (PLQY) and emission full-width at half-maximum (FWHM) at any desired peak emission energy (PE) i.e. emission color. These optimizations are performed without any prior experimental information, and they reach desirable PLQY, FWHM, and PE values substantially faster than existing black box optimization techniques in less than 25 samples. We then apply this same technique but instead pre-train the neural network models with prior experimental data before conducting the adaptive sampling procedure. As a result, we have further pushed the optimal measured values for nine of eleven target PE set points, in spite of performing the synthesis with a completely separate batch of precursors.

These techniques enable unsupervised material optimization and discovery and offer more consistent manufacturing of highly sensitive reactions. Further application of this strategy will advance the quality of commercial nanocrystals and expedite reaction studies, leaving more time and resources available for creative material synthesis exploration.

Anirudh Ganji[1], Anand Singh[2], Muhammad Shahzad[1]
Graduate Program: Computer Science[1]; Electrical and Computer Engineering[2]
Advisor: Muhammad Shahzad
Poster Number: 71

Characterizing the Impact of TCP Coexistence in Data Center Networks

The switch fabrics of today's data centers carry traffic controlled by a variety of TCP congestion control algorithms. This leads us to ask an important question: how does the coexistence of multiple variants of TCP on a shared switch fabric impacts the performance achieved by different applications in data centers? To answer this question, we conducted an extensive set of experiments with coexisting TCP variants using common data center topologies, like Leaf-Spine and Fat-Tree switch fabrics. We executed common data center workloads, which include Streaming, MapReduce, and Storage workloads, using four commonly used TCP variants, namely BBR, DCTCP, CUBIC, and New Reno. We also extensively executed iPerf workloads using these four TCP variants to purely study the impact of the coexistence of TCP variants on each other's performance without incorporating the network behavior of the application layer. We present comprehensive observations from these traces that have important implications in ensuring optimal utilization of data center switch fabric and in meeting the network performance needs of application layer workloads.

Ibrahim Hany and Ge Yang
Graduate Program: Nuclear Engineering
Advisor: Ge Yang
Poster Number: 89

ß-Ga2O3 (Fe) for next generation room temperature X-ray Detectors

X-ray detectors are essential for medical diagnostics, astrophysics observations, homeland security, nuclear safeguard, x-ray beam monitoring and industrial gauges development. Current state-of-the-art x-ray detectors need cooling, suffer from radiation damage, and need high operating voltages. In this work, we investigated the emerging wide bandgap semiconductor, ß-Ga2O3, for room-temperature radiation-hard low-power x-ray sensing. By doping ß-Ga2O3 with Fe, the n-type conductivity is compensated resulting in a high resistive material that is ideal for very low noise detector operation. (010) EFG grown Fe-doped ß-Ga2O3 was tested as a low-noise X-ray detector with Ti/Au electrodes vertical structure. Its performance at low, high and no applied voltages was examined. The fabricated detector showed high X-ray detection performance manifested in its signal's short fall and rise time (2O3/Ti/Au device. The detector's signal is also characterized by excellent linear relation with X-ray tube power and current and high signal to noise ratio (SNR) optimized at -5 V (> 103). Moreover, the X-ray induced current signal exhibits high stability. Possible charge transport mechanisms involving ion migration are suggested and discussed. In this study, Fe-doping is shown to significantly improve X-ray detection performance of Ga2O3, consolidating the applicability of Ga2O3 as a next generation X-ray detector functioning with low power, high SNR and linearity, and significantly improved transient characteristics.

Maksim Islam[1], Roshan Wathore[1], Grishma Jain[2], Karthik Sethuraman[2], Hisham Zerriffi[3], Julian D. Marshall[4], Rob Bailis[5] and Andrew P. Grieshop[1]
Graduate Programs: Civil Engineering[1]; Resource Optimization Initiative[2]; Forest Resources Management, The University of British Columbia[3]; Civil & Environmental Engineering, University of Washington[4]; Stockholm Environmental Institute[5]
Advisor: Andrew P. Grieshop
Poster Number: 104

Linking Cookstove Emissions to Indoor Air Quality: Outcome of a Multi-year Cookstove Intervention Trial in Rural India

Globally over 3 billion people use solid fuel cookstoves as their main source of household energy. The resulting emissions lead to household air pollution (HAP) associated with millions of premature deaths each year. Although various studies have shown alarming pollutant emissions associated with biomass stoves, there is now study where both emission and indoor air quality were measured across different seasons and at different locations. Thus, the quantitative linkage between cookstove emissions and 'the resulting HAP is still poorly constrained. In this study, we quantify the link between cookstove emissions and HAP measured during a multi-year intervention trial in two rural areas (Kullu in Himachal Pradesh State; Koppal in Karnataka State) in India. The study had three ~3-month-long measurement periods in each location. In the intervention, households chose from a range of stove models (e.g. advanced biomass, liquefied petroleum gas: LPG) for cooking and/or heating. We measured real-time and gravimetric indoor PM2.5 concentrations during ~5000 cooking events of different stoves. We also conducted simultaneous emission measurements for a subset of those cooking events. Our results show that stove technology, fuel properties (e.g., moisture content and fuel use rate), seasons, and cooking duration are significant factors affecting stove emissions. We observe substantial variation in indoor air quality linked to different stoves; for example, a factor of 2-4 reduction in indoor PM2.5 levels associated with LPG stoves. We apply a Monte-Carlo single box air quality model like that used for setting World Health Organization (WHO) emission tiers to link our measured emissions rates and PM2.5 concentrations, given household ventilation characteristics and cooking activity. The model greatly overestimates the kitchen PM2.5 concentration. Ongoing work will identify factors affecting the model performance to enable better prediction of indoor air quality and human exposure from given stoves.

Arjun Jayaprakash
Graduate Program: Civil Engineering
Advisors: James M. Nau, Mervyn J. Kowalsky, and Mohammad Pour-Ghaz
Poster Number: 106

Seismic Performance Guidelines for Steel Bridge Pile-Columns with Socket-type Connections

Steel piles doubling as columns above ground have been used to support important lifeline structures such as port piers, wharves, and bridge decks. These pile-columns are attractive as structural elements because they possess high strength-to-weight ratio and potential to be rapidly constructed. However, their use in high-seismic areas, such as the United States west-coast, has been limited. A major drawback of steel piles connected to steel cap-elements is their propensity to exhibit premature brittle failure in the form of weld cracking. Recently, external socket-type connections, such as the grouted shear-stud (GSS) connection, have shown promise in mitigating drawbacks of welded connections. The GSS connection possesses the ability to strengthen the connected region and relocate failure into the pile-columns, which results in a desirable mode of failure known as plastic hinging. This failure mode is preferred because it is ductile and has high energy dissipation capacity to resist large earthquakes. Through this study, we attempt to translate the laboratory success of the GSS connection into real-world engineering practice by providing design and assessment guidelines for good seismic performance of pile-column systems, which incorporate the GSS connection. The objective of this study was to build a simple design model for such systems in the form of semi-empirical equations, which can estimate the non-linear behavior of these systems in an earthquake. To this end, first, we tested large-scale specimens of bridge piers, which were instrumented with high definition optical sensors for strain measurement. Then, we developed computational models and calibrated them using the measured experimental data. Next, using these calibrated models, we performed a rigorous parametric study to understand system sensitivity to design variables. And finally, through statistical analysis of the rich numerical data thus generated, we developed semi-empirical equations, which can fully define the non-linear force versus displacement response of these systems.

Sourabh B. Kadambi
Graduate Program: Materials Science and Engineering
Advisor: Srikanth Patala
Poster Number: 111

Designing Structural Alloys via Interphase Boundary Segregation Engineering

Designing advanced structural alloys is crucial for infrastructure development and energy efficiency, with applications in automotive, aerospace and nuclear industries. Structural alloys are usually metallic materials with multiple elements added (alloyed) to a base metal to improve the mechanical strength and thermal stability. A commonly used strategy, called precipitation hardening, relies on alloying elements that precipitate from the matrix in the form of secondary-phase particles, which impart excellent strength. While a successful strategy, the temperature range over which these alloys can be utilized is limited. At high temperatures, the strength degrades during the lifetime of the component as the precipitates coarsen to larger than optimal sizes.

This thesis is inspired by recent experimental studies showing that further addition of specifically chosen solute elements can enhance the operating temperature range of the alloy. Such solute atoms segregate to the interphase boundary between the matrix and precipitate phases. Atomistic studies have shown that these solute atoms reduce the driving force for coarsening by reducing the excess energy of the boundary. To describe this mechanism, in this work, we developed a theoretical and computational framework accounting for the thermodynamic mechanism of solute segregation and the resulting kinetic effect on microstructure evolution. In this framework, the boundary quantitiesexcess solute and excess energysatisfy the universal Gibbs adsorption equation; therefore, model predictions of segregation behavior can be compared with experiments and atomistic simulations. For example, we demonstrate an application of the model to a light-weight magnesium-tin alloy and identify parameters that result in segregation of the solute zinc atoms to the interphase boundary. Using numerical simulations, we have demonstrated enhanced microstructural stability of a multi-component precipitation-hardening alloy engineered with solute segregation at the interphase boundary. The proposed framework will help guide experimental design of structural alloys for high-temperature applications.

Yi-Chun Lai, Joel J. Ducoste, and Francis L. de los Reyes III
Graduate Programs: Civil Engineering
Advisors: Joel J. Ducoste and Francis L. de los Reyes III
Poster Number: 121

Do the microbes from a saltmarsh improve anaerobic decomposition of marine microalgae Dunaliella viridis?

Using lipids from marine microalgae, Dunaliella viridis, for biofuel shows promise to replace fossil fuels because: (1) microalgae grow fast and have high lipids content; (2) seawater is used for cultivation, minimizing the need for freshwater; and (3) the lack of a cell wall potentially simplifies lipid extraction process. However, energy-intensive post-harvest processes such as dewatering and drying make microalgal biofuel production economically unfeasible. Anaerobic decomposition of residual microalgal biomass after lipid extraction can generate methane that increases the net energy recovery of microalgal biofuel production. Additionally, the left-over liquid after decomposition (liquid digestate) can be a nutrient source for microalgal cultivation. However, the high salinity of marine microalgae and their growth media can inhibit the methanogens responsible for producing methane. In many studies, researchers either wash the salts from the cells or adapt the microbial community to higher salt levels to mitigate the salinity problem. These extra steps require additional costs and may not mitigate salinity effectively. In this study, we compared the efficiency of anaerobic decomposition of Dunaliella viridis (D. viridis) using a high-salinity inoculum collected from a saltmarsh and a conventional low-salinity inoculum from a wastewater treatment plant. D. viridis cells were flocculated using sodium hydroxide and then fed to two anaerobic decomposition reactors with two different inocula. We examined the methane production performance of three substrate to inoculum ratios (0.5, 1, and 1.5 based on volatile suspended solids). Decomposition performance was evaluated through biogas composition, methane production, and microalgal decomposition efficiency. The 10-fold to 200-fold diluted liquid digestate was used as a nutrient source for the new microalgal culture, and the growth of D. viridis was assessed. The results of this study will help improve the anaerobic decomposition of marine microalgae by determining more appropriate inoculum sources and lower the overall cost of microalgal biofuel production.

Yanbin Li[1], Yichao Tang[2], Yaoye Hong[1], Shu Yang[3], and Jie Yin[2]
Graduate Programs: Mechanical Engineering[1]; Mechanical Engineering, Temple University[2]; Department of Materials Science and Engineering, University of Pennsylvania[3]
Advisor: Jie Yin
Poster Number: 127

Programmable active kirigami metasheets with more freedom of actuation:

Kirigami, Metamaterial, Thermal Actuation, Programmable Machine, Polarization Switch Kirigami (cutting and/or folding) offers a promising strategy to reconfigure metamaterials. Conventionally, kirigami metamaterials are often composed of passive cut unit cells to be reconfigured under mechanical forces. The constituent stimuli-responsive materials in active kirigami metamaterials instead will enable potential mechanical properties and functionality, arising from the active control of cut unit cells. However, the planar features of hinges in conventional kirigami structures significantly constrain the degrees of freedom (DOFs) in both deformation and actuation of the cut units. To release both constraints, here, we demonstrate a universal design of implementing folds to reconstruct sole-cutsbased metamaterials. We show that the supplemented folds not only enrich the structural reconfiguration beyond sole cuts but also enable more DOFs in actuating the kirigami metasheets into 3 dimensions (3D) in response to environmental temperature. Utilizing the multi-DOF in deformation of unit cells, we demonstrate that planar metasheets with the same cut design can self-fold into programmable 3D kirigami metastructures with distinct mechanical properties. Last, we demonstrate potential applications of programmable kirigami machines and easy-turning softrobots.

Kevin N. Lin[1], James M. Tuck[2] and Albert J. Keung[1]
Graduate Programs: Chemical Engineering[1]; Electrical and Computer Engineering[2]
Advisor: Albert J. Keung
Poster Number: 128

Dynamic DNA-Based Information Storage

Digital information is being generated at an unprecedented rate and is rapidly outpacing the capacities of conventional storage technologies. For over two decades, DNA has been considered a potential next-generation medium for data storage due to its high density, stability and low energy requirements. Aided by several transformative improvements in DNA sequencing and synthesis during the past decade, the likelihood of realizing practical DNA-based information storage has risen rapidly. However, as current systems primarily rely on polymerase chain reaction (PCR) to encode and access information, challenges like non-specific DNA-DNA interactions and database reusability pose barriers to practical storage systems. To achieve practical and economical DNA storage, we must address these fundamental challenges. Here, we develop a dynamic DNA-based storage system built upon a hybrid 'toehold' DNA structure that unlocks broad advantages. The system increases theoretical storage densities and capacities by eliminating non-specific DNA-DNA interactions common in PCR and augmenting the sequence space available to encode data. In addition, the hybrid DNA structure provides a physical handle that unlocks a wide range of in-storage file operations. Most importantly, the dynamic system allows for non-destructive file access by harnessing promoter-based transcription for reading information while returning the original information back to the file database. We hypothesize that this simple but powerful hybrid structure can lay the foundation for a dynamic information storage architecture that would eventually bring DNA storage one step closer to the practical implementation.

Valliappan Muthukaruppan
Graduate Program: Electrical Engineering
Advisor: Mesut E. Baran
Poster Number: 146

Decentralized Volt/Var Optimization in a Smart Distribution System

Volt/VAR control is the process of managing the voltage levels and reactive power flow throughout the power distribution system. Generally, electric utilities install legacy, slow-acting mechanical devices like Voltage Regulators, Load Tap Changers and capacitor banks throughout the circuit to address the voltage issues. But these devices fail to regulate the voltage efficiently in the presence of high penetration renewables like solar photovoltaics (PV) with significant intermittency in their output. With the recent amendment to the IEEE 1547 standard that governs the interconnection requirements for renewables, PV inverters are required to act as voltage regulating devices. But this, in turn, increases the number of control devices in the circuit which requires an efficient control scheme. Moreover, the communication infrastructure employed by electric utilities to control the devices in the field is merely through cellular or radio networks which have very low bandwidth and cannot manage high speed, high volume communication. In this work, we propose a decentralized Volt/VAR optimization scheme to efficiently control the voltage on a distribution circuit with highly intermittent and distributed PV in the system. The objective is to relieve both the computation and communication burden in the network. The proposed scheme is employed on multiple computers and microprocessor boards in a distributed computing platform communicating over a local area network. The analysis showed that the scheme was able to reduce the overall power loss in the system which is an economic benefit to the utilities while efficiently maintaining the voltage within limits. The distributed computing platform captures the processing delay between different agents which is critical when designing a real-time decentralized/distributed application.

Rajesh Paul[1], Zhen Gu[2], Jean B. Ristaino[3] and Qingshan Wei[1]
Graduate Programs: Chemical Engineering[1]; Bioengineering, University of California, Los Angeles[2]; Entomology and Plant Pathology, North Carolina State University[3]
Advisor: Qingshan Wei
Poster Number: 157

Microneedle-Based Rapid Plant DNA Extraction: Towards In-Field Detection of Plant Pathogens

Plant diseases affect global food security. Current methods for diagnosis of plant diseases are inefficient to monitor the disease outbreak and spread, as conventional diagnostic tests are limited in the laboratory settings. Extraction of DNA from infected plant leaves is an important step for molecular diagnosis of plant pathogens. Current laboratory-based plant DNA extraction protocols (e.g., cetyltrimethylammonium bromide (CTAB) extraction) involve multiple steps and require bulky benchtop equipment and skilled technicians. As a result, sample preparation becomes a major bottleneck that prevents advanced molecular technologies from deployment in the field. To expedite sample preparation and pathogen detection on site, we have developed a novel DNA extraction method using a polymer microneedle (MN) patch to isolate genomic or pathogenic DNA from plant leaves. A typical MN patch-based DNA extraction protocol involves two simple steps. First, a MN patch is pressed gently on plant leaf for breaking plant cell walls and releasing encapsulated nucleic acid materials. Next, the MN patch is peeled off and rinsed with TE buffer to collect adsorbed DNA from the needle tips. This method is minimally invasive, and isolates polymerase chain reaction (PCR)-amplifiable DNA within one minute from plant leaves. We used these MN patches to successfully extract Phytophthora infestans (a pathogen causing late blight disease in potato and tomato) DNA from both laboratory-inoculated and field-collected tomato leaves. For laboratory-inoculated samples, the MN patch-based DNA extraction method achieved 100% detection rate compared to CTAB extraction method when the samples were 3 days after inoculation. For the field samples, the MN extraction method successfully detected P. infestans in all blind samples collected from the local farm. This simple and rapid MN patch-based DNA extraction method could also be applicable to extract many other biomarker molecules from infected plant tissues in the field, paving the road towards in-field molecular diagnosis of various plant pathogens.

Kishore Ranganath Ramakrishnan
Graduate Program: Mechanical Engineering
Advisor: Srinath V. Ekkad
Poster Number: 169

Characterization of Transient Wall Heat Load for a Low NOx Lean Premixed Swirl Stabilized Can Combustor under Reacting Conditions

Modern combustor design optimization is contingent on the accurate characterization of the combustor flame side heat loads. Knowledge of regions of high and low heat loads on the liner wall helps designers optimize the cooling designs. The present work focuses on the experimental measurement of the transient heat load along a fused silica (quartz) optical can combustor under reacting conditions for a swirl stabilized premixed methane-air flame. Equivalence ratio was varied from 0.55 to 0.65. Reynolds number based on combustor diameter was varied from 12500 to 18000, where the preheated air temperature was approximately 373 K. The percentage of pilot fuel was varied from 6% to 10% of the main fuel flow rate. Inner and outer walls of the liner were painted with a high temperature flat black paint with an azimuthal offset to aid in infrared measurement of the wall temperature using an infrared camera. Particle Image Velocimetry (PIV) was employed to visualize the flow field for various reacting conditions studied in this work. Based on the heat transfer study, a detailed report of transient heat load along the length of the liner wall for varying reacting conditions has been presented here. The location of impingement of the flame onto the liner and velocity of the flow field were obtained from PIV measurements. Wall heat load at various planes along the length of the liner have been presented. Repeatability of this transient experiment was within 10% between eight different runs for various locations along the length of the liner, except for the region close to flame impingement zone. In the impingement zone, liner heat load varied by about 25% between different runs. It was observed that the change in heat load upstream of the location of impingement on the liner was insignificant with change in pilot ratio as the system tends towards a steady state, contrary to the regions downstream. Higher Reynolds number and equivalence ratios increased the heat load on the liner asexpected.

Nikhil Rastogi
Graduate Programs: Civil Engineering
Advisor: H. Christopher Frey
Poster Number: 171

Quantifying Emission Hotspots Along a Diesel-Powered Passenger Train Route

Passenger trains are typically more energy-efficient and low emitters of pollutants such as CO2, CO, and hydrocarbons compared to other means of transport. However, emission rates of nitrogen oxides (NOx) and particulate matter (PM) for diesel-powered locomotives are higher. Spatial variability in NOx and PM emission rates leads to emission hotspots and affects localized air quality and human exposure to train-generated air pollution. Identification of hotspot locations is needed to target emission reduction interventions. Current laboratory-based methods do not have a spatial resolution needed to identify hotspots. Therefore, emission rates were measured for over-the-rail (OTR) operation on the Amtrak-operated Piedmont passenger rail service. OTR measurements were conducted for 35 one-way trips using a portable emissions measurement system. Each train comprised 1-2 locomotives, 1 baggage/café car, and 2-4 passenger cars. To quantify localized emission rates, the rail route was divided into 0.25-mile track segments. Mass-per-distance based NOx and PM emission rates were quantified for each track segment. For each one-way trip and pollutant, hotspots were defined as the segments with the top 20th percentile segment average emission rates. On average, the hotspots comprised 45% and 48% of trip total NOx and PM emissions. On average over the entire route, NOx and PM emission rates from one train were equal to approximately 1000 light-duty passenger cars. On a per-passenger-mile basis, train NOx and PM emission rates were 30 times higher than for light-duty passenger cars. For trains to have lower NOx and PM emission rates versus other transportation means, trains must carry more passengers than current capacity. Most of the hotspots were located near stations in densely populated urban centers. At stations, NOx and PM emission rates were comparable to several thousand passenger cars. Higher emission rates in populated locations lead to higher exposure to pollutants versus other locations.

Eshwar Ravishankar[1],Ronald E. Booth[1], Melodi Charles[2], Jennifer Swift[2], Reece Henry[3], Yuan Xiong[3], Jeromy Rech[4], Wei You[4], Harald Ade[3], Carole Saravitz[2], Heike Sedeoff[2] and Brendan O' Connor[1]
Graduate Programs: Mechanical Engineering[1]; Plant and Microbial Biology, North Carolina State University[2]; Physics, North Carolina State University[3]; Chemistry, University of North Carolina, Chapel Hill[4]
Advisor: Brendan O' Connor
Poster Number: 172

Achieving Net Zero Energy Greenhouses by Integrating Semitransparent Organic Solar Cells

Greenhouses vastly increase agricultural land-use efficiency. However, they also consume significantly more energy than conventional farming due in part to conditioning the greenhouse space. One way to mitigate the increase in energy consumption is to integrate solar modules onto the greenhouse structure. Semitransparent organic solar cells (OSCs) are particularly attractive given that their spectral absorption can be tuned to minimize the attenuation of sunlight over the plants photosynthetically active spectrum. Here, the benefits of integrating OSCs on the net energy demand of greenhouses within the U.S. are determined through a detailed energy balance model. We find that these systems can have an annual surplus of energy in warm and moderate climates. Furthermore, we show that sunlight reduction entering the greenhouse can be minimized with appropriate design. These results demonstrate that OSCs are an excellent candidate for implementing in greenhouses and provide an opportunity to diversify sustainable energy generation technology.

Nathan Sanders
Graduate Program: Industrial Engineering
Advisor: C.S. Nam
Poster Number: 182

Brain Network Topology and the Cognitive Redline

Excessive cognitive workload is one of the most common causes of performance failures in human-machine systems. This is true in a wide variety of domains including driving, aviation, manufacturing, communications, and decision-making. Ideally, workload should be kept at a moderate level to prevent overload and provide a factor of safety. The point at which a person's mental reserve capacity is depleted and performance begins to decline is known as the redline. It is therefore critically important that new equipment, interfaces, and processes are designed to keep workload levels well below the redline. However, it is difficult to achieve this in practice because the techniques most commonly used to measure workload can be insensitive or intrusive. Our study proposes a novel application of electroencephalography (EEG) to overcome these drawbacks. It has been suggested that higher-order mental processes and effortful cognition depend on a breakdown of locally efficient, modular brain-network topology in favor of a more globally integrated pattern. We hypothesize that this breakdown in local efficiency may be a useful indicator of the cognitive redline. To test this hypothesis, we used the Air Force Multi-Attribute Task Battery (AF-MATB) to gauge participants' performance across a wide range of difficulty levels. We collected task performance data as well as subjective workload ratings using the NASA Task Load Index (TLX) and Bedford Scales while recording brain activity via EEG. We were thus able to identify the redline with several different measurement approaches. Preliminary results did indeed show that a sharp decline in functional brain network efficiency occurred in the vicinity of the redline. Our work has the potential to serve as a continuous, absolute measure of cognitive workload to supplement subjective- and performance-based measures, ultimately contributing to the safety and performance of workers in a wide range of fields.

Harleen K. Sandhu, Saran Bodda
Graduate Program: Civil Engineering
Advisor: Abhinav Gupta
Poster Number: 184

Digital Twin for Safe and Efficient Nuclear Reactors

In recent years, safe and economical operation of nuclear power plants has gained significant importance. This research aims at developing a Digital Twin (DT) of a nuclear reactor, by assimilating expert knowledge, physical models, sensor data and high-fidelity simulations. Incorporating these together with machine learning algorithms would assist the operators in managing its complete life cycle: from normal operations to accident scenarios. The US has about 100 operating reactors. Many of them are in the process of extending their life beyond 60 years. Some are being shut down because of economic inefficiencies. The proposed project aims to use new developments in artificial intelligence, machine learning, and statistical decision analytics to detect degradation in the aging fleet of reactors, and at the same time, be competitive in the energy market. A DT is a simple digital representation of the plant and its systems that continues to evolve using observed data and new simulation capabilities. A DT, therefore, continues to age with the plant and embodies the history of its operations and emergencies. Traditionally, limited instructions are available to an operator to manage an accident scenario. Understanding a plant's response, diagnosing the true fault and predicting subsequent actions in a stressful environment during a nuclear accident is a formidable task for any operator. The proposed DT is aimed at assisting the operator by providing appropriate diagnostics of the accident scenario, as well as a ranked list of potential actions. Furthermore, it would continue to track the plant's response and provide an updated set of actions, if required. This DT can be quite powerful in understanding a plant's response to an accident condition. The key components of a DT are diagnosis and prognosis, which aid in identifying accident scenarios and in evaluating the likely course of action for the operators.

Ryan Schoell[1], Li Xi[1], Yuchen Zhao[1], Peter Kenesei[2], Jonathan Almer[2], Xin Wu[3], Zhenzhen Yu[3], Zeev Shayer[4], Djamel Kaoumi[1]
Graduate Programs: Nuclear Engineering[1], Advanced Photon Source, Argonne National Laboratory[2], Metallurgical and Materials Engineering, Colorado School of Mines[3], Physics, Colorado School of Mines[4]
Advisor: Djamel Kaoumi
Poster Number: 187

In Situ Synchrotron X-ray Tomography of 304 Stainless Steel in a Simulated Marine Environment

One threat to the structural integrity of dry-storage canisters used to house spent nuclear fuel is known as chlorine-induced stress corrosion cracking. Chlorine-induced stress corrosion cracking of stainless steel 304 was evaluated in a simulated marine environment using synchrotron x-ray tomography to track the progression of cracks. Fatigue pre-cracked samples in air were obtained and smaller single edge crack samples were machined out using electrical discharge machining. A custom made tensile machine was constructed to induce a load on to a sample as well as control the temperature and relative humidity inside a kapton chamber used to simulate a marine environments. A drop of concentrated magnesium chloride solution was added to the crack and the tensile machine was placed on a rotating stage so that the sample was rotated 180° relative to the synchrotron x-ray source. Tomography showed the progression of the crack into a branching geometry near the surface. Stress intensity analysis of the sample showed the initial value was around 40 MPa m1/2, Finite element analysis showed that a higher stress intensity can lead to a branching shape of the principle stresses compared to lower stress intensities. Additionally, the small sample geometry needed for x-rays to penetrate, led to a plane stress condition which further promoted crack branching on the surface. Scanning/ Transmission Electron Microscopy (S/TEM) analysis equipped with Energy Dispersive Spectroscopy (EDS) showed the presence of $CrCl_2$, $NiCl_2{\cdot}6H_2O$, and $FeCl_2$ as well as the expected Fe_3O_4, Fe_2O_3, and Cr_2O_3. The chemical maps showed the ingress of chlorine while the magnesium stayed on the peripheral of the crack.

Karl Schuchard
Graduate Programs: Industrial Engineering
Advisor: Rohan Shirwaiker
Poster Number: 188

Anisotropic Tissue Engineering Scaffold Fabrication using High-Throughput 3D-Melt Blowing

Musculoskeletal tissues like the knee meniscus lack self-healing capacities once injured, due to their generally avascular nature. Often injuries to these tissues necessitate surgical interventions. Meniscectomy (surgical removal of the damaged meniscus), a standard treatment, often results in limited restoration of joint function and increases the risk of symptomatic osteoarthritis. Instead, a tissue engineering scaffold could be implanted to replace the permanently damaged tissue. Scaffolds are 3D-structures which mimic the microarchitecture, macro-geometry, and biomechanical properties of the native matrix they replace. Though promising, this strategy is limited by current scaffold manufacturing processes that lag in scalability or in mimicking native tissue microarchitectures. This study characterizes 3D-Melt blowing (3DMB), a new scalable manufacturing process for biomimetic tissue scaffolds. In 3DMB, nonwoven melt blown fibers are aggregated by a high-speed rotating collector positioned by a 6-axis robotic arm. Polycaprolactone (43 kDa), a widely utilized biopolymer, was used to fabricate scaffolds by varying critical process parameters collector surface speed (SS = 150, 700 m/min), die-collector-distance (DCD = 150, 200 mm), and collector fiber deposition location (FDL = 0, 80 mm). The effects of these parameters on scaffold fibrous, mechanical, and cellular CQA were multimodally evaluated. SS and FDL had significant effects on fiber diameter, angular coherency, and mechanical properties, while DCD had limited effects. Scaffolds (?8x3 mm) of contrasting CQA were seeded with NIH-3T3 fibroblasts (5 x 105 cells/scaffold) and cultured over seven days-. Scaffold cellular viability and metabolic responses were assessed by Live/Dead and alamarBlue, respectively. Scaffold design and time-point had a significant interaction effect on cellular CQA (p

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Poster Number: 190

Human cerebral organoids reveal early spatiotemporal dynamics and pharmacological responses of UBE3A

Human neurodevelopment and its associated diseases are complex and challenging to study. In particular, prenatal neurodevelopmental periods are hard to access experimentally, especially in humans. The role of UBE3A in Angelman Syndrome and Autism Spectrum Disorder is an archetype for these challenges. It is paternally imprinted in parts of the mouse brain, exhibits complex subcellular localization, and is suspected to dynamically establish these patterns in gestation. In this work, human cerebral organoids reveal that important spatiotemporal dynamics of UBE3A occur very early in human neurodevelopment. In particular, UBE3A localizes to the nucleus of neurons within a few weeks of organoid culture, with a stark transition established between EOMES and TBR1 cortical layers; these localization patterns are disrupted, and in some cases reversed, in Angelman Syndrome hiPSC-derived organoids. Organoids also exhibit early imprinting of paternal UBE3A within 6 weeks of culture, with topoisomerase inhibitors partially rescuing UBE3A levels in Angelman Syndrome organoids. One inhibitor also exhibits over two weeks of persistent rescue after just a single treatment. This work establishes human cerebral organoids as an important model for studying UBE3A biology and motivates their broader use in understanding complex neurodevelopmental disorders.

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Advisor: Mohammed Bourham
Poster Number: 194

Gamma Radiation Effect on the Corrosion Rate of Coated Steel Substrates for Application in Nuclear Waste Dry Casks

Corrosion behavior of gamma irradiated coated steel was investigated to determine effect of irradiation on the stability and integrity of coated samples for their use in dry cask nuclear spent fuel storage. Coated steel substrates were irradiated in the gamma unit and the corrosion behavior was evaluated. The substrates are 316 and 304 stainless steel and A36 carbon steel coated with different materials for different functionality to provide diffusion and corrosion barriers and crack-resistance. These coatings include a single layer of either of the following: TiO2, TiN, MoS2, and ZrO2. Samples were irradiated in increments of 1.1, 2.2 and 4.4 MRad. Three experiments were performed on the samples using Gamry instruments including polarization resistance, potentiodynamic and cyclic polarization in 1M NaCl solution at room temperature. It has been found in the case of stainless steel that as the irradiation increases, the corrosion rate increases as well. However, it was found for carbon steel that the irradiation decelerates the corrosion rate. Moreover, the coated and bare samples corroded similarly in both cases of pre and post irradiation. Finally, the samples' surfaces were characterized by SEM after performing the corrosion experiments.

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Poster Number: 203

The Investigation of Conducting Polymers with Ionic Additives: Delineating Molecular Interactions Governing Ordering and Tunable Properties

Solution-processable conducting polymers enable new applications and device concepts through their unique properties such as flexibility and biocompatibility. Poly(3,4-ethylenedioxythiophene):poly(styrenesulfonate) (PEDOT:PSS) is one of the most widely used conducting polymers and has attracted a great deal of attention due to easy tunability of its mechanical and electrical properties through processing techniques and additives. The ability to alter these properties allows PEDOT:PSS to be integrated into successful flexible/stretchable wearable electronics and organic electrochemical transistors (OECT) that display neuromorphic behavior such as short-term plasticity. Recently, ionic dopants have been added to PEDOT:PSS resulting in a new class of organic materials, known as conducting hydrogels, with a wide range of achievable properties. However, the role of these additives and their effect on molecular interactions within the system remains relatively elusive. In this work, we examine these additives to better understand the complex molecular interactions governing final material properties. In addition, we exploit the unique property of insolubility with the addition of specific dopants for OECT applications without the need of crosslinkers. A detailed study of molecular miscibility is conducted using techniques such as secondary ion mass spectrometry (SIMS) and used to interpret changes in electrical and mechanical properties characterized by sheet resistance and crack onset strain, respectively. To date, there has been reason to believe that various ionic additives promote ordering of PEDOT, in both solid samples and solutions, which is conducive to charge transport. The degree of ordering is linked to preferential molecular interactions that depend on electrostatic and physical properties of components of PEDOT:PSS and the ionic additive. We aim to develop a framework for predicting molecular interactions/miscibility with various additives allowing for complete control of electrical, mechanical, and solubility properties of these systems. A range of ionic additives will be incorporated into OECT devices to achieve variable neuromorphic functions.

Kimia Vahdat
Graduate Program: Industrial Engineering
Advisor: Sara Shashaani
Poster Number: 205

Improved Feature Selection with Simulation Optimization

In any machine learning problem with big data, redundant or uninformative features can significantly harm the prediction model in terms of its interpretability, prediction accuracy and efficiency. Traditionally, feature selection is being done with greedy search algorithms, which are susceptible to sub-optimal solutions, high-variability and selection bias due to the uncertainty in the data. We develop a Simulation Optimization framework, which looks for the best subset of features by utilizing bootstraps of the training set, where the random holdout errors are viewed as simulation outputs. We implement the proposed Simulation Optimization with Genetic Algorithms, noting that this framework is generalizable with any other solver on the integer space. Experimentations examine the effect of fixed versus adaptive replication sizes upon estimating the performance of each subset. Primary results suggests that higher accuracy and more robustness in solution size can be obtained at the cost of computational efficiency.

José J. Alvarez Retamales
Graduate Program: English
Advisor: Jeffrey L. Reaser
Poster Number: 8

Inter-generational Language use: Recent US Latinx immigrants' Perceptions of accented speech from US born immigrants:

Hispanicized English is characterized as having Native Spanish Phonology or L2 sounding accents in English, which subject those who have these accents to criticism and mockery from white Mainstream English speakers in the United States, in line with the monoglot ideologies pervasive in the country. First-generation immigrants, non-continental US-born immigrants, commonly exist in spaces where their variety English is not accepted as correct or even valid by Mainstream English speakers. Jane Hill describes Mock Spanish as the usage of incorrect Spanish as a tool employed by the white US majority as a tool that racializes and discriminates against Latinx L1 Spanish speakers. Complementarily, Jonathan Rosa posits Mock Inverted Spanglish to describe a tool for reclaiming Mock Spanish by second- and third-generation immigrants and showing in-group solidarity among Latinx communities. Although presented by the media as a homogenous group, established Latinx migrant communities dispute others' Latinx migrant identities and Latinidad, and who gets to claim these identities. This project then sought to understand how first-generation L2 English speakers in North Carolina perceive the productions of Hispanicized English or even Spanish from second-generation and third-generation immigrants and how previous interaction between groups, especially Mock language affected their view of language interactions. I performed six individual sociolinguistic interviews and two group interviews with six first-generation North Carolina Latinx immigrants. Using, discourse analytic methods to analyze the stances and positionalities that emerged, it was found that previous long term relationships with second- and third-generation immigrants and as well as rootedness to the space were factors in the perceptions of these accents by the first-generation immigrants. This leads us to think that perceptions of language are subjective, in-group belonging will promote a relationship that allows individuals with complex identities to flourish and dynamically use language as a tool for in-group solidarity within the Latinx community.

Yuhao Ba
Graduate Program: Public Administration
Advisor: Christopher Galik
Poster Number: 13

Corporate Leadership in the U.S. Environmental Governance Systems

The complexity and severity of today's environmental issues pose challenges on the conventional state-centric governance arrangements, necessitating the participation and cooperation from many non-state actors (e.g., private entities, communities, and nonprofit organizations (NGOs)). Among non-state actors, corporate entities possess a substantial role given their power in the market and society, their corresponding social responsibilities, as well as their organizational and institutional adaptability in developing alternative governance solutions. Theorizing corporate leadership in environmental governance systems, therefore, is in need to offers both theoretical and practical implications for the design and application of new environmental governance mechanisms. This is particularly suggested by recent shifts in global and regional political context where a reconfiguration of power and authority has been emerging due to the retrenchment of governmental forces. Currently under the spotlight is the United States with the Trump administration triggering a new policy agenda that has both global and local impacts. This analysis, therefore, attempts to explore the potential of corporate leadership in the U.S. environmental governance systems in response to the governance deficits due to the ongoing state retrenchment. To this end, the analysis first investigates the trajectory shifts of corporate power in the U.S. environmental governance processes by analytically chronicling corporations' involvement on social media platforms in the context of regulating fuel economy in the U.S. A theoretical model of corporate environmental governance leadership is developed next from an institutional perspective. The results suggest an ascending corporate involvement and demonstrate the institutional feasibility of corporate leadership in the U.S. environmental governance systems.

Michele Baldwin
Graduate Program: Liberal Studies
Advisor: Rob Dunn
Poster Number: 16

Sticks and Stones May Break Your Bones, But How Did We Learn to Use Them? An Evolutionary Perspective on the Development of Learning in the Stone Age

As evolutionary sciences have expanded, and fields such as evolutionary psychology and evolutionary medicine have gained momentum, popular trends have also shifted to focus on a return to the natural state of man. The term most often utilized in popular media is paleo, a reference to the paleolithic period, or stone age, a time of critical importance to the evolution of our ancestral hominins. Though much of the focus in popular culture has revolved around identifying physical attributes associated human origins, such as evolutionary applications to health (paleo-medicine), nutrition (paleo-diet), and exercise (paleo-physiology), there has only recently been expansion into the field of education, a move toward understanding the way in which knowledge was primitively acquired, a paleolithic perspective of learning. The question remains, however, how does one go about studying learning modalities of our paleolithic ancestors? Through examination of the evolutionary processes key to the development of critical skills learning, such as resource acquisition or tool usage, this paper attempts to reveal the hidden endowment of our shared paleo past, a harbinger of our modern existence. To do this, I will first define learning, what it is and why it evolves, before identifying passive and active learning processes. With this understanding, I will then employ a comparative model highlighting the learning modes of extinct and extant hominids, providing a basis from which paleo-education can be defined. Only with a clear definition of paleo-education can evolutionary approaches to teaching and learning prove to be of benefit to human progress.

Gina Beer
Graduate Program: English
Advisor: Agnes Bolonyai
Poster Number: 21

#selfcare: Who's who in self-care discourse on Instagram?

Self-care has been posited as a necessity since ancient Greek times and in the past 40 years it has been resurrected in Western health and wellness culture to include a variety of activities, coping mechanisms, and commodities. This study explores one of the most current iterations of self-care discourse by investigating a selection of Instagram users participating in self-care discourse online. By understanding the undercurrent of the trajectory of #self-care discourse, participants gain access to the ideologies behind the tools and mechanisms used to perpetuate and highlight certain aspects of #self-care discourse. Using a social semiotic approach to visual design and a textual analysis based on metapragmatic discourse, this study identifies preliminary salient social types emergent in the #selfcare discourse on Instagram: Mental Health Advocate, Self-Involved, Positivity Preacher, Spiritually Grounded, Movement Maven, Class Clown, and Instructor. After identifying which social types emerge, this study examines how the social types are constructed. A discussion of the social implications of these social types both within the #selfcare discourse on Instagram, and the larger self-care discourse concludes this study. These emergent categories speak to the current available representations of self-care, and the implications these representations have for viewers and participants in the self-care discourse. This study advocates for a heightened awareness of identity constructing mechanisms to empower viewers with choices when participating in #selfcare discourse.

Ekaterina Bogomoletc
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Advisor: Melissa A. Johnson
Poster Number: 27

Do you really need that dialogue? The association between the use of dialogic communication tactics and the level of public engagement on social media pages of nonprofit organizations

This study investigates whether the implementation of dialogic communication principles affects the success of social media communication efforts as reflected through key performance indicators that are commonly used by communication practitioners. More precisely, Facebook pages of the top ten U.S. charities are analyzed to see whether the charities employ dialogic communication principles, and if so, if the pages with a more frequent usage of dialogic communication tactics demonstrate higher levels of conversation rate, amplification rate, applause rate, and average engagement rate. The quantitative content analysis is conducted at the page level (n = 10) and at the level of posts (n = 978). The study demonstrated that each of the charities implemented some of the dialogic communication tactics. The results demonstrated no significant differences in the levels of public engagement between the pages with a higher number of implemented dialogic communication tactics at the page level and the pages with a lower number of implemented tactics. The results also demonstrated no association between a more frequent usage of dialogic communication tactics at the post level and the levels of conversation rate, amplification rate, applause rate, and average engagement rate.

Sarah Brown
Graduate Program: Psychology
Advisor: Eui Kim
Poster Number: 32

The Relationship Between Sexual Identity and Suicidal Ideation: The Moderating Effect of Bullying Victimization

Sexual minority youth who identify as lesbian, gay, bisexual, or questioning (LGBQ) are at elevated risk for negative psychological outcomes compared to their heterosexual peers; sexual minority youth report higher depression, anxiety, suicide risk, discrimination and victimization than heterosexual youth, particularly during late adolescence. Campus bullying victimization can act as a potential risk factor to negative emotional outcomes in both heterosexual and sexual minority youth. Though previous literature contends bullying victimization explains the relationship between sexual identity and suicide ideation, minority stress and ecological theory suggests that bullying victimization may serve to strengthen this relationship. Thus, the current study examines the moderating effect of campus bullying victimization on the relation between sexual identity and suicidal risk utilizing the Youth Risk Behavior Survey with a nationally representative sample. In addition, sex differences in these relations are investigated. Participants include a sample of 9th-12th grade students in the United States from public and private high schools. Preliminary analyses indicate significant interactions for bullying victimization, sexual identity, and suicidal risk; data analyses are in progress and will be discussed at the presentation of this study. Likewise, limitations and implications to inform future research and practice within schools will be discussed.

Rebecca Cibulskis
Graduate Program: International Studies
Advisor: Heidi Hobbs
Poster Number: 41

Interfaith Initiatives in International Education: Engaging the Intersection between Global Learning and Worldview Diversity

Institutions of higher education are increasingly allocating time, professional positions, and physical spaces toward diversity, equity, and inclusion (DEI) initiatives in the United States. Developing awareness around personal identities and cultures is becoming a more important factor in the social sciences generally. At the same time, institutions are often balancing traditional religious affiliations with a student population that is increasingly diverse in worldview and faith experience. Interfaith initiatives and programs have emerged as a practical solution to engaging students across worldview diversity. With international students representing much of the institutional diversity around this identity at NC State University and similar institutions, there is an opportunity for meaningful interfaith engagement with this student population. At NC State, however, a gap remains between practitioners of DEI and those who support global engagement. This research builds upon the American Council on Education's At Home in the World initiative to identify cross-cultural learning as the intersection between worldview diversity and global learning in the context of higher education. By considering learning outcomes related to international and interfaith education, this project identifies best practices for supporting students' growth around communities of difference. The findings recommend practical ways to implement interfaith initiatives into existing global learning structures at NC State University for increased cross-cultural awareness.

Logan Clem
Graduate Program: English
Advisor: Chris Anson
Poster Number: 42

Re-Inhabiting the Disciplines: Fostering Generative Value Disposition toward Writing Transfer with a Critical Pedagogy of Place in FYW

This project investigates how transfer of first-year writing skills and concepts might be affected by the use of a critical pedagogy of place. A critical pedagogy of place combines place-based education and critical pedagogy. Place-based education practitioners aim to connect their instruction to the local place in which they teach. Place-based approaches to education have been shown to help integrate liberal arts values in non-liberal arts disciplinary courses and to help students find increased value in writing instruction. However, the use of place-based approaches to teach intro-to-discourse-style first-year writing courses remains underexplored. This project works in two phases. First, working at the intersection of writing in the disciplines, critical pedagogy, place-based education, and autoethnography, I explore how place-based approaches to education might be used alongside existing writing studies pedagogies like Writing in the Disciplines and Writing about Writing and propose one implementation in the form of a new major research and writing assignment which I call a place-based autoethnography. Then, to assess this implementation, I collect two sets of student reflective writing completed before and after doing the assignment. Using a grounded theory approach, I analyze these responses to identify changes in how students report that they will use writing skills beyond the classroom. Preliminary analysis identifies that students primarily see writing as a way to advance through educational and occupational hurdles. I hypothesize that the place-based approach will influence students to see more complex personal and civic uses for writing. This qualitative study contributes to research on writing transfer, especially research on students' dispositions toward the value of college writing instruction.

J.W. Decker
Graduate Program: Public Administration
Advisor: Bruce D. McDonald
Poster Number: 55

The Diffusion of Merit Aid Programs Across State Lines: A 50 State Analysis

Merit scholarships are based on a student's performance in high school, either through GPA, standardized test results, or a combination of the two. States award merit aid scholarships as a tool to motivate students to achieve in high school and enroll in college. These merit aid programs also aim to eliminate brain-drain, which is the movement of high-performing students to out of state institutions, as well as increase the access of postsecondary education to low-income families. Since 1990, 34 states have adopted these programs in some form. Using an event history analysis approach and data for all 50 states from 1990 to 2015, this paper explores the mechanisms of how merit aid programs diffuse across state lines and the state education characteristics that support adoption. The findings show that neither the state's education attainment level nor the higher education capital outlays are statistically significant, indicating that educational offerings do not influence the decision to adopt merit aid policies. However, diffusion mechanisms of regional influence play a large role in whether a state adopts. Further, the type of public university system in a state has a large effect on whether merit aid policies are adopted. Finally, as the share of underrepresented racial populations in a state increases, the likelihood that a state adopts merit aid actually decreases, running counter to the argument made for adopting merit scholarships. Ultimately, regional diffusion mechanisms prove most influential in adoption, furthering the need to understand policy diffusion mechanisms.

Kari Doyle
Graduate Program: Technical Communication
Advisor: Huiling Ding
Poster Number: 57

Building Intelligent Content

This project is a follow-up study in developing a chatbot for the Master of Science in Technical Communication (MSTC) program at NC State University. The previous study consisted of Phase 1 in creating improvements to the accessibility of information and enhancing the user experience through chatbot interaction with prospective students. The purpose of this project was to implement Phase 2 of chatbot development. The problem discovered in Phase 2 was the need for complex AI with machine learning capability to be implemented into the MSTC chatbot to increase accuracy, intelligence, and provide a more positive user experience. To fill the gap in chatbot technology by creating a better conversational flow and human experience in chatbot development, more complex AI was implemented through Dialogflow and synced to Slack and Chatfuel via Janis AI Assistant, as well as the implementation of JSON coding to redirect and exchange data between the platforms, which allowed the chatbot to understand the context of words and user intent in conversation. The addition of Dialogflow AI created a more accurate and intelligent chatbot, producing a closer aligned human interaction and positive user experience.

Kelsey Dufresne
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Advisors: Maggie Simon and Jason Miller
Poster Number: 59

In the Anchorhold: Creating Virtual Reality Spaces to Embody Julian of Norwich's Writing and Positionality

As an anchoress, Julian of Norwich confined herself to a form of reality and existence that many cannot fully understand due to its harsh and regimented size, complete isolation, and ultimate sensory deprivation. While her anchorhold was not focused upon in her written word, it caused severe limitations to her existence in her world and was fundamental to her lived experience as both an anchoress and a writer. To make her writings and realities as an anchoress more accessible to students, I created a virtual reality system modeled after Julian of Norwich's anchorhold through utilizing and employing Oculus and Unity applications. These technologies inherently carry vast amounts of art, design, geometry, and physics, proving themselves to be reflective of an interdisciplinary experience and study. Fascinatingly numerous parallels arose between VR creation, implementation, and utilization as the experience of the anchorhold, including the roles of barriers, isolation, sensory deprivation, and wear on the body. Thus, VR technology can allow us to perhaps discover and evaluate how the restriction of place and space are evident and relevant factors presented in her written works as well as help users to embody her own positionality - even if only marginally. Lastly, and most significantly, past scholarship has focused on how VR prepares students for the worlds they will navigate in the future (Misak 42), but it can easily be argued that VR implementation allows for students to explore and better understand worlds and positionalities that no longer exist or that we have limited access to - such as Julian of Norwich's anchorhold.

Misak, John. A (Virtual) Bridge Not Too Far: Teaching Narrative Sense of Place with Virtual Reality. Computers and Composition, vol. 50, 2018, pp. 39-52. ScienceDirect, https://doi.org/10.1016/j.compcom.2018.07.007. Accessed 25 March 2019.

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Poster Number: 62

Sexual Health Interventions for Black and Latinx Adolescents: Two Meta-analyses

Black and Latinx adolescents are at high risk for contracting HIV/STIs and experiencing unplanned pregnancy. Although sexual health interventions aimed at decreasing these risks exist, evidence linking sexual health interventions to Black and Latinx adolescents' sexual behavior has not been synthesized. In two meta-analyses, we examined the associations between sexual health interventions and three behavioral outcomes (abstinence, condom use, and number of sex partners) and three psychological outcomes (sexual health intentions, sexual health knowledge, and sexual health self-efficacy) among Black and Latinx adolescents. Potential moderators of intervention success were also explored. A systematic search was conducted of studies published through January 2019 using PubMed, PsycINFO, and CINAHL databases and relevant review articles. Studies were included if they: included a U.S.-based sample of Black or Latinx adolescents; evaluated a sexual health intervention using experimental/quasi-experimental designs; included a behavioral outcome; and were published in English. Standardized mean difference and 95% confidence intervals were extracted and meta-analyzed using random-effects models. Across 29 studies reporting on 11,918 Black adolescents, sexual health interventions improved abstinence and condom use as well as sexual health intentions, knowledge, and self-efficacy. Intervention effects were consistent across factors such as participant gender and age, as well as intervention dose. Across 12 studies reporting on 4,673 Latinx adolescents, sexual health interventions improved abstinence, condom use, number of sex partners, and sexual health knowledge. Effects were consistent across a number of demographic and clinical characteristics, though culturally-tailored interventions produced greater change in condom use than non-tailored interventions. Overall, sexual health interventions are associated with improvements in sexual well-being among Black and Latinx adolescents. There is an urgent need for wide scale dissemination of these programs to address racial disparities in sexual health across the U.S.

Georgia Green
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Advisor: Jim Michnowicz
Poster Number: 80

An acoustic analysis of / in the Spanish of the Southeast US

There are several instances of Spanish language change specifically while in contact with English, such as differences in morphosyntax or in the phonetic components of verbal speech (Shin & Otheguy, 2009). Prior research has found that some speakers of Spanish in the US - particularly bilingual heritage speakers - display an incipient English-like distinction between two graphemes and (Boomershire and Ronquest, 2019).

In Spanish, these graphemes are both represented by the phoneme /b/ and there are few instances of labiodental realizations of . In English, /b/ and /v/ are realized in phonetically different ways. This distinction makes English-Spanish contact important for investigating how major-minority languages respond to contact with majority languages.

Recently, studies have utilized automated acoustic methods to examine this possible phonemic split (Trovato 2017; Chetty et al. (under review)). The present study takes a step toward applying these methods to a larger data pool.
Data in the present study comes from 24 sociolinguistic interviews with heritage and immigrant Spanish speakers from Central America and Mexico residing in the Southeast.

Interviews were transcribed and force aligned using FASE (Wilbanks, 2015). Subsequently, following Chetty et. al. (under review), which found higher Center of Gravity (COG) correlating to a labiodental pronunciation, a Praat script was used to measure COG of intervocalic /b/ tokens (middle 60%, limited to above 750Hz - see File-Muriel & Brown, 2011).
This study's results indicate that there is a statistically significant difference in grapheme production, with being produced with a higher COG. Visible yet statistically insignificant differences across generation, sex, and country of origin are also present.

Additional data presented will include the results of a complete replication of Chetty et. al. (under review) to test additional automated acoustic methods on a larger data pool.

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Advisor: Amy Halberstadt
Poster Number: 86

White parents' racial socialization strategies predict children's friendship choices

Knowledge of how to navigate an increasingly diverse world is becoming increasingly important. The strategies that White parents use to guide their children help foster or hinder their children's understanding of race. Across three studies, we explored White parents' racial socialization strategies and how they might affect the racial homogeneity of their children's peer networks. In the first study, 274 we measured White parents' racial socialization strategies. In a confirmatory factor analysis, we found three factors to describe the racial strategies for White parents. These were: color-conscious (a = .86; discussion of racial inequalities), color-mute (a = .83; avoidance of discussing race), and color-blind (a = .71; denial of racial differences). In the second study, 100 White parents' completed this measure of racial socialization strategies and reported on their children's peer network. We found that parents who endorsed color-mute strategies had children who seemed to prefer like-race children (that is they had a racial homogenous peer network; r = .34, pr = .49, pr = -.47.

Dustin Harris
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Advisors: Jessica Katz Jameson, Joann Keyton, Kami Kosenko
Poster Number: 90

The Role of Communication Within Toxic or Supportive Non-Profit Work Environments

Workplace environments, sometimes referred to as climate, are constructed by the communication of organizational members, and these environments can have positive or negative impacts on organizational members in areas such as physical and mental health, work-life balance, job satisfaction, employee engagement, conflict management, collaboration, innovation, and dissent. Given the impact that such climates can have on employees' personal and professional lives, the goal of this qualitative study was to create a typology of communication strategies that nonprofit employees can use to promote positive work environments. Semi-structured interviews were conducted with 17 non-profit employees who were between the ages of 25 and 64 and who had been with their current non-profits for a minimum of two years. The interviewees were asked to describe what they think about when they hear the term toxic work environment. They were also asked to describe the opposite of a toxic environment - often called a supportive environment for the sake of this study. Once interviewees self-defined these environments, they were asked about the communication behaviors that they had observed that had caused, minimized, or prevented toxic or supportive climates within their non-profits. Preliminary themes that emerged included: the communication behaviors of a single employee can create a toxic environment (conversely, a single leader can create a supportive environment); a lack of accountability from leaders or colleagues can create toxicity; and non-profit employees often have difficulty communicating workplace concerns because of a lack of appropriate staff or private spaces.

Nora E. Hassan
Graduate Program: International Studies
Advisor: Jessica Liao
Poster Number: 92

The Nature of Russia and China's Emerging Alliance and its Impact on U.S. National Security

Terrorism is no longer the biggest concern to United States national security. That honor now lies with great power conflicts. In 2010, America was the lone superpower and it looked as if the world was going America's way. That is no longer the case. Looking back, it is clear that 2012 was the turning point. In 2012, Xi Jinping came to power in China and Vladimir Putin skirted the Russian constitution to became President of Russia for a third term. Putin, Xi, and their respective countries are on an upward trajectory while the United States is, at best, stagnating and, at worst, declining. So, what happened in the years since 2012? This paper attempts to decipher that question. It does so by answering the central question: how does the Russia-China relationship impact United States foreign policy? As well as additional questions that must be addressed such as, what is the nature of Russia and China's emerging relationship? Is there potential for conflict between Russia and China? What should be American's foreign policy response towards Russia and China's relationship? This paper finds that Russia and China's relationship is more than what is often labeled as a strategic partnership; it is not a deep relationship like that of the U.S and the U.K. Nevertheless, Russia and China's relationship is growing deeper and stronger. Russia and China's relationship can be maintained because of the four pillars the relationship rests on. The first two are economic and military relations between the two. The third is their shared foreign policy goals, such as countering a common threat, the U.S. The last, and most important, pillar is their shared ideology and world outlook of countering U.S. hegemony, democratic norms, and democracy, as well as the personal friendship between Presidents Putin and Xi.

Jessica Hernandez
Graduate Program: Psychology
Advisor: Kate E. Norwalk
Poster Number: 93

Work Life Balance of Parents of Children with Mental Health Needs

Work life integration, or the ability to successfully combine paid work with other aspects of personal life, can be particularly challenging for parents of children with physical and mental health conditions. However, prior research has focused primarily on families of children with a diagnosed disability or chronic health condition. Subsequently, far less is known about work life integration among parents of children with subclinical symptomatology. This study helps address this gap by focusing on parents of children who have recently experienced an emotional problem, such as extreme anxiety or depression. Data were drawn from the MIDUS Boston Study of Management Processes, collected in 1995-1997. Through phone interviews and mailed questionnaires, participants (n = 302) reported on their work attendance, experiences with financial and marital problems, and whether or not their child had experienced an emotional problem in the previous six months. Results suggest that parents who reported that their child had recently experienced an emotional problem also reported elevated experiences of financial and marital problems. Additionally, financial problems were more strongly related to work attendance for parents of children with an emotional problem than for parents whose child did not experience an emotional problem. These results inform research on the need to support parents whose children do not have a formal diagnosis (i.e., minority children, children of low socioeconomic status, and children in foster care), yet struggle with a mental health issue.

Tyler Jackson
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Advisor: Jim Michnowicz
Poster Number: 105

Trilled /r/ of Spanish Heritage Speakers

This study investigates the use of the trill /r/ and its variants by Spanish heritage speakers in North Carolina. Previous studies have shown that the trill /r/ is not always produced with the expectant variant with two closures (Manuel Diáz-Campos, 2008), but in fact can be produced in several different variants. In his study into trill variation in Dominican Spanish, Erik W. Willis states, Variation in the production of the phonemic trill has long served as a defining feature of dialectal variation in characterizations of Spanish variation (Willis, 2006). For this study, tokens were coded as a tap, trill2, trill 3, trill4+, approximant, or fricative.

Preliminary data collection from 311 tokens has shown that nearly half the expected uses of the trill /r/ have been produced as taps at a rate of 47.27%. This next most common variant was the expected variant with two closures, although it only occurred in 29.9% of the tokens when the trill /r/ was appropriate. The chart below shows the percentages of the other variants coded in the preliminary data collection. With only one token produced, the fricative /r/ was by far the least common produced in the 311 tokens. Along with social factors such as country of origin, occupation, education level, and time spent in the United States, this study will also analyze linguistics factors such as word position, and preceding and following sounds.

After further data collection and a similar analysis of immigrant speakers, it is predicted that the typical trill will continue to occur less often than it is expected to. In a 1999 study, Hammond came to the conclusion that the expected trill is absent in the normal discourse of the vast majority of native speakers (Hammond, 1999).

Amidu Kalokoh
Graduate Program: International Studies
Advisor: William Boettcher
Poster Number: 112

Corporate Social Responsibility in Sierra Leone's Mining Sector The Case of Koidu Limited and Koidu Community

Corporate social responsibility (CSR) is a topical issue in both corporate and academic circles. Yet, there is disagreement on what it is and what it is not, as well as its relevance to business and communities. On the one hand, it is argued that CSR is an initiative that corporations should undertake to establish a cordial relationship with their host communities to prevent conflict that will undermine their business. On the other hand, it is maintained that CSR is a philanthropic engagement that undermines profit maximization; therefore, it should not interest corporations. These divergences set the purpose of this research by seeking out how CSR is implemented in Sierra Leone's mining sector, and why it is effective or otherwise in promoting productive relationship between companies and communities. This study uses a case study design to examine the application of CSR by Koidu Limited in the Koidu Community, and thus gives insight to CSR as a business approach to build corporate-community relations in a way that is beneficial to both parties. The use of document analysis allows the examination and interpretation of data from different sources that include government, civil society organizations, journals, and the media. The company's commitment to providing economic and social support has proven inadequate to the community's demands. Community discontent over relocation packages, low and poor employment, dependence on CRS proceeds, and anxiety for potential environmental impacts are some of the factors that led to local and international protests that accounted for fatalities and temporarily halted the company's operations. National regulations on CSR compliance are somewhat imprecise and offer a weak foundation for its effective implementation, and consequently create ambiguities in the interpretation of reciprocal responsibilities of both parties.

Joel D. King
Graduate Program: Anthropology
Advisor: Dru McGill
Poster Number: 118

Consuming or Consumed: Economic Strategies and Consumption Behaviors at a 19th Century Farmstead and Community Hub

The ways in which we interpret the past determines our understanding of the present. Our current consumer culture is increasingly profit driven. Marketing methods attempt to convince us of what products we must acquire to be successful and happy. How and when did this culture begin in rural communities in the southeastern United States? This project seeks to rescue from obscurity, the lives of the forgotten ordinary. Using historical documents, combined with the archaeological record, I helped a descendant community tell the story of a rural non-plantation based southern farmstead family. I examined the changing consumption patterns at a multi-generational sight in southwestern Alamance County, North Carolina. The goal was to determine what caused the collapse and ruin of a family and their community hub. Long abandoned and forgotten, I studied their strategies for resistance or conformance to consumer trends to provide the public with a better understanding of the decisions and actions used in the past to deal with the effects of capitalism on those at the periphery. The information gained from this project will help create a regional synthesis of rural farmsteads to compare to global trends. Such comparisons reveal the disparate effects consumer culture has had on populations in the past. This is vital as even today populations continue to experience these disparate effects and still lack equal access to avenues for economic success. We form our identities in part based on how we judge those who came before. When we fail to investigate the everyday folks of the past, we fail to see how we create the us of today.

Barbara Loeffler
Graduate Program: Liberal Studies
Advisors: Karey Harwood, Cathy Crossland, Kelly Lynn Mulvey
Poster Number: 132

Utilizing Middle School Language Arts Curricula To Enhance Interpersonal Communication and Empathy in an Effort to Decrease Sexual Harassment

Sexual harassment is defined as unwanted sexual behavior that interferes with your life, and 81 percent of students report experiencing sexual harassment during their school lives, with 35 percent of students reporting their first experience occurred in the sixth grade or earlier. Harmful impacts associated with sexual harassment include depression, anxiety, eating disorders, decreased GPA, and increased school absences. Thus, it is critically important to include developmentally appropriate interventions to decrease sexual harassment in our schools. As current interventions show mixed results, a literature-based series of teaching lesson plans based on the existing middle school (grades 6-8) English Language Arts (ELA) curriculum used in North Carolina has been developed. Focused on character development, social interactions between characters, and themes associated with bullying and harassment, these lessons utilize specific literature selections to improve empathy and interpersonal communication skills by teaching adolescents to recognize how their words and actions can result in harassment and help them learn to better self-regulate their personal behaviors. Lessons include direct teacher instruction, peer learning, creative writing, group projects, performance, and movement, with emphasis placed on adolescent cognitive and social development. Surveys of future ELA educators attending NC State show 97 percent of respondents believe it is very important to teach middle school students how to reduce bullying and sexual harassment in the school setting by teaching them how to improve their interpersonal communication skills, 95 percent of respondents say they would be willing to include lessons or discussions in interpersonal communication within their regular ELA curriculum, and 48 percent state a preference for 6 or more lessons on interpersonal communication per year. These lessons will be implemented in participating pilot NC middle school classrooms, and the effectiveness of the lessons will be evaluated by gathering and analyzing data obtained through pre- and post-intervention student journaling exercises.

Allura Lothary
Graduate Program: Psychology
Advisor: Thomas M. Hess
Poster Number: 133

How feeling younger keeps us engaged with life: Importance of staying engaged in older adulthood

A large body of research in older adulthood stresses the importance of subjective age on health and well-being outcomes. Subjective age refers to how old an individual may feel and has been studied various ways to understand different health outcomes in older adulthood (such that feeling older is associated with higher rates of mortality and steeper declines in cognitive functioning; Stephan et al., 2016; 2018). Research has shown an association between how old we feel and our attitudes, or beliefs or feelings, towards the aging process overall. This study sought to better understand how changes in how old we feel result in changes in our aging attitudes. In this study, we looked at activity engagement as a way to understand how changes in how old we feel alter our attitudes. We expected that if an individual feels older than their chronological age, this may be impacting their experience with daily living by decreasing the number and frequency of daily leisure activities they engage in. In turn, this reduction in engaging with life will ultimately alter how satisfied we are with the aging process and our overall attitudes about aging. Approximately 140 participants (ages 65-85 at Wave 1) in the Raleigh, NC area participated in a 5-year longitudinal study. The current study found evidence for the proposed model by measuring the associations between 28 different types of leisure activities, subjective age, and aging expectations across 3 waves of data. These results are particularly important for understanding how individuals' attitudes about their own aging process may be a result of disengagement with life and daily activities engagement. Results from this study may help inform future interventions to help increase activity engagement and improve aging attitudes in older adulthood.

Travis R. Merchant
Graduate Program: English
Advisor: Andrew Johnston
Poster Number: 141

'Wake Up, Get Up, Get Out into the New Environment': The Speculative Reality of Persona 5

The digital Tokyo of Persona 5 (2016) teems with vivacious energy that brings the animated locale to life. Throughout the player's time in this digital Tokyo, the loading screens remind the player about the date, the changing weather, and the public's interests and concerns. These actions in the game act as an echo from the world the player inhabits through ecomimesis; in turn, this object breathes its own life by bending its own existence to create an animated speculative reality that exists separate from the player interacting with the game. By materializing as a probe, it presses up against the player and informs her that the world inside the confines of the game does, in fact, breathe. This engagement with Persona 5 also doubles as a metagamea game about games and containing its own games which pushes the player to consider this world as acting separately from herself. This project examines Persona 5 as an animated object through speculative realism which allows for its own reality to thrive with or without the player. By leveling out the relationship to the game and removing the highly masculinized definition of a gamer, the game as object can avoid being hacked or overpowered by the player. Instead, she can participate within the world as just another player character within the large array of NPCs (non-player characters) discovering the digital Tokyo. Engagements with activities, weather, time, and inhabitants force the player to reconcile her place in this animated world that flourishes on its own.

Kelsey Mischke
Graduate Program: Sociology
Advisor: Michael Schwalbe
Poster Number: 142

Body Dissatisfaction, Body Projects, and Efficacy-Based Self-Esteem: Paths into Bodybuilding

Female bodybuilders defy gender conventions; they develop musculature, engage in activities, and occupy spaces usually associated with men and masculinity. While scholars have debated what women's participation in bodybuilding means for understanding gender, few studies have investigated the process through which women become bodybuilders. The current study examines this process through life history interviews with three female bodybuilders. The data reveal the importance of reflected appraisals and body dissatisfaction as catalysts for participants' entry into bodybuilding. Negative reflected appraisals and unfavorable social comparisons problematized each woman's body during adolescence. Each responded by engaging in body projectsan organized set of activities aimed at transforming the body. Through body projects, participants reshaped their bodies, generated efficacy-based self-esteem, and altered their self-conceptionsin turn altering their lives. However, despite the enhanced self-efficacy and higher self-regard that resulted from their body projects, the negative reflected appraisals the women received as adolescents had lasting effects. The women continued to see features of their bodies as problematic. This research contributes to knowledge regarding identity verification, emotion, action, and the self by demonstrating the central role of the body in shaping self-feelings. It also demonstrates the value of life history methods for uncovering the social psychological processes that affect life trajectories.

Ana Montiel Sánchez
Graduate Program: Foreign Languages and Literature
Advisor: James Michnowicz
Poster Number: 143

The transition from ceceo towards distinción in three locations of Málaga: a sociolinguistic analysis.

The following study analyzes the existing competence in the pronunciation of the sibilant /s/ as [s] or [?], considering two phenomena: ceceo and distinción, in three locations in the province of Málaga, in Southern Spain, among which the capital city is included.

This region, which traditionally uses the [?] form (Penny, 2000) seems to register a change towards distinguishing the phoneme, as previously studied in the province ((Ávila Muñoz, 1994; Villena Ponsoda et al., 1996, 2012, 2014).

Data shown were collected through sociolinguistic interviews, reaching a total of 24 speakers (8 speakers per region), including women and men from three generations and different education levels. Regions include the province's capital, Málaga, and the remaining areas are located towards the interior part of the province, such as Alhaurín de la Torre (metropolitan area) and Cártama, a smaller town in the mountains.

As of now, preliminary results include a categorical analysis of [s] vs [?] of 16 speakers from the capital and the metropolitan area (8 men/8 women, 8 young/8 old). Final results will include an acoustic analysis (COG) and the comparison of the three locations' patterns.

Results from the capital show a significant effect of age: only older speaker produced tokens of [?]; and sex among the older speakers, as [?] can be observed more frequently among older male speakers. Results from the metropolitan area show tokens of [?] among older women, although the acoustic analysis shows more variety in the forms used by female speakers ([s?] and [?], which is significant because it proves the transition towards distinción, but not as the same level as women from the capital.

The analysis of the last region, Cártama, is expected to show the presence of [?] through generations and among younger speakers, which will display the increased presence of [?] as we get deeper in the region's countryside.

Anne Njathi
Graduate Program: Communication, Rhetoric, and Digital Media
Advisor: Aoriana de Souza e Silva and David Rieder
Poster Number: 151

The Effects of Digital Credit Lending Apps on Low-Income Earners in Kenya: A Case of Tala FinTech Company

Financial inclusion has been a relevant topic of study in ICT4D (Information and Communications Technologies for Development) for Africa. This is partly because there has been an increase in smartphone use, with mobile applications (apps) running efficiently through higher speeds of Internet connectivity. In particular, digital credit apps have had a disruptive effect on traditional banking networks by opening up services such as digital loans to previously unbanked low-income earners. This paper is a contribution to the ongoing discussion, more specifically, leveraging on Tala FinTech company. This paper investigates how the ease of access to credit is contributing to rampant digital credit uptake. Leveraging on secondary sources of data, this paper compares Internet penetration against accessibility and adoption of Tala digital credit app to explore to what extent Internet use facilitates financial inclusion for low-income households, what promotes or negates Internet use. Therefore, even as we praise FinTech for financial inclusion of low-income earners we must evaluate if increased access to digital credit loans, absent regulatory framework, has the potential to promote indebtedness for low-income earners who lack the financial and technical knowledge to responsibly capitalize on these apps. Although this once excluded population is now financially included, findings from this paper indicate that the financial health of low-income households is being affected by creating high levels of household debt or jeopardizing future borrowing opportunities. These findings also challenge the technocratic assumption that access to increased mobile internet, thus, digital credit apps, necessarily leads to financial inclusion. Despite FinTech technological breakthrough in onboarding the unbankable, this paper concludes that the process of innovating FinTech solutions should not ignore the dynamics around serving this populous. Digital credit apps are raising new challenges, necessitating a reevaluation of the apps' process and structure.

Leslie Pierce
Graduate Program: Sociology
Advisor: Michaela DeSoucey
Poster Number: 161

The Gendered Framing of Weight Loss Surgery

Rates of bariatric surgery have increased in the last 20 years in the U.S. This rise is often attributed, in part, as a social response to the country's obesity epidemic (Saguy and Almeling 2008). Of those Americans who received some type of weight loss surgery (WLS), 80 percent identified as women (Fuchs et al. 2015; Young et al. 2016), even though the percentage of obese Americans is nearly identical for American men and women, at around 30 percent for both (CDC 2017a). Studies have yet to unpack the gender disparity in who undergoes WLS. Building on previous research comparing meaning making via medical and media discourse, I argue that these outlets reveal gendered patterns in how the public and medical community views WLS. In this study, I explore how both the media and medical research frame WLS for men and for women. Drawing on insights from stigma theory and fat studies literature, I analyze media and medical articles about WLS to consider how framing legitimates the discrimination of fat people, and to contribute to an improved theoretical understanding of stigma related to body weight. This analysis reveals that media and medical articles frame WLS in ways that are both gendered and raced, perpetuating sexism, racism, and stigma within the institutions of media and medicine.

Charice Putnam, Tayler Mariner, Janelle Burnette
Graduate Program: Social Work
Advisor: David Fitzpatrick
Poster Number: 33

Substance Use, Trauma, and Parenting: Assessment of the Trauma-Informed Treatment Needs of Parents with Substance Use Disorder

Research suggests that family-based traumas, especially adverse childhood experiences (ACEs), are a major risk factor for the development of substance use disorders (SUDs). Findings show one in eight children live with a substance-using parent (Mersky, Janczewski, & Topitzes, 2017). Many of these children are at higher risk of experiencing child abuse, neglect, and later SUD (Berger et al., 2010). While the research clearly demonstrates the cycle of trauma and SUD among families experiencing parental substance use (PSU), research on trauma-informed interventions specifically designed for parents in recovery is lacking. The current study sought to assess the need for a trauma-informed care approach at a local, residential, substance use recovery facility, from the perspective of parents in recovery. Data were collected from mothers and fathers at the facility, using a mixed-methods design. Participants completed a questionnaire that measured childhood and adult experiences of trauma using a 17-item modified ACEs measure (Mersky, Janczewski, & Topitzes, 2017), prior engagement in treatment, and perceived treatment needs related to parenting while in recovery. Follow-up interviews were conducted to further expand on participants' responses to the questionnaire. Findings from the assessment will support the treatment facility in addressing trauma and its impact on parenting during recovery. Findings from the needs assessment will also add to the knowledge base regarding trauma-informed interventions for parents in recovery. Future research should focus specifically on fathers' trauma history and its impacts on substance use and parenting, as this group has reported feeling less supported in their parenting roles while in recovery.

Fallon Reagan
Graduate Program: International Studies
Advisor: Jessica Liao
Poster Number: 173

Hedging Their Bets: Global Strategies of Thailand and the Philippines Amidst a Great Power Rivalry

The modern-day power rivalry between the United States and China has sparked concern not only on the American home front, but also globally. Allies and enemies of both superpowers closely watch the actions and reactions of the Americans and Chinese as the two states compete for power. However, though the media and the general population tend to focus solely on the US and China, smaller states are playing a key role in their policies vis-à-vis the two powers. This is especially true in Southeast Asia, where several small states are attempting to assess the power rivalry while maintaining their autonomy and perhaps even reap benefits. This paper explores the particular cases of the Philippines and Thailand by demonstrating how the two states are practicing strategic ambiguity in their relations with the United States and China. A comparative case study framework is implemented in order to discern what domestic factors are affecting the military, economic, and foreign policy choices of the Philippines and Thailand under the Duterte government and the Thai military junta. In turn, these choices are examined through the lens of the two states' bilateral relations with the United States and China in order to discern how each country's unique domestic situation is impacting its international relationships with two dominant superpowers. By explaining how the Philippines and Thailand are practicing the international relations concept of hedging, this paper underscores the importance of small state players in the region, as well as how their grand strategies may affect the American-Sino great power rivalry.

Cynthia Rosenfeld
Graduate Program: Communication, Rhetoric, and Digital Media
Advisors: Elizabeth Craig and Helen Burgess
Poster Number: 179

Talking Trash: The Rhetoric of Waste Bins

There is no mythical land of away. We have a trash problem, and plastic is a major contributor. In 2015, we generated 34.5 million tons of municipal solid plastic waste. Ironically, plastic containers, from household cans to plastic liners to the large green bins we place on our curbs, held that solid waste at one time and were soon to be their own contribution to the tons of discarded material. The banality, opacity, and capacity of our waste bins facilitate consumer culture. Reflective design can help us query our trash practices by defamiliarizing the trashcan through making its attributes and properties visible and explorable. Talking Trash is an act of reflective design in which I wove a waste bin from the environmental articles of various magazines. Next, I setup a Twitter account, @Talking_Trash_, to tweet about items I was placing in the bin. In the final version, I imagine the bin as fitted with an Arduino to tweet when objects are placed in the bin. Ultimately, I argue that our trashcans engage in a rhetoric of the everyday that encourages consumer practice and waste-world-making. Talking Trash provides insight into the public and private natures of waste, the revealing and concealing our bins promote, and the affordances of materiality present in our waste bins. Talking Trash is an intervention of hope of making change that matters in the Anthropocene.

Ayana Sadler
Graduate Program: Technical Communication
Advisor: Stacey Pigg
Poster Number: 180

Bridging the Gap Within Patient-Centered Rhetoric: Understanding the Impact of Medical Rhetoric on Underrepresented Communities

Rhetoricians have addressed the dearth of healthcare services inadequately marketed towards marginalized groups. Scholars assume that there are connections between patient-centered dialogue gaps and the rise of health disparities. Although health literacy is a widespread problem, it is commonly not considered when developing patient-centered materials. In this study, rhetoricians gain a better gauge of the novice's perspective on medical rhetoric and the limitations presented to underrepresented patients. A group of four ethnically diverse, female, NC State University (NCSU) students participated in the research study. Although there is a plethora of diversity among NCSU campus, scholars refer to the lack of comprehensible materials marketed towards underrepresented groups. The focus group was structured to help assist in identifying responses associated with novice's comprehension of medical rhetoric for a commonly prescribed drug. Together, the focus group analyzed a Yasmin birth control label to measure their knowledge of patient-centered rhetoric. Methods consisted of participants highlighting jargon and sentences of unfamiliarity within the birth control label. Following, the group had an open discussion sharing their experience with medical rhetoric. The highlighted labels and interview data were collected for a coded analysis of the corpus. Words that were commonly highlighted helped to reveal frequently misunderstood jargon and genres of jargon. The focus group discussion was transcribed to assist in identifying concerns and future ideas for creating empowering patient-centered materials. The focus group revealed the need for more communicative practices that identify methods to embrace cultural competency. My research encourages rhetoricians to learn more about the components needed to create comprehensible rhetoric.

Jason D. Saville, Sean M. Noble, Lori L. Foster
Graduate Program: Psychology
Advisor: Lori L. Foster
Poster Number: 152

Examining Virtual Reality Learning Acceptance Using the Unified Theory of Acceptance and Use of Technology

Post-secondary institutions are investing in and utilizing virtual reality (VR) for many educational purposes, both as a learning tool and as a technology to be studied. Institutions such as vocational schools, community colleges, and universities need to understand what psychological factors drive students' acceptance of VR in order to determine whether, under what conditions, how, and for whom to deploy VR for learning. The Unified Theory of Acceptance and Use of Technology (UTAUT; Venkatesh et al., 2003) offers a theoretical framework for understanding students' receptivity to VR for learning. Undergraduate university students (N = 300) read a description of VR and video training mediums, then indicated which they would choose to learn a novel task. Three psychological variables performance expectancy, effort expectancy, and social influence tended to be related to acceptance of VR, which was measured in two ways, as: (a) rated intentions to use VR, and (b) preference for VR over the video-based alternative. Relative weights analyses conducted to compare the importance of the three predictors revealed that performance expectancy was the most influential antecedent of VR acceptance.

Kathryn Schwaeble
Graduate Program: Public Administration
Advisor: Tom Birkland
Poster Number: 189

An incremental return to the status quo? The diffusion of mandatory sentencing policy reform

This study explores whether punctuated equilibrium theory (PET), a framework for understanding the policy process which presents policy change as incremental most of the time but occasionally interrupted by drastic change, helps explain the relative speed of innovative changes in policy and the speed of subsequent rollback of the policy. It has been established that different policies diffuse at different speeds. Yet do variations in original innovation speed carry through to the speed of reform or return to the status quo? We know much more about original innovation diffusion than that of policy retreat or change, so the speed of reform and what factors influence it are critical to explore, as it is possible different dynamics influence reform. This study uses the case of mandatory sentencing policies and their reform at the state-level within the United States, as well as traditional policy diffusion methodology. This case allows for several comparisons across policies, as there are different types of mandatory sentencing policies, such as drug-related sentences and gun enhancements. It is hypothesized according to PET that the original innovation (the initial mandatory sentencing policy) will diffuse more quickly, and the reform or repeal (the rollback of a mandatory sentencing policy type) will be much more difficult, and thus occur more incrementally. It is important to understand the speed of these policy regressions to the norm as it will help us better comprehend patterns of policy change at the state level. The factors which lead to the original policy adoption and those which contribute to the ultimate reform are also compared so that we can better understand why differences in speed of diffusion are present. Overall, the trend of slow return to status quo holds up; the current study extends this to better understand why.

Earl Stockham
Graduate Program: Liberal Studies
Advisor: Kim Stansbury
Poster Number: 198

The Effect of Policy Changes on Military Culture: An Exploration on Diversity Training in Military Units

Over the past 10 years, the U.S. Military has taken significant steps to align military culture with evolving social changes more prominent in American society. Since 2010, three big social policies have been repealed in efforts to modernize the Armed Forces and align military values with public sentiment. First, was the repeal of the 'Don't Ask, Don't Tell' policy affecting gay and lesbian rights to serve openly in the military. Followed by the dissolution of the 'Ground Combat Exclusion' policy which barred women from pivotal military jobs that overtly affected career advancement equally to men. And finally, the reversal of the 'Transgender Service Ban', which discriminated against transgender and transitioning soldiers prohibiting them from military service. Despite the progressive changes to policy and regulation though, toxic cultures of abuse and oppression continue to plague military communities. Levels of discrimination, sexual harassment, and assault continue to rise in the military despite training programs aimed at improving awareness and acceptance throughout the ranks. This study utilizes open source survey data to investigate attitudes towards current training programs implemented as a result of these policy changes. By examining soldiers' perceptions of their environment, areas of improvement related to training and enrichment programs will be identified in efforts to help soldiers better understand and navigate the social complexities found in their communities. Repealing policy alone does not guarantee equality of rights or safety from persecution. As Military policies continue to evolve in congruence with societal expectations, more comprehensive training methods are necessary to ensure maximum integration and to address unintended social consequences related to the dynamic shifts in military culture.

Bryce Stout
Graduate Program: Communication
Advisor: Nicholas Taylor
Poster Number: 199

Hegemonic Hand Movements: Microethnography of Mimetics in Super Smash Bros.

Competitive video gaming is a global and dynamic media industry; but how do competitive gamers themselves make sense of the skills required to compete at elite levels?

This study employs ethnographic and "micro-ethnographic" techniques -- observations of competitive Smash Bros players and tournaments, and video recordings of their match play -- to uncover the tacit abilities and understandings that constitute elite play in one of the most long-standing competitive gaming scenes in the world. Specifically, the study reports on video recordings of players as they participate in matches, and semi-structured interviews involving these same players watching and commenting on these recordings, in order to better understand the intimate relationships between bodies, controllers and screens that form the unmarked but vital heart of elite competitive gameplay.

Lori Townsend
Graduate Program: Liberal Studies
Advisor: Alicia McGill
Poster Number: 204

Utilizing GIS in Humanities Research to Foster Public Engagement with Historical Sites: Gilbert Town, Rutherfordton NC

This applied research project highlights Gilbert Town Historic District, a site on the National Register of Historic Places ?(NR)? in Rutherfordton, North Carolina. Informed by an interdisciplinary approach, this project integrates and draws on methodologies from history, anthropology, and geographic information science (GIS) to further public engagement with historical landscapes. Archaeological and historical sites across North Carolina are often forgotten or are in danger of destruction due to development. Rural sites, in particular, such as Gilbert Town are often overlooked within the larger agrarian landscape, simply because they do not appear historic in nature (i.e. containing historic structures and/or buildings). The project objective is to highlight an important historical resource and generate new understanding of and interactions with the historic landscape among local stakeholders and interested parties. This objective is pursued in an interdisciplinary fashion by collaborating with stakeholders, conducting historical research, and creating a Story Map for Gilbert Town utilizing GIS software. The intent is to reach users through an interactive stage and facilitate engagement with place-based historical narratives. Using space as a lens to understand and interpret historical landscapes provides a tangible resource to which to tie the stories, transforming space into a place for discourse. Digital humanities projects, like this one, provide communities with a tool to engage with the historically significant places within their neighborhoods. This can foster a sense of ownership and promote community participation around at-risk historical resources. Additionally, by engaging audiences through accessible online platforms, historians and heritage practitioners can promote an understanding of locally significant landscapes within broader historicalnarratives.

Bethany Van Scooter
Graduate Program: English
Advisor: Zachary Beare
Poster Number: 206

Where Writing Happens: An Institutional Ethnographic Study of Graduate Writing at NC State University

Many graduate students encounter new writing tasks and unfamiliar rhetorical situations in graduate school. Often these writing situations involve what John Swales describes as occluded genres, meaning that their expectations and conventions are out of sight to novices entering the discourse (18). Faculty members are often at a loss for how to teach students these genres (or feel it is beyond the purview of their class), so they send students elsewhereto graduate level writing centers or to other departmental or university programming meant to provide writing instruction and support. Interested in the challenges faced when trying to provide graduate-level writing instruction and in exploring the various support structures that exist within the university system, this capstone project investigates the various sources of writing support offered to graduate students across the disciplines at NC State University.

According to Michelle LaFrance, institutional ethnography is a method of inquiry designed to discover how our everyday lives and worlds are embedded in and organized by relations that transcend them, relations coordinating what we do with what others are doing elsewhere and elsewhen [sic] (22). In order to do this, I analyze the institutional texts such as the Writing Resources for Graduate Students webpage, the Graduate Writing Center website, institutional documents from different departmental websites and program descriptions, and templates for documents such as emails and guides. Essentially, through analyzing institutional sites of writing, where writing happens and how it happens on a social level, I begin to understand how these institutions first took shape, their original goals, how/if they meet those goals, and how students function within these spaces as well.

Allison Worsdale
Graduate Program: Communication
Advisor: Kami Kosenko
Poster Number: 215

Sexual Consent in the LGB Community

In recent years, there has been a sexual revolution that has drawn attention to the meaning of sexual consent and created a necessity for all people to be better educated on the term. The public has become hyper-aware of sexual harassment and sexual assault because of the Me Too movement, which brought to light the fact that sexual harassment and violence have become normalized in our society to the level that there needs to be additional education on consent and policies put in place, to shift this norm (Lee, 2018). The Me Too movement, as well as other similar cultural movements whether national or international, have opened the discussion up to policymakers, legal professionals, scholars, and the public about how people define and negotiate consent in relationships of varying intimacy. Previous research on sexual consent has focused solely on heterosexual individuals and their impressions of how people define and negotiate consent in relationships, leaving lesbian, gay, and bisexual (LGB) individuals out of the conversation and potentially vulnerable in their sexual communication with partners. Although issues surrounding consent are of significance to LGB individuals, we know little about how they define and negotiate consent as well as where they learn this information. Through the framework of social support, a qualitative study was completed with 25 individuals participating in in-depth interviews to answer the research questions: what are the meanings of sexual consent for LGB adults, what dilemmas have LGB adults faced when discussing sexual consent, and what factors have shaped LGB adults' views on sexual consent. In order to determine the approach that the LGB community takes towards defining and negotiating sexual consent, it will require an understanding of how the meaning of this concept is constructed within this community.

Samantha Zottola
Graduate Program: Psychology
Advisor: Sarah Desmarais
Poster Number: 162

An Intersectional Examination of Race, Gender, and Age Bias in Bail Amounts

Across the United States, efforts are underway to reduce bias in monetary bail assignments. However, little is known about the intersection of multiple social identities and demographic characteristics as they relate to decisions about the amount of bail assigned to individuals at first appearance. An intersectional understanding of how bail is assigned is necessary to effectively evaluate whether reform efforts equitably reduce bias in bail assignments. To address this gap in knowledge, my goal was to examine main and interactive effects of legally relevant variables (i.e., number of charges, charge severity, and booking number), race, gender, and age on bail amounts assigned across repeated jail bookings. I used multilevel modeling in a heterogeneous sample of defendants (N = 24,062) booked into a large, urban county jail over a three-and-half-year period. All legally relevant variables demonstrated main effects in the expected direction. Specifically, more charges, more serious charges, and more bookings resulted in higher bail amounts. However, 2-way and 3-way interactions with race, gender, and age qualified these main effects. One 3-way interaction between charge severity, age, and race demonstrated that, regardless of charge severity, older defendants were assigned higher bail than younger defendants and that Black defendants were given higher bail than White defendants. Another 3-way interaction between race, gender, and age showed that older defendants were assigned higher bail amounts for all race and gender combinations except Black men: younger Black men were assigned higher bail than older Black men. Taken together, findings show bias in bail assignments at the intersection of multiple identities and demographic characteristics. These findings emphasize the importance of applying an intersectionality framework to ensure that current bail reform efforts are successful in promoting more equitable and less carceral pretrial decisions, particularly decisions around bail practices.

Bradley Allf
Graduate Program: Fisheries, Wildlife & Conservation Biology
Advisor: Caren Cooper
Poster Number: 7

The New Citizen Scientist: Multi-Project Participation

Citizen science, the practice of engaging the public in authentic scientific research, has grown rapidly as a field over the last decade. This has well-documented benefits to the researchers that utilize citizen science data. But beyond the benefits of the scientific data generated by citizen science, an emerging body of research suggests that citizen science may benefit conservation due to its impact on citizen science volunteers. For instance, research shows that citizen science participation can lead to increases in environmental knowledge, ecological interest, and pro-environmental behaviors. Yet the bulk of the research on the impact of participation on volunteers is project-centric, focusing on how a single project impacts volunteers. Given the recent growth in citizen science, it may be more appropriate to adopt a volunteer-centric perspective, which focuses on how volunteers holistically engage with citizen science across this emerging landscape of projects. As a precursor to studying the potential benefits of a volunteer-centric approach, I explored whether today's citizen scientists are participating across multiple projects and topics. Based on my analysis of survey data and digital trace data from multiple citizen science projects, I demonstrate that citizen scientists are often multi-project participants, and sometimes cross disciplinary boundaries. Early analyses reveal that style of participation is associated with higher gains in volunteer outcomes like interest in science and nature compared with participation dynamics more narrowly focused on a single project or topic. Taken together, I propose that researchers interested in understanding the value of citizen science to impact volunteers adopt a volunteer-centric perspective, taking into consideration the fact that volunteers may be contributing to multiple citizen science projects. Doing so may model a more accurate, holistic representation of the broad societal value of citizen science at large to effect change in the public's attitudes and behaviors around conservation topics.

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Poster Number: 15

Consequences of a mortality complex on bitternut hickory structure and regeneration in a second growth northern hardwood forest in northern WI

A second-growth northern hardwood forest in Wisconsin experienced extensive bitternut hickory (Carya cordiformis) mortality between 2010 and 2016. Similar mortality events over the midwest in the last decade have been reported, but undocumented, and are attributed to a complex of factors involving the hickory bark beetle (Scolytus quadrispinosus) and an associated pathogenic fungus Ceratocystis smalleyii. We have intensively monitored the vegetation in a long-term experimental site in the Flambeau River State Forest and have documented mortality through time. The objectives of this study are to (1) confirm the presence of hickory bark beetle and C. smalleyii, (2) quantify and characterize the extent of mortality, and (3) test the hypothesis that mortality patterns are density dependent. These objectives can inform how the disease affects the stand structure and regeneration potential of bitternut hickory, and how certain conditions may increase the likelihood of a decline event. Bitternut hickory trees showing crown dieback were selected, felled, and subsampled for fungi. Fungi was isolated from wood samples, grown in moist chambers, and identified. Stem surveys were conducted periodically starting in 2005 until 2016 for seedlings through trees. We confirmed the presence of C. smalleyii and hickory bark beetle at the site. Seedling density (10cm) have experienced significant mortality, with 85% hickory mortality between 2010 and 2016. Additional analyses are focused on evaluating whether the proportion of hickory in the neighborhood of an individual influences the likelihood of morality and identifying any other predisposing factors. The mortality complex has caused a significant reduction to the bitternut hickory population in the study area and will potentially have lasting consequences on the persistence of the species in the area.

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Poster Number: 35

Evaluating the Influence of Sport Context Factors and Coaching Behavior on the Physical Activity Production of High School Athletes During Practice Time

Most U.S. children and adolescents do not achieve sufficient levels of moderate-to-vigorous physical acitivity (MVPA) on a daily basis. Organized sports have been promoted as a potential strategy to increase physical activity (PA) behavior of youths, however research does not consistently support that sport participation alone contributes to higher rates of PA. The purpose of this study was to assess the practice design and coaching behavior of a variety of high school sports during practices in North Carolina and its association with the PA behavior observed in athletes. The System for Observing Fitness Instruction Time (SOFIT) was used to objectively measure PA in twenty different sports. Data collection was conducted during 598 varsity sport practices in twelve schools. Participants accrued a substantial amount of PA during practice time, but PA production varied. The sports that were characterized with high amounts of running like cross country, track & field, and soccer had high MVPA. Cheerleading, softball, and baseball were low in MVPA. A majority of the boys' sports generated more PA than girls' sports. The context was significant in determining how much PA occurred. Sports that placed extra emphasis on game simulation, fitness, and skill development drills can be expected to have higher levels of MVPA. Practices where the coach was either promoting fitness or observing had higher MVPA rates than during instruction or management tasks. Regression analyses revealed that practice context (R2 = 0.31) had a greater predictive relationship to PA than sport type (0.06) and coaching behavior (0.05). The full models explained 41% and 52% of the PA behavior for boy and girl athletes, respectively. The results contribute to our understanding of how different sports and their practice contexts contribute to PA during practices. Managers/coaches can improve PA rates of youths by modifying the environmental factors surrounding sport.

Stephanie Chizmar
Graduate Program: Forestry and Environmental Resources
Advisor: Rajan Parajuli
Poster Number: 39

Allocating North Carolina's Forest Development Program Funds: An Econometric Analysis

North Carolina's primary cost-share vehicle for forestland owners, the Forest Development Program (FDP), has been funded solely through a tax assessment on the forest products industry since state appropriations ceased at the end of fiscal year 2009. The demand for cost-share funds from landowners exceeds available resources, leading to intermittent waiting periods. Consequently, there is a need to assess the historic usage of cost-sharing funds to determine how future funds can be utilized within the current constraints. Actual cost-share reimbursements are noticeably less than the amount originally approved by the NCFS. This study attempts to determine which moderators such as landowner characteristics, forest location, project practice acreage, and land management practices explain this trend. We utilize historical time-series project data maintained by the NCFS. We perform regressions on the dependent dichotomous outcome where a project either did not fully utilize or did fully utilize cost-share funds. The implications of this study will serve as recommendations for the future allocation of FDP cost-share funds.

Megan Coffer
Graduate Program: Geospatial Analytics
Advisor: Helena Mitasova
Poster Number: 45

Mapping seagrass ecosystems with commercial satellite imagery

Seagrass meadows are an important carbon sink, but challenges in land-based mapping have hindered quantifying their global extent and hence accurately assessing their carbon storage capacity. Satellite remote sensing can offer a cost-effective approach for mapping coastal seagrass ecosystems. However, previous studies using both coarse- and fine-scale resolution sensors for seagrass detection have not presented transparent guidance for data processing, limiting implementation of their methods across different systems. This study offers a standardized approach and in-depth discussion of data processing for two commercial satellite platforms, while comparing their usability for seagrass mapping. A single scene from both DigitalGlobe's WorldView-2 satellite and Planet Labs' RapidEye satellite constellation were obtained at St. Joseph's Bay in Florida, USA, corresponding with the same time frame of field measurements in November 2010. WorldView-2 collects data in 8 spectral bands at a 2-m spatial resolution, RapidEye in 5 bands at 6.5-m resolution. A standardized data processing regime was developed, transforming imagery from basic products, as delivered from each company, to produce analysis-ready products usable for a variety of scientific applications. This is the first processing protocol of its kind, and will be made available for public use upon publication of results. Once each satellite scene was processed into an analysis-ready product, satellite-estimated reflectance was compared against field measurements. A convolutional neural network (CNN) was then used to classify each satellite scene into deep water, land, submerged sand, intertidal, and seagrass. Results were compared to field-based measurements of both continuous and patchy seagrass. WorldView-2 overpredicted seagrass coverage compared to field-based measurements while RapidEye underpredicted. However, WorldView-2 indicated higher agreement, particularly along the transition from seagrass to submerged sand. Results suggest both satellite platforms can effectively map seagrass in coastal systems, but the finer spatial resolution of WorldView-2 allows improved quantification in areas of patchy seagrass.

Tyrik Cooper
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Advisor: Zakiya Leggett
Poster Number: 48

A greenhouse study evaluating fiber quality and production of industrial hemp in loblolly pine soils

Industrial hemp has been recognized as a plant primarily used for the production of cloth, paper, and CBD oil. In most scenarios, the industrial hemp is planted as a monoculture system. However, very few have investigated intercropping industrial hemp in loblolly pine plantations. This study allows us to understand the dynamics of hemp plants, identify possible gender roles, and improve the utilization of land for both economic gain and sustainable practices.

We obtained soil from two loblolly pine plantations (Schenck Forest -Raleigh, NC and Jacksonville, NC), which were compared to our control (potting soil). Clones will be planted on each soil type and evaluated for biomass, fiber length, and CBD oil production. Previous preliminary studies that evaluated the feasibility of intercropping hemp have revealed that the plants will grow in these acidic soils. However, our next phase is to look into the physical properties of these plants to observe any differences due to varying soil types. In addition, we can also identify if sex plays a role in fiber length. The females are used for the production of CBD oil, while the males are primarily used to pollinate females before being discarded. We hope this research project will provide information on an opportunity for landowners to effectively utilize their land, while also gaining a significant profit with the addition of a new industry.

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Poster Number: 56

Forest floor manipulation effects on the relationship between aggregate stability and ectomycorrhizal fungi

Forest floor and mineral soil manipulations have an effect on soil aggregate stability and ectomycorrhizal fungi (ECM), important soil properties to the growth of pine trees. The study site is a 12 year old loblolly pine (Pinus taeda L.) plantation managed by Weyerhaeuser Company in the Lower Coastal Plain, approximately 8 miles east of New Bern, North Carolina. The treatments include three levels of forest floor retention: removed, control, and doubled and two levels of forest floor mixing with the mineral soil: mixed and unmixed. We examined the impacts of these forest floor manipulation techniques on aggregate stability and ECM, as well as the relationship between ECM community success and aggregate stability levels in the rhizosphere. ECM community success was evaluated with fatty acid methyl ester (FAME) analysis and an acid-phosphatase enzyme proxy while aggregate stability was assessed using the soil mean weight diameter approach. Data analysis is ongoing, and we hope our study will inform forest managers in planning site preparation techniques and in preserving site quality.

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Poster Number: 70

Multi-project Engagement in Citizen Science: Mapping Digital and Self-Reported Project Connections

Citizen scientists are joining multiple projects, leading to exciting outcomes for project managers, volunteers, and the field of citizen science as a whole. Between September 2017 and December 2018, 73% of volunteers on SciStarter.org joined multiple projects, beginning to connect disparate projects and to expand their own citizen science experience. Multi-project engagement has been associated with sustained engagement with citizen science and increased learning outcomes. Additionally, this style of engagement lays the groundwork for shared management practices including cultivated learning trajectories, thematic portals, and continued collaboration across the citizen science landscape. While we know that citizen scientists are joining multiple projects, we still don't know what these patterns of participation are and what may influence these behaviors. Understanding these behaviors across the citizen science landscape is important for revealing both the current state of citizen science and future directions for research. Our research uses social network analysis to map and analyze the underlying network of projects that is created when volunteers join multiple projects. We also compare digital trace data to self-reported engagement in order to understand patterns of multi-project engagement in both an online platform and real world engagement. These comparisons illuminate current patterns of multi-project engagement and assess what future research is needed for researchers and practitioners to both take advantage of current multi-project engagement and to foster this behavior in more citizen scientists.

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Poster Number: 76

Blending capitals: Sustainable development through craft-beverage tourism

Craft-beverage tourism, defined as travel motivated by an interest in tasting and learning about craft beverages (e.g., distillery visits), has become an attractive strategy for communities looking to diversify their economic activities. Beyond economic benefits, craft-beverage tourism stimulates the preservation of local traditions, fosters community pride, and promotes biodiversity conservation. Despite these benefits, little scientific evidence exists regarding the factors contributing to the development of craft-beverage tourism, which may be hindering their chances of success. Therefore, this study identified the key capitals (resources) needed and process followed in the development of craft-beverage tourism. Two sustainable community frameworks -Creative Place-making and Community Capitals- were integrated to support the study theoretical design.

The study was conducted in Wake County (NC). Participants were recruited through purposive and snowball sampling. Ultimately, 30 craft beverage stakeholders were interviewed including producers, tourism service providers, event organizers, information curators, retail businesses, and business support organizations. The interviews were recorded and transcribed verbatim, and analyzed through thematic coding. Open codes were organized through axial coding guided by the constructs of the chosen frameworks. Data analysis revealed that the development of crat-beverage tourism is attained through community capital growth being accelerated by creative place-making's elements (i.e., creativity and meaning). Three levels of community capitals were identified in the spiraling up effect caused by creative place-making. Natural, human and built capitals serve as the foundation for craft-beverage tourism development. Once these capitals are accelerated, social and cultural capitals boost. Lastly, enhanced social and cultural capitals prompt political and financial capitals. Identifying the capitals that play a role in the craft-beverage tourism development will allow communities to prioritize their investments on such capitals to foster their endeavors in a sustainable manner.

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Poster Number: 84

Evaluation of Paper Straws to Understand the Gaps for an Effective Alternative to Plastic Straws

Consumer demands for sustainability and recent changes in government policies and regulations, such as the ban on single-use plastic products, are forcing companies to consider new alternatives to plastic straws. There has been tremendous growth in the development and production of paper technology. However, there are concerns regarding paper straw quality and its stability over time when in contact with beverages. Therefore, this study evaluated the performance and properties of commercially available paper straws and their counterpart plastic straws in the beverage drinking application. The paper straws were composed mainly of hardwood fibers that were hard sized. The results indicated that all the evaluated paper straws lost 70% to 90% of their compressive strength and absorbed 30% of the straw weight after being in contact with the liquid for less than 30 min. This study provides directions and methods for testing paper straws, defines the property limitations of several commercial paper straws relative to plastic straws, and proposes new paper and coating solutions to improve these limitations. Tracking of the time-dependent weight gain and compressive strength of paper straws under immersion of liquids was an insightful way to evaluate paper straw product performance.

Meredith Hovis
Graduate Program: Forestry and Environmental Resources
Advisor: Fred Cubbage
Poster Number: 97

Forest Access, Rights, and Benefits: Exploring the Role of Community Forests as an Innovative Approach for Rural Livelihoods

Forests in the U.S. support livelihoods, protect environmental quality, and provide social benefits. However, their modest market returns and provision of nonmarket goods and services that often go uncompensated place them at some risk of over-exploitation and loss to other land uses with greater market values. A potentially promising renewed approach to redress the imbalances between social forest benefits and limited market returns are "community forests" that permit forest tenure and access rights, which develop forest resource benefits, achieve economies of scale, capture increased market and nonmarket returns, contribute to rural economic development, and enhance forest retention and management.

Community forests in the U.S. occur on tribal forest lands, federal forest lands under stewardship contracts to community-based organizations, and lands held in trust for communities by local government or non-profit entities, among other models. However, there is limited empirical data on their status, trends, characteristics, uses, and outcomes. Through mixed social science methods, our results shed light on the state of community forestry in the U.S. We focus our research, using four case studies where we compare the community forest's governance and administration processes, forest uses, and benefits to the local community. We discuss U.S. community forestry characteristics and conditions, which lead to enhanced forest retention, ecosystem services provision, environmental protection, profitability, and community well-being and resilience.

Morgan A. Hoy
Graduate Program: Natural Resources
Advisor: Rajan Parajuli
Poster Number: 98

Economic Contributions of the Green Industry in North Carolina, 2019: Quantifying the importance of Green Industries in State Economies

Green is a prominent buzzword these days with definitions ranging in association with climate change to forestry products and sustainability. This study focuses on Green Industries with reference to businesses involved in the industries of production, service, and distribution of landscaping, arboriculture, and garden equipment in addition to ornamental plants in urban settings. IMPLAN, an input-output modeling software, was used to quantify indirect and induced effects stemming from direct business activities in green industries. Results are then reported and interpreted to estimate the job markets as well as monetary contributions of the green industries to North Carolina. Results indicate that Green industries in North Carolina contribute $134,985,485,676 billion dollars to the state economy, supporting 948,938 jobs with a total payroll of $49,638,332,269.00 billion.

Omoyemeh Jennifer Ile
Graduate Program: Forestry and Environmental Resources
Advisor: John King
Poster Number: 100

Integrating short-rotation coppice culture of American sycamore into conventional agriculture as a purpose-grown feedstock for bioenergy production

Short rotation woody crops (SRWC) are a potential source of biomass energy, that if properly integrated into conventional cropping systems, could help avoid food vs. fuel issues and possibly enhance the environmental performance of agriculture. To achieve these outcomes requires a tree species that is easy to establish, tolerates environmental stress, and has reasonable productivity with low inputs. Our work suggests American sycamore (Platanus occidentalis), may be more appropriate for this purpose than more widely researched genera such as Populus and Salix due to its ease of establishment and tolerance of environmental stress. We quantified the biomass productivity and changes in soil properties of American sycamore SRWC after 5 growing seasons compared to a conventional agricultural field. Examining the effects of four planting density treatments (10,000, 5,000, 2,500, and 1,250 trees per hectare) on productivity. Allometric analysis using linear regression of productivity vs. tree diameter was used to estimate biomass production. Mean cumulative aboveground biomass was the greatest in the 10,000 trees per hectare (tph) planting density(39.12 ± 2.36 Mg ha-1) followed by the 5,000 tph (36.52 ± 0.96 Mg ha-1) with no significant difference. Similarly, the 10,000 tph and 5,000 tph had the highest aboveground net primary productivity of 9.03 Mg ha-1 yr-1 and 6.25 Mg ha-1 yr-1 respectively while the 1,250 tph density treatment was significantly the lowest (0.61 Mg ha-1 yr-1). The 2,500 tph had the most plant available water and the highest amount of soil field capacity. The tree plots had a smaller bulk density (1.59 Mg m-3) compared to the agricultural field (1.62 Mg m-3) with no significant difference. Furthermore, the tree plots showed significant improvements in the water stable soil aggregates and plant available water compared to the agricultural field. These results suggest that American sycamore can be an integral part of securing our energy future, offseting fossil fuel CO2 emission while reducing the use of environmentally harmful chemicals and improving agricultural soil health.

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Poster Number: 101

Future declines in quaking aspen disproportionately affect Rocky Mountain viewscapes along scenic roadways

The expansive vistas, rugged topography, and distinctive species of mountain systems make viewscapes - the visible portions of a landscape with which people form a connection - essential cultural ecosystem services. However, these mountain landscapes are particularly sensitive to the impacts of climate change and land use change. Like the systems they make up, viewscapes, too, are subject to alterations, but the cultural ecosystem services they provide are both underrepresented in ecosystem service assessments and are rarely considered from future or dynamic perspectives. Here we forecast change in a cultural ecosystem service, using climatic shifts in quaking aspen distribution along scenic roadways as an example of how viewscapes change through time. We simulate three scenarios of future aspen distributions using a process-based spatially-explicit model of forest disturbance and succession: warmer and drier, warmer and wetter, and no climate change. We computed aspen visibility in 32,949 viewscapes along designated scenic and historic byways of the Colorado Rocky Mountains. Across all three scenarios, we found declines in both the total area of aspen and in the aspen visible from roadways. But, declines in viewscapes were 1.5-3.1x greater than in the study area overall. Differences between visible and total aspen are greatest in the mid-elevations (2,000-3,000m), where this species is currently most abundant. The opposite pattern occurred below 2,000m, where aspen is forecasted to increase and become disproportionately more visible from scenic by-ways. At higher elevations, aspen loss is proportional between total and visible aspen. An ensemble of all three model scenarios indicates that the mid-elevations will most likely support future populations of quaking aspen. Difference between declines in aspen across the landscape and visible declines along designated routes has implications in landscape planning centered on the preservation of scenic beauty and aesthetic value. This analysis highlights the importance of employing viewscapes perspectives to garner comprehensive understanding of the cultural ecosystem service dynamics of symbolic and aesthetically valuable species.

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Poster Number: 114

Assessing long term variability in phosphorus stream loadings using a hybrid Bayesian watershed model

Eutrophication is a primary cause of freshwater quality impairments. It occurs due to excessive amounts of nutrients (nitrogen and phosphorus) entering waterbodies from anthropogenic sources and can lead to algal blooms, fish kills, and water supply degradation. Hybrid models such as SPARROW (SPAtially Referenced Regressions On Watershed attributes) have been used to estimate nutrient loading from various source categories. However, these models are generally developed for long-term average conditions, which limits their ability to assess temporal drivers of nutrient loading and make predictions for future hydrological conditions. Here, we use a hierarchical Bayesian framework to incorporate temporal drivers of nutrient loading (e.g., varying source distributions and precipitation) to model phosphorus, which has been recognized as the principal limiting nutrient in many lakes and reservoirs. We account for temporal variability by using year specific precipitation, land use and other source information. The Bayesian framework allows us to include prior knowledge about parameters that control nutrient loading and transport, which helps inform our model and reduces uncertainty in nutrient loading estimates. We model the Jordan and Falls Lakes watersheds of the NC Piedmont over a four-decade period (1982-2017). The model shows that nutrient retention within the watershed stream network was low (the importance of natural land preservation in mitigating nutrient loading.

Eddie Lauer
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Advisor: Fikret Isik
Poster Number: 123

Genetic dissection via high-density linkage mapping and bulked segregant RNAseq identifies multiple candidate broad-spectrum fusiform rust resistance genes in Pinus taeda L.

Fusiform rust, caused by the fungus Cronartium quercuum f. sp. fusiforme, is the most important disease affecting loblolly pine plantations in the United States, resulting in multi-million-dollar annual losses to the forestry and wood products industry. In this report, we detail the first discovery of alleles which confer broad-spectrum fusiform rust resistance. Using an integrated approach combining high-density linkage mapping with bulked-segregant RNAseq, we mapped these alleles with high resolution in the pine genome, identified the sequence of candidate genes, and determined their effects on disease outcome at the population level. Within-family QTL analysis using a controlled inoculation on two full-sib families of 1000 individuals indicated two resistance loci in both families which differed markedly in their genomic localization and resistance profile. In the most resistant family, both alleles reduced the odds of infection by around 20-fold, and the alleles exhibited additive gene action with respect to the odds of infection. RNAseq using bulked samples of resistant and susceptible seedlings revealed nonsynonymous substitutions in two TIR-NBS-LRR genes and one CC-NBS-LRR gene, all of which completely cosegregated with disease status. Fine mapping is currently underway in order to determine allele content and gene order of these loci, as well as to identify markers which can be used in developing the first true breeding disease resistant pine varieties.

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Advisor: Caren B. Cooper
Poster Number: 158

The Effects of Urban Noise and Light Pollution on Songbird Physiology

With expanding urbanization, the effects of recurring human activity are having a drastic impact on species activity, communication, and physiology. Urbanization brings components such as artificial light and anthropogenic sound (or noise) pollution. I propose to examine the degree to which noise pollution, light pollution, and noise and light pollution combined are associated with variation in the health and physiology of Northern Cardinals (Cardinalis cardinalis). Based on noise and light pollution maps of Raleigh, I will recruit volunteers strategically to create a stratified sample of yards to capture Northern Cardinals. I will collect morphological and physiological metrics from each bird, including blood for detailed stress-related biochemical markers for male cardinals. I expect indices of cardinal's health to be highest in areas with both high levels of noise and high levels of light at night. My study will provide insights into how human-induced changes to the abiotic environment might affect songbird health.

Heather Starkey, Lokendra Pal, Hasan Jameel
Graduate Program: Forest Biomaterials
Advisors: Lokendra Pal and Hasan Jameel
Poster Number: 197

Application of Unbleached Micro- Nano-Fibrillated Cellulose (MNFC) for the Production of More Sustainable Packaging Materials

Recycled paper for the production of linerboard has been the forefront of the sustainability within the paper industry, but recycled products are limited in their strength properties. With the rise in consumer preference for more sustainable packaging materials, with the long-term goal of replacing petroleum-based packaging, a novel method to improve paper strength was developed by incorporating bleached micro-nano-fibrillated cellulose (MNFC) in the sheet. Despite the positive lab-scale results, viability in a large-scale process is not possible yet due to the high cost of bleached MNFC and the negative impacts it will have on production speed. A low cost, unbleached MNFC was investigated to see if it has the same reinforcing capabilities as the high cost, bleached MNFC. The MNFC was characterized by fines content, crystallinity, charge, and SEM imaging. In preliminary studies, MNFC was added into the papermaking slurry before the sheet was formed, and its reinforcing capability was determine by measuring the burst and short span compression strength. The results showed that sheets containing unbleached MNFC were stronger than those without, and additional studies showed that pulping costs could be reduced further by decreasing the total amount of raw materials used. In order for MNFC to be implemented in an industrial process, we must understanding what is required to mitigate MNFC's negative impacts on production speed without sacrificing strength or printability. We hypothesize that optimization of the addition strategy of MNFC into the sheet in conjunction with a chemical additive will mitigate the increase in drainage time and will improve the quality of the paper.

Victoria Vayer
Graduate Program: Fisheries, Wildlife and Conservation Biology
Advisor: Lincoln Larson
Poster Number: 207

The HUNT for Answers: College Students' Unique Connections to Hunting and Outdoor Recreation

The persistent decline of hunting across the United States has generated an array of ecological, economic, and social consequences sparking initiatives to recruit, retain, and reactivate hunters. Effective R3 methods are needed to counteract hunter declines, and generate new hunting advocates to support wildlife conservation.

Our research focuses on a promising target: college campuses, where a diverse population of millions of millennials are eager to try new activities. Students' developmental proclivities, coupled with the vibrant social atmosphere of college campuses, creates a situation where R3 initiatives might thrive. To investigate this, our team spent two years studying students in more than 20 states, focusing on their connections to outdoor recreation and wildlife.

Analysis of nearly 20,000 surveys, indicates that, regardless of academic major, urban/rural upbringing, or various other demographic characteristics, many college students are interested in hunting. Among students, 31% said they had hunted, 62% approve of hunting, and 49% might hunt in the future. Most students likely to engage in future hunting were white (80%), but significant proportions of individuals from non-traditional hunting backgrounds also expressed interest in hunting:35% were women, 37% grew up in urban areas, and 30% were majoring in disciplines other than agriculture or natural resources.

Motivations for hunting varied, but tended to focus on local game meat acquisition and wildlife population management. The most prominent barriers to hunting were (1) rather do other activities, (2) lack of free time, (3) reluctance to kill an animal, (4) moral objection to hunting (5) lack of skills required. Our work highlights the potentially valuable contributions of universities to the R3 movement. The work helps identify ways that conservation organizations can connect with students, to advance R3 and foster recreation enthusiasts who may experience and support wildlife conservation for the rest of their lives.

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Advisor: Bethany Cutts
Poster Number: 209

Using qualitative interviews to characterize environmental and health concerns post-disaster

Natural hazards rearrange environmental risk landscapes; new environmental risks may emerge or existing environmental risks may travel, become exposed, or become concealed in the aftermath of disaster events. These environmental risks may have health impacts on disaster survivors, compounding disaster impacts. Currently, little is known about the extent to which disaster survivors perceive, understand, interpret, or respond to these changing post-disaster risk landscapes. In this study, we explore environmental and health concerns in the aftermath of Hurricane Florence (2018) through a novel interactive semi-structured interview protocol. We analyze 49 qualitative interviews from disaster survivors in Robeson County, North Carolina to characterize post-disaster environmental and health concerns. Using open- and selective-coding analysis strategies, these qualitative interviews aid our understanding of the post-disaster risk landscape, by detailing how characteristics of risks make them more or less detectable to citizens in the aftermath of disaster. Findings suggest that the levels of detection by residents may impact whether residents take action to address these post-disaster environmental risks. Based on survivor narratives, risks which are physically perceptible are more likely to elicit recovery, remediation, and mitigation behaviors; however those risks which are less detectable or undetectable using human senses, are less likely to be addressed. These results suggest that emergency preparedness may want to raise awareness of, or help 'unveil' these less detectable risks, to increase the chance that residents will act to reduce their risk before, during, and after a disaster.

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Poster Number: 219

The release of microfibers during textile laundering of cotton fabrics and their behavior in aquatic environments: effect of fabric finishes

The presence, compatibility, and biodegradability in the environment of pervasive textile microfibers shed during laundering or use has been increasingly recognized as an important environmental issue. Textile materials that biodegrade are greatly advantageous relative to those that are not. In this research, the influence of typical textile finishes on the persistence of cotton fibers in aquatic environment has been assessed in aerobic conditions using an RSA PF-8000 respirometer (ISO 14851) using an inoculum of activated sludge at low concentration, 30 ppm of total suspended solids. The presence of the finishes alters the surface chemistry of the fibers and their biodegradation rate in aquatic environments. Fibers and fragments of the same cotton knitted fabrics (interlock) without a finish and with different finishes such as durable press, silicone softener, C6 based fluorinated (Non-PFOA) water repellent, and a dye (C.I. Reactive blue 19) were tracked and fit to kinetic biodegradation models, relative to cotton fabrics without treatments. The biodegradation of fabrics with some levels of crosslinking in the finishing treatment was more affected than other finishes. Cotton fibers with water repellent finish have the longest lag-phase (?) in which the biodegradation is delayed initially, whereas cotton fabrics with durable press finish had the lowest degradation rate and degraded the least among the samples. Despite the differences in rate, all the cotton samples reached more than 60% biodegradation in 102 days; in fact, the cotton fibers with silicone softener degraded by 90%. The biodegradation rates with respect to the different samples are in agreement with the observed trends of the same samples for cellulase hydrolysis and cellulase adsorption experiments. This indicates that the finishes decrease both the adsorption of enzymes excreted by the microorganisms and the initial rates of biodegradation relative to untreated cotton; however, the cellulosic material maintains its biodegradability.

Rachel M. Atkins, Karl W. Wegmann
Graduate Programs: Marine, Earth, and Atmospheric Sciences
Advisors: Karl W. Wegmann and Paul Byrne
Poster Number: 12

Investigating the impacts of anthropogenic hillslope modification on landscape evolution and nutrient mobilization

The arrival of Euro-American settlers in the Piedmont region of North America and the increased used of hillslopes for settlement and agricultural purposes resulted in significant upland soil loss and the aggradation of meter-thick deposits of legacy sediment upon valley bottoms as basin sediment yields increased up to 25 times background sedimentation rates. Forest clearing and other anthropogenic modifications to hillslopes disturbs the landscape by removing vegetation that formerly intercepted rainfall. The removal of vegetation subjects exposed soil to increased direct precipitation, which in areas with clay-rich soils, may lead to rapid hillslope gullying and sediment aggradation upon the adjacent valley floor. We hypothesize that such landscape alterations impacted headwater streams by displacing channel initiation points down valley.

This study explores drainage networks in William B. Umstead State Park near Raleigh, NC to determine the influence of this additional legacy sediment on channel head migration. Using statistical relationships between upslope contributing area and local valley slope, the spatial positions of predicted channel head locations across the landscape are determined and compared to their observed locations in the park. By coupling these analyses with field observations, we find that channels are initiating downslope of their statistically predicted locations. This indicates that in an effort to return to their equilibrium locations after being displaced down-valley by the influx of legacy sediment, channel heads are now migrating back up into currently unchannelized valley reaches. The current up-valley migration will not only lead to localized landscape dissection, but will also result in a large flux of sediment and nutrients that may impose significant impacts on hydrologic, biologic, aquatic, riparian, and chemical functions in downstream environments. We present a quantification of the physical and chemical consequences of channel head migration in such environments aimed at improving our understanding of sediment and nutrient additions to Piedmont streams and coastal watersheds.

Kyla A. Beguesse[1,2], Aurore Canoville[1], Lisa L. Herzog[1], and Lindsay Zanno[1,2]
Graduate Programs: Biological Sciences[1], Paleontology[2]
Advisor: Lindsay Zanno
Poster Number: 22

Bone pathologies in the early cretaceous therizinosaurian Falcarius utahensis

Paleopathologies provide key information on evolution and epidemiology of disease, and behavior in extinct animals. We describe osteopathologies in the right metatarsus II and left humerus of the early diverging therizinosaurian, Falcarius utahensis, recovered from a paucispecific bonebed in the Lower Cretaceous Cedar Mountain Formation of eastern Utah. The two specimens come from a bonebed estimated to contain over 100 disarticulated skeletons making it unlikely they are from the same individuals. Analysis of the bonebed suggests these individuals succumbed to a mass mortality event. To date, the exact cause of this catastrophic event and subsequent death of so many individuals is still unknown. Morphologic diagnoses are based on macroscopic and histologic examination of fossilized lesions, and comparative pattern recognition analysis of histomorphologic features in vertebrate pathologic processes. Macroscopically, the metatarsus and humerus exhibit irregular nearly circumferential bulbous expansion in the mid-diaphyseal region. Histologic lesions in the metatarsus are consistent with healing fractures stabilized by chronic calluses with one encasing a large fragment of necrotic bone (sequestrum) lined by a peripheral layer of reactive bone (involucrum). Large sequestra have been well-documented to complicate fractures and delay healing by causing instability at the fracture ends, thereby inhibiting the normal development of a callus. Histomorphologic features in the metatarsus provide evidence that this was a complicated fracture in the pes of a subadult with delayed healing. Histology of the humerus reveals lesions most consistent with chronic osteomyelitis with microabscess formation, osteonecrosis and lysis, and subperiosteal and endosteal reactive bone formation. The pattern and distribution of these lesions are suggestive of an infectious etiology that initiated in the corticomedullary junction and extended to the subperiosteal periphery of the humerus. Further research is required to evaluate the prevalence of additional osteopathologies, and if these pathologies have any correlation with the mass mortality event.

Aldo Carmona-Baez, Emily C. Moore, Natalie Roberts, Kaitlin P. Coyle, Gargi V. Damle, Amanda Cass, Erin Peterson, David Reif, and Reade Roberts
Graduate Program: Genetics
Advisor: Reade Roberts
Poster Number: 36

Evidence for sex-specific genetic architecture of gut length in Lake Malawi cichlid fishes

Trophic specialization is key to the phenotypic and species diversity observed across life. Several characteristics of gut morphology and physiology correlate with trophic levels. The most common example of these correlations is found in vertebrates, where organisms with a plant-based diet generally have longer digestive tracts compared to animals at higher trophic levels. Despite its importance, very few studies have explored the genetic basis of diet adaptation. In this study, we used recently diverged Malawi cichlid species as a model to identify candidate genes involved in gut length variation with a forward genetics approach. We performed QTL mapping of gut length on two F2 mapping populations from hybrid crosses between species of cichlids from different trophic levels. Our results suggest the presence of sex-specific QTL in the genetic architecture of gut length, as well as several inversions between the genomes of the parental species. This analysis represents the first identification of naturally evolved, adaptive genetic variants associated with gut length. In addition, we integrated these mapping results with transcriptomic studies to pinpoint the genes and pathways driving the evolution of the gut.

Nathaniel P. Curtis[1], Angie Mordant[2], Manuel Kleiner[2] and Ryan W. Paerl[1]
Graduate Programs: Marine, Earth, and Atmospheric Sciences[1]; Microbial Biology[2]
Advisor: Ryan W. Paerl
Poster Number: 51

Cellular Responses of Auxotrophic Phytoplankton to Exogenous Supplies of Thiamin and its Precursors

Low concentrations of vitamin B1 (thiamin) potentially limit oceanic primary productivity and biomass to support food webs. Vitamin B1, which acts as a coenzyme in cellular processes such as central carbon metabolism, is composed of pyrimidine and thiazole precursor moieties. Despite requiring this vitamin, prevalent marine bacterioplankton and eukaryotic phytoplankton are B1-auxotrophs that lack the ability to synthesize thiamin or its moieties de novo. Recent studies indicate that some auxotrophic algae exhibit higher growth rates when grown on precursors compared to thiamin; the biochemical pathways enabling this response are largely unknown. In this study, we compare growth and maximum yields of a B1 auxotrophic strain representative of cosmopolitan marine algae, Ostreococcus lucimarinus CCE9901, when provided either thiamin or a combination of a thiazole and a pyrimidine precursor to meet its vitamin demand. Additionally, we employed proteomics to investigate the cellular growth responses of the microalgae on B1 versus moieties. CCE9901 exhibits specificity for the thiazole 5-(2-hydroxyethyl)-4-methyl-1,3-thiazole-2-carboxylic acid (cHET) and will not grow on the widely-studied thiazole 4-methyl-5-thiazoleethanol (HET). Use of cHET with different pyrimidine precursors led to significant differences in maximum cell yield and half-saturation growth constants. Specifically, pyrimidine 4-amino-5-aminomethyl-2-methylpyrimidine (AmMP), a product of vitamin B1 degradation, supported significantly higher maximum cell yields and demonstrated a lower half-saturation (Ks) value for maximum growth rate. The results of corresponding proteomic analyses will help understand the responses to each of these treatments on a cellular level, lending novel insight into the reasons why the provision of specific sources of vitamin B1 lead to varied growth rates and maximum cell yields, as well as furthering understanding of vitamin B1 metabolism in key marine microalgae.

Alexandra G. Forderhase, Hannah C. Styers
Graduate Program: Chemistry
Advisor: Leslie A. Sombers
Poster Number: 66

Simultaneous Voltammetric Detection of Glucose and Lactate in Rat Striatum Evoked by Electrical Stimulation of the Midbrain

Glucose and lactate provide energy for cellular functions in the brain, and serve as an important carbon source in the biosynthesis of a variety of molecules. Thus, there is a critical need to quantitatively monitor neuroenergetic substrates, such as glucose and lactate, in situ on a time scale commensurate with neuronal function. In this work, carbon-fiber microbiosensors were coupled with fast-scan cyclic voltammetry (FSCV) to simultaneously monitor glucose and lactate fluctuations at a discrete location in rat striatum in response to electrical stimulations of the nigrostriatal projection to the region. Systematic variation of stimulation parameters revealed the distinct dynamics by which glucose and lactate respond to the metabolic demand of synaptic function. Immediately after stimulation, the availability of both glucose and lactate increased in the extracellular space. If stimulations were sufficiently intense, glucose and lactate concentrations then immediately fell below baseline in response to the incurred metabolic demand. Glucose concentrations fluctuated over a larger range than those of lactate as stimulation duration increased, and glucose dynamics typically led those of lactate. These measurements of glucose and lactate fluctuations at a discrete recording site provide an unprecedented comparison of glucose and lactate dynamics in response to metabolic demand elicited by neuronal activation.

Akhil Francis[1], J. K. Freericks[2], A. F. Kemper[1]
Graduate Programs: Physics[1]; Physics, Georgetown University, Washington, DC[2]
Advisor: Alexander Kemper
Poster Number: 67

Quantum computation of magnon spectra

We demonstrate quantum computation of two-point correlation functions for a Heisenberg spin chain. Using the IBM Q 20-qubit quantum machines, we find that, for two sites, the correlation functions produce the exact results reliably. For four sites, results from the IBM Q 20-qubit Tokyo quantum computer are noisy due to read out errors and decoherence. Nevertheless, the correlation functions retain the correct spectral information. This is illustrated in the frequency domain by accurately extracting the magnon energies from peaks in the spectral function.

Jordan Frick[1] , Samanvitha Sridhar[1] , Shaun O'Donnell[2] , Paul A. Maggard[2] and Daniel B. Dougherty[1]
Graduate Programs: Physics[1], Chemistry[2]
Advisor: Daniel B. Dougherty
Poster Number: 68

Discovery of Memristor effects in a-RuCl3

Memristors, non-linear, history dependent charge transport devices, are of interest in the field of neuromorphic computing.We have discovered memristive properties in the spin-orbit-assisted Mott insulator a-RuCl3. Bulk transport measurements in a-RuCl3 show pinched hysteresis behavior, which defines the memristor, as well as S-shaped negative differential resistance. Low threshold fields lead us to believe the effect is primarily due the electrical couplings at the metal contacts. We have developed a model to describe this behavior by simulating a Schottky barrier at the contacts of the device.

Eric Geiger
Graduate Program: Mathematics
Advisor: Irina A. Kogan
Poster Number: 74

Non-congruent non-degenerate curves with identical signatures

Determining whether or not two planar curves are congruent under some group action is an important problem in geometry and has applications to computer vision and image processing. To address this problem, the signature curve parameterized by differential invariants was introduced by Calabi, Olver, Shakiban, Tannenbaum, and Haker and has been used in various applied problems including medical imaging and automated puzzle assembly. We construct examples of non-congruent, non-degenerate simple planar closed curves with identical Euclidean signatures, thus disproving a claim made in Hickman (J. Math Imaging Vis. 43:206-213, 2012) that all such curves must be congruent. We show a general mechanism for constructing such examples by exploiting the self-intersection points of the signature and state an updated congruence criterion for simple closed non-degenerate curves confirming that for curves with simple signatures the claim made by Hickman holds.

Sagi Gillera[1], William Marinello[1], Brian Horman[1], Heather Stapleton[2], Heather Patisaul[3]
Graduate Program: Toxicology[1], Nicholas School of the Environment, Levine Science Research Center, Duke University[2], Biological Sciences, NC State University, Center for Human Health and the Environment[3]
Advisor: Heather Patisaul
Poster Number: 77

Flame Retardant Exposure Affects Social Behavior and Neurodevelopment

The rapidly rising incidence of neurodevelopmental disorders in children is raising speculation that developmental exposure to environmental contaminants may be contributory. Firemaster 550 (FM550) is one of the most prevalent flame-retardant (FR) mixtures used in foam-based furniture and baby products. We have published evidence of sex-specific effects of FM 550 exposure on a range of socioemotional behaviors including anxiety, attachment and memory in prairie voles (Microtus ochrogaster). Previous work, in various vole species, has linked prosocial traits to the oxytocin (OT) and vasopressin (AVP) systems and its interactions with the mesolimbic dopamine pathways. To test the hypothesis that FM550 affects the development of the social brain, we investigated the impact of perinatal exposure on the neuronal systems involved in social behavior. In this study, dams were exposed to 0, 500, 1000, or 2000 µg of FM550 via subcutaneous injections throughout gestation, and pups were exposed beginning the day after birth until weaning at postnatal day 21. Brains from adult offspring of both sexes were collected and assessed for immunoreactive (ir) OT, AVP, and tyrosine hydroxylase (TH) (a dopamine marker) neurons in the paraventricular nucleus of the hypothalamus (PVN) and OT-ir, and AVP-ir neurons in the supraoptic nucleus of the hypothalamus (SON). Effects were sex- and dose-specific in the regions of interests. Our studies demonstrate the utility of the prairie vole for investigating the impact of chemical exposures on social behavior.These data support the hypothesis that developmental FR exposure impacts the social brain and demonstrate the value of the prairie vole for assessing chemical effects on sociality and attachment. Future studies will probe the possible mechanisms by which these effects arise.

Khushi Goda[1,2] and Fikret Isik[1,2]
Graduate Programs: Genetics[1], Cooperative Tree Improvement Program[2]
Advisor: Fikret Isik
Poster Number: 78

Optimal Mating for Monoecious Species: an example from Pinus taeda

Developing an algorithm that helps maximize genetic gain while maintaining genetic diversity for monoecious species is imperative. It is a challenge to balance two crucial but contrasting goals of capturing as much genetic gain as possible while managing short-term and long-term inbreeding in the monoecious species breeding programs. While methods and algorithms for animal breeding are well-established, an efficient algorithm suited to monoecious species remains elusive. Towards this goal, we have adopted advance optimization method like second-order cone programming (SOCP) and evolutionary genetic algorithm, the differential evolution (DE) algorithm, to optimize mate-pair designing. Optimal Mating for Monoecious species, OMM, is an optimization algorithm developed that can utilize genetic relationships to create an optimal mating list. OMM maximizes the genetic gain, minimizes the increase in average group coancestry and avoids inbreeding in the proposed progeny. The Cooperative Tree Improvement Program at North Carolina State University manages the genetic improvement of Loblolly pine, a monoecious species. Loblolly pine has a high genetic load and suffers significantly from inbreeding depression, making it an ideal candidate to test the algorithm. OMM optimized mating list is compared to mating lists created using positive assortative mating (PAM) and random mating (RM). OMM was most successful in maximizing genetic gain while controlling inbreeding levels, in both short-term and long-term setting. Using OMM to optimize the mating list from initial population of 961 monoecious loblolly pine tree candidates resulted in a genetic gain of 40% per year over 10 cycles. The completion of this study will see the development of a suite of software that can utilize not only genetic relationships from pedigree but also utilize genomic relationships derived from SNP markers. The framework and methods tested for loblolly pine breeding have relevance to the breeding of other monoecious species as well.

Quibria A.E. Guthrie, Briley Humphrey, and Caroline Proulx
Graduate Programs: Chemistry
Advisor: Caroline Proulx
Poster Number: 83

Applying Aerobic Oxidation of N-aryl Amino Acids to Inter- and Intramolecular Hydrazone Ligation

Bioorthogonal chemistry has become a powerful tool in the manipulation of biomolecules under mild conditions. The use of aniline catalyst in oxime and hydrazone ligation at physiological pH has increased their use in bioconjugation applications. We have previously demonstrated the mild oxidation of N-terminal N-aryl amino acids in situ and its utility in oxime ligation at physiological pH. Tuning the electronics of the phenyl ring allowed for reactivity at varying pH and has allowed for Ca-substitution to increase diversity. We have begun to expand the use of this chemistry beyond intermolecular couplings with aminooxy-terminated peptides. Our goal is to apply our previous methods for oxime ligation to intermolecular peptide-peptide ligation and head-to-tail macrocyclization by translating ligation conditions to the formation of hydrazones. We report high-yielding ligations for both inter- and intramolecular hydrazone formation. This ability to tune reactivity by pH could allow for orthogonal ligation in total protein synthesis or controlled, one-component macrocyclization. Selectively controlled cyclization and added diversity at the Ca- position could be used to improve binding activity or cell permeability, which could be beneficial for therapeutic applications. Specifically, we could potentially use our methods to environmentally trigger macrocyclization near tumor cells, as there is known to be a high concentration of reactive oxygen species nearby.

Keith D. Hillaire[1], Michael D. Dickey[2] and Karen E. Daniels[1]
Graduate Programs: Physics[1], Chemical and Biomolecular Engineering[2]
Advisor: Karen E. Daniels
Poster Number: 94

Marangoni Fingering Instabilities in Oxidizing Eutectic Gallium-Indium

Eutectic gallium-indium (EGaIn), a room-temperature liquid metal alloy, has the largest tension of any liquid at room temperature, and yet can undergo fingering instabilities. This effect arises because, under an applied voltage, an oxide builds up on the surface of the metal. The oxide acts like a surfactant, lowering the interfacial tension and allowing spreading under gravity. In the experiments presented, we examine the hypothesis that the fingering instabilities, including both tip-splitting and spreading to a fractal-like morphology, arise due to Marangoni instabilities. Our experiments are performed with EGaIn droplets placed in an electrolyte bath of sodium hydroxide; by placing the EGaIn on copper electrodes, which EGaIn readily wets, we are able to impose a fingering wavelength on the spreading. Two transitions are observed as a function of current: (1) a minimum current at which EGaIn spreads out from the copper electrode; (2) the current at which the fingers become unstable to shorter wavelengths and spread inhomogeneously. We present a phase diagram as a function of current and initial wavelength and identify a minimum wavelength below which single tip-splitting does not occur.

Matt Jenkins[1], John M Cummings[1], Alex Cabe[1], Kaj M. Hulthén[2], M. Nils Peterson[3], R. Brian Langerhans[1]
Graduate Programs: Biology[1]; Biology, Lund University[2]; Fisheries, Wildlife and Conservation Biology[3]
Advisor: Brian Langerhans
Poster Number: 107

Natural and anthropogenic sources of habitat variation influence exploration behavior, stress response, and brain morphology in a coastal fish

A major goal of evolutionary ecology is to better understand how environmental variation affects organismal phenotypes. This understanding can also help mitigate negative anthropogenic impacts. We investigated two ecological drivers of behavioral, physiological, and morphological variation in Bahamas mosquitofish inhabiting tidal creeks: hydrological connectivity (i.e. tidal-creek fragmentation) and structural habitat complexity. We tested a priori predictions for how these factors might influence exploration behavior, stress response, and brain morphology. Populations that have experienced severe human-induced restriction of tidal exchange from the ocean exhibited greater exploration of a novel environment, a smaller telencephalon (relative to body size), and a stronger physiological stress response to a mildly stressful event. These changes matched adaptive predictions based on 1) reduced chronic predation risk owing to lower densities of piscivorous fish and 2) decreased demands for navigating tidally dynamic habitats. Populations from sites with greater structural habitat complexity had a higher propensity for exploration and a relatively larger cerebellum. These patterns matched adaptive predictions related to elevated demands for navigating complex environments. Our findings demonstrate that environmental variation, including recent anthropogenic impacts .

Stephanie E. Johnstone
Graduate Program: Microbiology
Advisor: Scott M. Laster
Poster Number: 109

Visualizing uptake of a fluorescently labeled alkamide in mammalian cells

Alkamides are a class of fatty acid amides found in a number of plant species which may have useful medicinal activities. Alkamides have been shown to act on ion channels and receptors on mammalian cells modulating their activity. Additionally, alkamides may be useful as a drug delivery system as certain alkamides have been shown to cross cell monolayers, diffuse into serum, and cross the blood brain barrier. Currently, the mechanism by which alkamides exert their effects on cells is unclear. Therefore we sought to evaluate uptake of alkamides by confocal microscopy with a fluorescently labeled alkamide. Our experiments showed that the alkamide N-isobutyldodecanamide labeled with fluorescein (FITC-alkamide) is able to rapidly enter a variety of cells types, and that uptake is both time- and concentration-dependent. We also found that the FITC-alkamide molecule enters cells through the endocytic pathway and is dependent on functioning actin filaments. Finally, our data suggests that the FITC-alkamide molecule accumulates in middle to late stage, Rab7 positive, endosomes. This work represents the first study directly visualizing alkamide uptake by mammalian cells. Future studies will be focused on determining whether endocytic uptake of alkamides is important to their function, and the use of alkamides as a targeting mechanism for endocytic drug delivery.

Brandon M. Lewis, William H. Battye, Viney P. Aneja
Graduate Program: Marine, Earth, and Atmospheric Sciences
Advisors: Viney P. Aneja and William H. Battye
Poster Number: 126

Human Exposure Model and CAFOs: Implementing Air Pollution Modeling for Environmental Justice Analysis in the North Carolina Hog Industry

Concentrated animal feeding operations (CAFOs) produces tons of animal waste, which can inherently pollute air, soil and water when not properly processed. The concentration of hog production in North Carolina have raised concerns of the disproportionate exposure of air pollution on vulnerable communities. Pollutants such as ammonia, hydrogen sulfide, acetaldehyde, and methanol are emitted by CAFOs and at high enough concentrations could affect human health. This research investigates the exposure of air pollutants and possible health impacts of nearby community members looking at the disparities in health risk on different populations. We use HEM-3, Human Exposure Model, to estimate ambient concentrations, human exposures, and health risks from CAFOs and combine this with Census demographic data (2010) to investigate whether exposures to these pollutants differ by race/ethnicity and age. In this work, we limit our analysis to Duplin County, North Carolina. Based on current results, the average predicted concentration of NH3 in Duplin county is 25 ug/m3, and the average predicted concentration of H2S is 0.25 ug/m3. Future work will continue to analyze the health indications expected from these concentrations and implications of environment injustice using statistical methods to compare expected health impacts on different populations.

Chang Liu
Graduate Program: Statistics
Advisor: Ryan Martin
Poster Number: 130

An Empirical G-Wishart Prior for Sparse High-dimensional Gaussian Graphical Models

In Gaussian graphical models, the zero entries in the precision matrix determine the dependence structure, so estimating that sparse precision matrix is an important and challenging problem. We propose a novel empirical version of the G-Wishart prior for sparse precision matrices, where the prior mode is informed by the data in a suitable way. Paired with a prior on the graph structure, a marginal posterior distribution for the same is obtained that takes the form of a ratio of two G-Wishart normalizing constants. We show that, thanks to the data-driven prior centering, this ratio can be easily and accurately computed using a Laplace approximation, which leads to fast and efficient posterior sampling even in high-dimensions. Numerical results demonstrate the proposed method's superior performance, in terms of speed and accuracy, across a variety of settings, and theoretical support is provided in the form of a posterior concentration rate theorem.

Shaun O'Donnell[1], Ching-Chang Chung[2], Abigail Carbone[1,2], Rachel Broughton[3], Jacob Jones[3], and Paul Maggard[1]
Graduate Programs: Chemistry[1], Analytical Instrumentation Facility[2], Materials Science and Engineering[3]
Poster Number: 153

Synthesis and Characterization of Metastable Sn(II)-Containing Perovskite Oxides and Their Photocatalytic Properties

The synthesis of metastable crystalline solids represents an exciting frontier of solid-state research. Many thermodynamically unstable phases have been predicted to exhibit highly desirable properties, but as of yet their synthesis remains more or less empirical in nature. Despite numerous computational investigations predicting favorable properties for Sn(II)-containing oxides, relatively few have been successfully synthesized. Metastable Sn(II)-containing perovskites, with the highest known Sn(II)-content, were synthesized for the first time using a nonconventional flux synthesis approach. Critically, some of the general underlying properties governing the synthesis of metastable compositions have been experimentally determined, allowing for rational strategies in future synthesis of metastable materials. Starting from Ba(Zr1-yTiy)O3 (BZT), the (Ba1-xSnx)(Zr1-yTiy)O3 (BSZT) compositions were synthesized with increasing Sn(II) substitution of up to ~50% to 60% before the onset of decomposition. Thermodynamic calculations show that the BSZT phases are highly metastable versus decomposition to the binary oxides. The formation of BaClF drives the flux-mediated exchange reaction, while the high cohesive energy of the perovskite lattice and low reaction temperature and time mitigates long-range phase segregation and allows for kinetic trapping. The band gaps of synthesizable BSZT compositions range from 3.92 eV (BaZrO3) to 1.95 eV (Ba0.7Sn0.3Zr0.5Ti0.5O3). Photocatalytic water oxidation experiments showed high rates for molecular O2 evolution under combined UV+Vis and Vis irradiation, with the maximum rate under both conditions occurring for (Ba0.6Sn0.4)(Zr0.5Ti0.5)O3 (~408 μmol O2 h-1g-1 and ~216 μmol O2 h-1g-1, respectively). The smallest bandgaps and highest photocatalytic rates are observed for compositions with the greatest Sn(II) concentration, and the compositions with the greatest metastability. Thus, these results demonstrate a new general pathway to metastable perovskites that can be important in the future discovery of crystalline solids with enhanced physical properties.

Awino Maureiq Edith Ojwang'
Graduate Program: Biomathematics
Advisors: Peter Ojiambo and Alun Lloyd
Poster Number: 155

Network modeling of plant disease epidemics in space and time: The case of Cucurbit Downy Mildew (CDM) in the eastern United States

Over the last 20 years, systematic research has been conducted to develop and validate models for the prediction of Cucurbit Downy Mildew (CDM). These efforts have resulted in a prediction framework to guide farmers and policymakers in making relevant management decisions. The prediction framework relies on CDM reports from an extensive network of sentinel plots (disease monitoring locations, strategically placed within specific US states). This research uses CDM epidemic data from 2008 to 2016 from these sentinel plots to answer three questions. First, we identify the most important sentinel plots, in terms of node strength and network stability, by analyzing the network structures. Second, we predict the nodes with the highest probabilities of infection, by developing a dynamic network model that accounts for host density, wind speed, wind direction, and incorporates the power-law dispersal. Third, we predict the epidemic front, using regression models which are validated using observed data. The analysis identified the most important nodes in terms of CDM transmission and monitoring. The results could help to reduce the resources required to predict and manage CDM introductions and outbreaks.

Sarah E. Orr and David B. Buchwalter
Graduate Program: Toxicology
Advisor: David B. Buchwalter
Poster Number: 156

Developing a mayfly model to assess salinity stress in freshwater ecosystems

Freshwater ecosystems are becoming increasingly salty due to human activities such as mining, irrigation of arid landscapes, and application of road salts. Ecologists are observing that these salinity increases are associated with steep declines in biodiversity, and in some cases complete extirpation of some sensitive faunal groups of aquatic insects, such as mayflies. However, no laboratory models exist to represent these sensitive taxa and the ionoregulatory biology of these organisms remains remarkably understudied. Our lab is developing the baetid, parthenogenetic mayfly, Neocloeon triangulifer, into a novel model organism to further assess the physiological consequences of salinity stress in freshwater ecosystems. Previous work in our lab has demonstrated the negative life history consequences of salinity stress. In general, we observe that high salinities delay development, decrease body mass and egg production, and ultimately reduce survival. In addition, with use of radiotracers such as 22Na+, 35SO4-2, and 45Ca2+, we can measure uptake rates of major ions across different concentrations of salts. We believe that mayflies tightly regulate the ionic concentration of their hemolymph, but their uptake rates increase with external salt concentration and temperature. Thus, we hypothesize that the energetic cost of ion turnover drives the decreased fitness and survival in these animals. Because the N. triangulifer life cycle is relatively short, we can link physiological processes directly to fitness outcomes. Further, this parthenogenetic species allows genetic endpoints such as the expression of relevant genes to be less affected by inter-individual variation. Combining these techniques, we can link multiple levels of biological organization (e.g., mRNA expression, ion flux rates, and life history outcomes) to determine the overall effects of freshwater salinization in this mayfly model. Few aquatic insect species are culturable in laboratory settings, which is one of the many reasons that N. triangulifer is a promising and powerful research tool.

Christopher M. Poteat, Yujin Jang, Myunggi Jung, and Vincent N. G. Lindsay
Graduate Programs: Chemistry
Advisor: Vincent N. G. Lindsay
Poster Number:164

Synthesis of ß-Lactams and Cyclobutanones via Formal [3+1] Cycloaddition of Chiral Cyclopropanone Equivalents

Cyclopropanone derivatives have long been considered unsustainable synthetic intermediates due to their extreme strain and kinetic instability. We have recently reported the enantioselective synthesis of 1-sulfonylcyclopropanols as stable yet powerful equivalents of the corresponding cyclopropanone derivatives, via a-hydroxylation of sulfonylcyclopropanes using a bis(silyl) peroxide as electrophilic oxygen source. Both the electronic and steric nature of the sulfonyl moiety, which serves as a base-labile protecting group and confers crystallinity to these cyclopropanone precursors, were found to have a crucial impact on the rate of equilibration to the corresponding cyclopropanone, highlighting the modular nature of these precursors and the potential for their widespread adoption as synthetic intermediates. The utility of these cyclopropanone surrogates is demonstrated in a mild and stereospecific formal [3+1] cycloaddition with simple hydroxylamines acting as nitrene equivalents, leading to the efficient formation of chiral ß-lactam derivatives. These chiral cyclopropanone precursors are also found to be excellent electrophiles for Grignard additions. The addition of vinyl magnesium bromide to cyclopropanone forms a vinyl cyclopropanol adduct, which can be intercepted with strong acids via Markovnikov addition to access to chiral cyclobutanones.

Elle Rooney[1], Prasad Bandodkar[2], and Gregory T. Reeves[1,2]
Graduate Programs: Genetics[1], Chemical & Biomolecular Engineering[2]
Advisor: Gregory T. Reeves
Poster Number: 178

FlySection: A Database of Gene Expression Patterns in Embryonic Drosophila

Fluorescence microscopy images are frequently used for quantitative genetics and modeling of gene regulatory networks (GRNs) in the Drosophila blastoderm; however, few consolidated sources of these data exist that allow easy curation of datasets. We present a database, called FlySection, that will be publicly available for access through the Reeves' lab website to contain quantitative data on gene expression patterns extracted from images generated by our lab. These data will be searchable and available for download. FlySection consists of a JavaScript webapp where users can search for relevant images using a few categorizing labels or quickly create datasets using criteria for parameters extracted from the images during analysis. The app accesses a Firebase Real-time Database where the results of our image analysis are stored. We expect that this database will assist members of the Drosophila research community who are studying gene regulatory networks in development to explore existing hypotheses and uncover new hypotheses for further study by collecting a large volume of image data in one place that is easily accessible and sorted by fly genotype, gene, fixed vs. live imaging, protein vs. mRNA imaging, or specific parameter values from which custom datasets can easily be constructed.
We present some examples, including pooled datasets drawn from FlySection that allow for greater statistical power than images acquired and analyzed by a single researcher, datasets that contain a wider scope of images than might be expected to apply to a given question, and novel questions generated by examining datasets created with FlySection.

Corey M. Scheip[1,2], Richard M. Wooten[1], Jesse S. Hill[1], Thomas J. Douglas[1], David M. Korte[1], and Karl W. Wegmann[2]
Graduate Programs: North Carolina Geological Survey[1], Marine, Earth, and Atmospheric Sciences[2]
Advisor: Karl W. Wegmann
Poster Number: 185

Debris flows triggered by 24 August 2019 storm in the Nantahala Gorge, western North Carolina - understanding a first-order spatial correlation with 2016 wildfire locations

On 24 August 2019, approximately 100-130 mm of precipitation over a 5-hour period triggered multiple debris flows in the Nantahala Gorge, Swain County, western North Carolina. First responders and motorists were trapped by debris flows that blocked a 1.2 km section of US 19/74 in at least six places and woody material and debris blocked the Nantahala River in three places. Following the event, the North Carolina Geological Survey produced a series of progressively updated maps to support responders and stakeholders. We used a combination of unmanned aerial system (UAS) imagery, Normalized Difference Vegetation Index (NDVI) from multi-spectral satellite imagery, and fieldwork to map the debris flow tracks. Of the 32 mapped debris flows, 23 initiated in areas of previous wildfire burn from the 2016 Ferebee and Tellico fires. Increases in debris flow susceptibility following wildfire is well documented in the western United States, however, this is the first documented debris flow swarm to spatially correlate with recently burned areas in the southeastern US. Wildfire associated canopy loss can decrease canopy interception potential, increasing the amount of surface runoff. Loss of root biomass can lead to destabilizing effects in shallow soil and fire mortality of trees and shrubs can reduce evapotranspiration, thus increasing antecedent soil moisture conditions. Ongoing work aims to understand potential connection between the events and may serve as a first case study of wildfire increasing debris flow susceptibility in the southeastern United States.

Ahmed Shaban and Rongmon Bordoloi
Graduate Program: Physics
Advisor: Rongmon Bordoloi
Poster Number: 191

A Spatially Resolved Study of Galactic Outflows in a Gravitationally Lensed Galaxy

Galactic outflows play an important role in galaxy evolution by regulating the star formation process and transporting metals from the galaxies into the intergalactic medium. Understanding these outflows will help to build better models for galaxy evolution. Previous studies have used long slit spectrographs to study the galaxies as a whole. This would just give average global properties of outflows in galaxies. In this work, we use the MUSE integral field unit spectrograph to study the outflows in a gravitationally lensed star-forming galaxy at redshift z = 1.7. The magnified image of the galaxy provides us with higher levels of Signal-to-Noise ratios and much better spatial resolution compared to the unlensed galaxies. In this experiment, we test if the outflow properties depend on properties of individual local star-forming regions of the galaxy or not, or if they are a global phenomenon in the galaxy and have the same properties in all regions. We use the MgII and FeII emission and absorption lines as tracers of the cool gas in the outflows. By studying these lines, we find out that outflows depend on the properties of individual local star-forming knots. By mapping the outflows using MgII emission, we see that the outflows are spatially extended compared to the stellar continuum.

Neelam Sheoran[1], Brenton Boland[1], Elnaz Shabani[2], R.E. Gorga[2], Jason Bochinski[1], Laura Clarke[1]
Graduate Programs: Physics[1], Wilson College of Textiles[2]
Advisor: Laura Clarke
Poster Number: 192

Conducting insulators: How ionic conductivity may be the key to the next generation of polymer nanofibers

The next generation of technologies in energy storage, filtration, drug delivery, wound healing, and tissue engineering will require inexpensive, lightweight, and robust micro to nanoscale fibers. Currently, nanoscale polymer fibers are produced through a process of solution electrospinning, however, most commercial thermoplastics cannot be used in this process because they are not soluble. The current alternative to solution electrospinning, traditional needle melt electrospinning, has many pitfalls as well, including frequent needle clogging, low throughput, and severe difficulty pumping the highly viscous molten thermoplastic at low feed rates. We have developed an unconfined geometry melt electrospinning approach as an alternative to these processes. This process is compatible with recyclable thermoplastic and is free from toxic solvents while eliminating clogging, increasing throughput, and removing the limitation of a low feed rate. We have optimized various processing parameters such as electric field and temperature of the melt to produce solvent-free, high mechanical strength microfibers of polyethylene.

There have been numerous studies establishing a direct correlation between the viscosity of the polymer solution and electrospun fiber diameter. However, recent studies have shown that altering the ionic conductivity of polymer solutions in solution phase electrospinning may also have a significant effect on fiber diameter. My poster will focus on applying these same principals to unconfined melt electrospinning. Specifically, the effect of ionic conductivity on unconfined melt electrospinning. I will report ionic conductivity measurements obtained using broadband impedance spectroscopy, viscosity measurements from a rotational plate rheometer, and changes in electrospinning, including changes in jet formation time, jet quantity, and resulting fiber diameter, as conductivity is tuned. By understanding the role of ionic conductivity in the melt electrospinning process, we can open the door to fabricating the type of nanofibers that will be required for the next generation industrial applications.

Sam Sridhar[1], Tony Wang[2], Aram Amassian[2], Kenan Gundogdu[1], Daniel B. Dougherty[1]
Graduate Programs: Physics[1], Materials and Science Engineering[2]
Advisors: Daniel Dougherty and Kenan Gundogdu
Poster Number: 196

Exploring Hot Electron Cooling Mechanisms in Hybrid Lead Halide Perovskites

Over the last decade, hybrid lead halide perovskites (LHP's) have shown record photovoltaic efficiencies and are promising candidates for next generation devices known as "hot carrier" solar cells. In such devices, highly excited carriers can surpass performance limits set by the band gap of the material if their thermal relaxation can be avoided. However, hot electron cooling is often rapid and involves a complex interplay of electron-electron, electron-phonon, and phonon–phonon interactions. Using time-resolved photoelectron spectroscopy, we observe a slower hot electron cooling rate in methylammonium lead bromide (MAPbBr3) compared to MAPbI3. Our finding deviates from the trend expected from a simple Fröhlich model of hot electron cooling by coupling to longitudinal optical (LO) phonons. We interpret this discrepancy as a signature of a phonon "bottleneck" effect that could be exploited to optimize hot carrier lifetimes. Understanding this effect brings us closer to a coherent picture of ultrafast energy relaxation mechanisms in hybrid LHP's.

Qun Sui
Graduate Program: Statistics
Advisor: Sujit K. Ghosh
Poster Number: 200

Entropy Based Subsampling Methods in the Era of Big Data

Under the big data settings, parameter estimation can often become computationally infeasible for popular regression models. Subsampling techniques, in these cases, play a significant role. Traditional subsampling techniques like leveraging methods consider only information from the covariates, excluding those from responses, thus often results in the loss of efficiency of such estimators based on chose subsamples. We propose two approaches based on entropy based criteria, one is based on selecting samples that contribute most to the likelihood with a fixed number of sub data size, while the other is based on determining the most possible subsample size within a Bayesian framework. Both methods are evaluated in terms of the entropy method, which measures the information entropy from full data and sub data. The likelihood based optimal subsampling (LBOSS), which simultaneously optimize model parameters and subsampling indicators have several advantages: (i) It converges faster than other methods thus takes less time; (ii) It is a better estimator in terms of Mean Squared Error; (iii) Sub data would lose less information.

Laura J. Wendelberger, Brian J. Reich, and Alyson G. Wilson
Graduate Program: Statistics
Advisor: Alyson G. Wilson and Brian J. Reich
Poster Number: 212

Interpretable Machine Learning Using Multiple Models

As data dimensionality increases, machine learning tools are becoming increasingly relevant for model selection. Various forms of penalized regression attempt to fit the best model for a dataset by downweighting the effect of variables that are likely to non-influential. However, these methods fail to take into account the existence of model uncertainty; in a dataset with highly correlated predictors, a single interpretation of the model identifies only one set of possible covariates when in reality there may be several. Bayesian Model Averaging (BMA) acknowledges model uncertainty, but mainly identifies very similar models. On the other end of the spectrum, a set of models based upon principal components are dissimilar due orthogonality, but do not explain the response equally well and lose some interpretability. A method which identifies several fundamentally different, useful models is desired. We propose a Multi-Model Penalized Regression (MMPR) to simultaneously identify several possible dissimilar linear models that explain the response. We introduce a form for a model similarity penalty which encourages variable shrinkage and/or sparsity among the different models based upon the settings to produce models containing different subsets of variables. Along with the similarity penalty, a sparsity penalty and a sum of squared errors term serve to eliminate non-influential variables and ensure good fits. Models identified in this way are interpretable, represent model uncertainty, and have the potential to identify previously uninvestigated sets of features.

D.J. You, H.Y. Lee, A.J. Taylor-Just, and J.C. Bonner
Graduate Programs: Toxicology
Advisor: James Bonner
Poster Number: 217

Sex Differences in Acute and Chronic Lung Inflammatory Responses to Nickel Nanoparticles

Nickel nanoparticles (NiNPs) are widely used in various technological applicaitons. A strong association between nickel inhalation exposure and asthma, pulmonary fibrosis, and lung cancer has been established in humans. In general, epidemiology studies show that women are more susceptible than men to chronic inflammation, while men are more susceptible to acute inflammation. Therefore, we hypothesized that male mice would be more susceptible to acute lung inflammation, whereas female mice would be more susceptible to chronic lung inflammation when exposed to LPS or/and NiNPs. The goal of this study is to explore mechanisms of susceptibility between male and female mice to acute and chronic lung inflammation after NiNP exposure. For acute study, C57BL/6J male and female mice were treated by oropharyngeal aspiration with vehicle (0.1% Pluronic in PBS), LPS (5μg/kg), NiNPs (4 mg/kg), or both, and sacrificed 24 hrs post-exposure. For the chronic study, mice were exposed to vehicle, LPS (0.83μg/kg), NiNPs (0.67 mg/kg), or both at day 1, 3, 5, 15, 17, and 19, and sacrificed 24 days post initial exposure to the stimulants. The acute study showed that male mice had higher IL-6 and neutrophils in their BALF after NiNP or LPS/NiNP treatment. For the chronic study, we observed increased numbers of monocytes in the BALF of male mice after NiNP or LPS/NiNP exposure. Male mice also had higher levels CCL2 in their lung lysates compared to the female mice. Overall, these findings suggest that human acute or chronic exposure to NiNPs and/or LPS would result in more severe lung inflammation or the inefficient resolution of inflammation in males.

College of Veterinary Medicine

Kaori U. Davis[1,2], M. Katie Sheats[1,2]
Graduate Programs: Comparative Biomedical Sciences[1]; Center for Comparative Medicine and Translational[2] Research
Advisors: Katie Sheats
Poster Number: 53

Asthma is a significant health concern that affects people of all ages worldwide.

Equine asthma syndrome (EAS) demonstrates many of the pathophysiological characteristics of nonatopic human asthma, which has led EAS to be used as a naturally occurring model. Previous work from our lab determined that MARCKS (Myristoylated Alanine Rich C Kinase Substrate) protein is an essential regulator of cellular inflammatory functions. The goal of this study was to obtain proof of principle data to support MARCKS inhibition as a viable therapeutic approach for EAS. We hypothesized that MARCKS levels would be increased in BAL cell lysates from horses with EAS, and that inhibition of MARCKS in zymosan-stimulated equine alveolar macrophages (ex vivo) would diminish respiratory burst. Lysates were prepared from BAL cells isolated from horses with no, mild/moderate and severe EAS. MARCKS levels were determined using equine specific MARCKS ELISA (MyBioSource). Cultured equine alveolar macrophages were pretreated with a MARCKS inhibitor peptide (MANS), control peptide (RNS) or vehicle and stimulated with zymosan for 5 hours. Reactive oxygen species levels were determined by luminescence to evaluate respiratory burst. Based on the analysis with One-way ANOVA (pex vivo attenuates respiratory burst. These findings point to a possible role for MARCKS in the pathophysiology of EAS and support MARCKS inhibition as a potential therapeutic strategy.

Constanza Meneses[1,2,3], Yen-Hao Lai[1,3], Brooke Bollinger[3], Yarines Gonzalez[3], Karen Marcus[3], B. Duncan Lascelles[1,2,3], Michael W. Nolan[1]
Graduate Program: Department of Clinical Sciences[1], Translational Research in Pain Program[2], North Carolina State University-College of Veterinary Medicine[1,3]
Advisors: Duncan Lascelles
Poster Number: 140

Head and neck (HNC) cancer patients frequently experience radiotherapy-induced oral mucositis (RIM) and associated pain (RAP).

Severe orofacial RIM/RAP can be modeled in mice; as in people, these animals experience both critical weight loss and facial hypersensitivity. The purpose of this study was to enhance our modeling of RAP by developing outcome measures that specifically report orofacial pain. Four groups of 8 female Balb/c mice underwent tongue irradiation (IR) and received administration of either carprofen, hydromorphone, nerve growth factor blockade (a-NGF), or saline (control). RIM and body weight were monitored daily. Novel measures of orofacial pain were assessed both before and after analgesic administration, and included: (1) nest building; (2) grooming; and (3) eye wiping in response ophthalmic administration of a mild noxious stimulus. The most effective analgesic (a-NGF) was then used to assess outcome measure repeatability in a larger, independent experiment. 84 Balb/c mice underwent IR or sham irradiation, and either saline or a-NGF. RIM severity, body weight, nesting and grooming behaviors were assessed. A 2-way repeated measures ANOVA, chi-square analysis and Fisher's exact post hoc tests were used for analysis (P Our results support the use of this testing system as a model for severe acute orofacial RAP in rodents. Mice with severe RIM experience critical weight loss, impaired nesting and grooming activities, and exaggerated eye wiping responses to mild noxious stimuli. The incomplete mitigation of RAP by a pure mu agonist opioid, or NSAID, is consistent with human responses to analgesic therapy for acute orofacial RAP. Our results indicate that NGF inhibitors may represent a useful tool for clinical management of orofacial RAP.

Drake Phelps[1,2,3], Jacob Driggers[1], Anika Palekar[1], and Jeffrey A. Yoder[1,2,3]
Graduate Programs: Comparative Biomedical Sciences[1], Molecular Biomedical Sciences[2], Comparative Medicine Institute, Center for Human Health and the Environment[3]
Advisor: Jeffrey A. Yoder
Poster Number: 159

Inhibition of the Respiratory Burst by Six Per- and Polyfluoroalkyl Substances (PFASs)

Per- and polyfluoroalkyl substances (PFASs) are a class of nearly 5,000 anthropogenic compounds used in the production of non-stick coatings, food wrappers, water- and stain-resistant fabrics, and fire-fighting foams. Due to their ubiquity, persistence, and mobility in the environment, 99% of Americans have detectable levels of PFASs in their blood. Exposure to PFASs has been linked to cancer, thyroid disease, and impaired adaptive immune system responses. However, the impact of PFASs on the innate immune system remains unknown; should the innate immune system be impaired, the host may be susceptible to infectious or neoplastic disease. In order to investigate this, larval zebrafish and a human neutrophil-like cell line were exposed to six different PFASs that have been detected in the water and air in Fayetteville, North Carolina: PFOA, PFOS, PFHxA, PFHxS, GenX, and fluoroether E1. Initial range-finding studies were performed to determine doses that were non-teratogenic to zebrafish and non-cytotoxic to human cells. Doses for which no teratogenicity or cytotoxicity were observed served as the highest doses tested in subsequent assays. We then measured the respiratory burst as a functional readout of innate immune function. Range-finding studies for developmental toxicity and cytotoxicity identified PFOA and PFOS as developmentally toxic to larval zebrafish, but none of the tested PFASs were cytotoxic. In the respiratory burst assay, PFOA, PFOS, PFHxA, and E1 suppressed the respiratory burst in vivo. However, in vitro, all of the PFASs that were tested suppressed the respiratory burst. This may indicate that, while PFASs are able to directly impair innate immune function in vitro, certain PFASs may target other organ systems in vivo, resulting in no observable immune dysfunction. Future studies plan to explore this hypothesis, whether PFAS-induced immunotoxicity is differentially influenced by chronic or acute exposure, and whether exposure to PFASs confers susceptibility to infectious disease.

Kathryn M. Polkoff, Nithin Gupta, and Jorge Piedrahita
Graduate Program: Comparative Biomedical Sciences
Advisor: Jorge Piedrahita
Poster Number: 163

Transgenic Porcine Model for Studying Hair Follicle Stem Cell Dynamics

In the skin, a population of epidermal stem cellsmarked by the surface receptor LGR5is responsible for giving rise to hair and maintaining growth and development throughout the hair cycles. These cells are only found within the hair follicleexcept when there is a wound in the vicinity, in which case they migrate from their niche to re-epithelialize the wound. These same cells are found to be the major source of cancer initiating cells in basal cell carcinoma. However, the behavior of these cells has only been studied in depth in mice models, which, unlike humans, have thin epidermis and dermis, synchronized hair follicle cycling, and proportionally higher density of hair follicles (fur instead of hair)all factors that can impact interpretation of results and translation to human clinical populations, and all factors that humans share with pigs. Given the important roles of hair follicle stem cells, limitations of the mouse model, and the lack of well-validated commercial antibodies to detect LGR5 expression, we have developed a novel transgenic pig carrying a nuclear H2B-GFP reporter driven from the endogenous LGR5 promoter using CRISPR/Cas9 and homology directed repair. Our results show that LGR5 is faithfully expressed in the bulge of the porcine hair follicle during catagen, anagen, and telogen, and furthermore that LGR5 progeny give rise to hair in the pig. In addition, flow-sorted LGR5-hi expressing stem cells form skin organoids with long term potentiation potential, while LGR5-lo and negative populations do not. In conclusion LGR5 is a marker of hair follicle stem cells in the pig and we have created a physiologically relevant model for the study of human epidermal hair follicle stem cells. Future studies will use this novel model to study the role of LGR5-stem cells in wound healing, hair growth, and cancer.

Amber D. Reed[1], Matthew A. Nethery[2], Rodolphe Barrangou[3], Allison Stewart[4] and Casey M. Theriot[1]
Graduate Programs: Microbiology[1], Functional Genomics[2], Food Science[3], Molecular Education, Technology and Research Innovation Center[4]
Advisor: Casey M. Theriot
Poster Number: 174

Strain dependent inhibition of Clostridioides difficile by commensal Clostridia encoding the bile acid inducible (bai) operon

Clostridioides difficile is one of the leading causes of antibiotic-associated diarrhea. Gut microbiota derived secondary bile acids and commensal Clostridia such as C. scindens that encode the bile acid inducible (bai) operon are associated with protection from CDI, although the mechanism is not known. Thus, we hypothesized that commensal Clostridia were able to inhibit C. difficile through the production of inhibitory secondary bile acids such as deoxycholate (DCA) from primary bile acid cholate (CA). Supernatants from commensal Clostridia grown with different concentrations of CA were added to C. difficile cultures to assess inhibition, and LC/MS was performed to assess the concentration of CA and DCA. Expression of selected genes from the bai operon was assessed through qRT-PCR. When C. scindens ATCC 35704 and VPI 12708 were grown in the presence of 2.5 mM CA, 1.96 mM DCA was produced and C. difficile growth significantly decreased. C. hiranonis only produced 0.78 mM DCA when supplemented with 2.5 mM CA, while C. hylemonae did not produce any DCA. Neither strain grown with CA was able to inhibit C. difficile growth. Consistent with the LC/MS results, expression of bai operon genes increased in C. scindens ATCC 35704, C. scindens VPI 12708 and C. hiranonis, but not C. hylemonae. Competition for nutrients was also examined using an in vitro competition assay. C. difficile outcompeted all four commensals in rich media. The ability of commensal Clostridia that encode the bai operon to inhibit C. difficile in vitro in the presence of CA is strain dependent and correlates with the amount of DCA produced. Understanding the relationship between commensal Clostridia and the pathogen C. difficile in the gut is vital for designing targeted bacterial therapeutics.

Christine A. Wang, William J. Love, Siddhartha Thakur, Cristina Lanzas
Graduate Program: Comparative Biomedical Sciences
Advisors: Cristina Lanzas, Siddhartha Thakur
Poster Number: 210

Applying Chain Graph Models to Identify Livestock Management Risk Factors for Antimicrobial Resistance among Campylobacter coli from Agricultural Swine Populations

Antimicrobial resistance (AMR) is a major threat to human and animal health today, rendering once treatable infections untreatable. Although antimicrobial use is known to directly select bacterial populations that are resistant to those drugs, other important risk factors influencing the epidemiology of AMR are incompletely understood. Several complex mechanisms enable the exchange of genetic material among populations of unrelated bacteria (e.g. mobile genetic elements), thereby influencing the rise of multidrug resistant bacterial populations. Thus, resistance to an antibiotic may still arise even without using that specific antibiotic. Traditional analytical methods used in epidemiological research rely solely on generalized linear models to identify risk factors for health outcomes; however, these methods are less suitable for evaluating AMR risk factors while simultaneously accounting for the complex, non-linear dynamics of AMR selection and persistence. In this study, we utilize a multi-layered chain graph model to identify risk factors for phenotypic resistance while also accounting for potential complex genetic mechanisms underlying AMR selection and persistence. We applied this model to populations of Campylobacter coli isolated from agricultural swine herds experiencing varying degrees of antimicrobial exposure and other management practices. In addition to antimicrobial usage, we found that risk for fluoroquinolone- and macrolide-resistance differed based on biosecurity practices employed at each farm and whether animals were reared entirely indoors or outdoors. Results and computational methods from this study are applicable to human public health surveillance data.

Joshua Wheeler[1,2], Anthony F. Domenichiello[3], Gregory S. Keyes[3], Kristen Maiden[3], Jennifer Jensen[3], John M. Davis[4], Zhi-Xin Yuan[3], Christopher E. Ramsden[3,5,6], Santosh Mishra[1,2],

Graduate Programs: Molecular Biomedical Sciences, Comparative Medicine Institute, Lipid Peroxidation Unit, Laboratory of Clinical Investigation, National Institute on Aging, NIH[3]; Department of Psychiatry, University of Illinois at Chicago[4]; Intramural Program of the National Institute on Alcohol Abuse and Alcoholism, NIH[5]; Physical Medicine and Rehabilitation, University of North Carolina-Chapel Hill[6]

Advisor: Santosh Mishra

Poster Number: 213

Bioactive derivatives of linoleic acid and their stable analogs as potential pain mediators

Pain is a common problem that is affected by oxidized lipids. We recently identified a family of oxidized derivatives of linoleic acid in skin as potential mediators of pain and itch. Among these, 13-hydroxy-9,10-epoxy-linoleate (13,9-HEL) was higher in the free lipid pool of psoriatic lesions as compared to control skin. 13,9-HEL augmented sensory neuron CGRP release only at low pH, suggesting that an acid-derived product could play a role in pain. Here we expand upon prior work by quantifying 13,9-HEL and its acid-derived trihydroxy-linoleate derivative (13,9,10-THL) in human and rodent skin lipid pools, and testing activities of endogenous lipids and novel analogs in rodent sensory neurons and behavior assays. 13,9-HEL and 13,9,10-THL were present in free (bioactive) and esterified (structural) lipid pools of skin. Using calcium imaging, we show both compounds (1μM) evoked Ca2+ transients in murine sensory neurons. Further, in vivo study show that intradermal injection of 13,9,10-THL (but not 13,9-HEL) evoked pain-related behaviors with a more rapid onset and overall potency comparable to PGE2 and 9-HODE (classic lipid mediators of pain). We further investigate structural determinants of 13,9-HEL and 13,9,10-THL activity in mice using similar approaches as described above. Interestingly, analogs and small molecules activated neurons and evoked pain-related behaviors in mice in a manner that was comparable to, and in some cases more potent or longer-acting than, their parent endogenous mediators. We further determined that 13,9,10-THL is capable of sensitizing responses to noxious thermal stimuli in wild type mice; however, this sensitization is lost in both TRPA1 and TRPV1 knockout mice. In summary, our results suggest that 13,9,10-THL is a potential thermal pain mediator in mice.

Ruksana Baby
Graduate Program: Fiber and Polymer Science
Advisor: Kavita Mathur
Poster Number: 14

Development of a Skin-Fabric Friction Model with an Objective to Prevent Friction Induced Skin Injuries

While friction is important to perform day-to-day tasks, enhanced friction can lead to many skin related issues such as tissue deformation and skin damage, decubitus ulcers or pressure ulcers, friction blisters, failure of skin graft surgery and even more severe unwanted problems in people with immobility and/or compromised skin conditions. The Agency for Healthcare Research and Quality (AHRQ) provided an estimation that more than 2.5 million individuals develop pressure ulcers annually that costs the US healthcare system $9.1-11.6 billion per year due to increased health care utilization. Textiles being the primary contact of skin, has a significant impact on skin health and therefore in the formation and prevention of pressure ulcers and other skin injuries. This research aims at preventing or even reducing the incidence of textiles-induced friction injuries by investigating the physical mechanisms of friction in woven fabrics, skin and their interaction in combination with the effects of mechanical parameters (pressure, shear, frequency, speed and time) and microclimate. The ultimate goal of this study is to develop an empirical skin-fabric friction model utilizing all the underlying factors to eliminate the gap between theoretical and empirical observations, and therefore provide realistic prediction to enable designing tailored textiles structures for specific application and end-use performance.

Dakota Batch
Graduate Program: Textile Technology Management
Advisor: Katherine Annett-Hitchcock
Poster Number: 19

Development of pre-consumer food waste as a form of alternative natural dye

Synthetic dyes are common in the textile industry due to their wide range of colors, low cost and ease of manufacturing. However, studies have shown that some synthetic dyes are harmful to human health and the environment. Natural dye application is viewed as a dye alternative and is a growing industry with potential to utilize waste from the food industry. Research in developing food waste as a form of alternative dye exists, however, improvements in colorfastness and scalability can assist in creating a circular economy. The objectives were to analyze the amount of food waste needed to produce a depth of shade of color necessary to dye a textile product, and test the procedures using standard industry test methods. The study utilized varying amounts of used coffee grounds and onions skins, obtained from on-campus and local dining facilities. Onion skins and coffee grounds were in plentiful supply and easily separated as waste products by kitchen staff. Dyes were extracted from the plant materials using the Pilot Lab in the Wilson College of Textiles, and a pre-mordant procedure was utilized to ensure optimal dye absorption.The extracted dyes were then applied to 100% cotton swatches, utilizing varying concentrations of dye. The colorfastness of the dyed swatches were then tested using industry (AATCC) test methods. The extraction and application procedures produced swatches with a variety of shade depths for both plant materials. This was expected, given the variation in dye concentration. Tests showed that, on average, swatches achieved acceptable dry and wet colorfastness ratings in addition to color staining rating. The study contributes to research on the use of natural dyes on textiles by demonstrating that acceptable color fastness can be achieved. The study also shows that this type of procedure can contribute to the development of small scale circular textile economies.

Elizabeth Cobarrubias, Braden Li, Amanda Mills, Jesse S. Jur
Graduate Program: Textile Engineering
Advisor: Jesse S. Jur
Poster Number: 44

Design and Test Strategies for Biopotential Sensors in Smart Garments

Heart disease prevails as the leading cause of death worldwide, yet vigilant heart health monitoring solutions remain unavailable. Dry electrode integration in garment systems can potentially fill this gap because the electrodes offer more benefits than traditional wet electrodes that have a limited shelf life and can cause skin irritation. However to compete with gold-standard wet electrodes, dry electrodes and integration methods face many technical challenges; they must be soft, flexible and breathable for long-term user comfort, they must be powerful enough to obtain a clear and accurate ECG signal (reduce motion artifacts, impedance, and SNR) and they must be durable enough to withstand laundering. Multilayer dry electrode samples were fabricated by screen-printing Ag/AgCl conductive ink onto a polyurethane film, then applied to a fabric backing via heat lamination. This study focuses on improving ECG signal quality via electrode design and strategic garment integration, understanding the skin-electrode interface, and identifying appropriate electrode test methods. Breathability, which is associated with increased comfort by enabling sweat evaporation, is a critical attribute for successful long-term health monitoring. Dry electrodes were designed with varying surface area and vacancies in the conductive ink layer and polyurethane layers to test moisture vapor transmission rate and to correlate its effects on electrode-skin impedance. Small holes distributed across the electrode surface showed improved breathability with minimal sensor degradation. One challenge of designing dry electrodes is accounting for the variability between individual's skin properties. Reproducible skin phantoms were created to provide a substrate where dry electrodes are characterized using a standardized skin simulant, thus eliminating performance variability between human test subjects and developed a testing method to benchmark electrodes. This study defines key parameters that enhance the design features of dry electrodes that are suitable for long-term monitoring of ECG signals in garment systems.

Hadir Eldeeb
Graduate Program: Fiber and Polymer Science
Advisor: Abdel-Fattah Seyam
Poster Number: 60

Modeling Tensile Behavior of 3D Orthogonal Woven Composites from High Performance Natural Fibers

The interest in producing composite materials from natural fibers has been increased to reduce environmental impacts of using synthetic fibers. Hemp and flax fibers have been used as reinforcement in composites due to their high specific strength and modulus. They possess a high vibration dampening, high fiber yields, and pest and drought resistance. These properties make hemp and flax excellent candidates for composite reinforcement and possibly a more sustainable replacement of high performance synthetic fiber composites in areas like automobiles, consumer goods, and construction.

While there are numerous previous work on modeling tensile properties of 3D composites, including composites from 3D orthogonal woven (3DOW) preforms from synthetic flat tows, there is no similar work dealing with composites from 3DOW preforms from natural fibers. This lack of research directed the objective of this work. A generalized analytical model was developed to predict the entire load-elongation curve of the 3DOW preforms from hemp and flax fibers in terms of structural parameters, including weave pattern, using finite deformation technique and considering the nonuniformity of natural fibers. The model was verified experimentally for broad range of composite structures and it was found that there is a good agreement between experimental results and the model.

Wade Ingram
Graduate Programs: Fiber and Polymer Science, Materials Science and Engineering
Advisors: Richard Spontak and Jesse Jur
Poster Number: 103

Nanotextured PET Fibers Using Block Copolymer Self-Assembly and Sequential Vapor Infiltration

This work seeks to create unique hybrid nanostructures on the surface of PET fibers using block copolymer self-assembly and sequential vapor infiltration (SVI). Using a polystyrene-block-methyl methacrylate copolymer (PS-b-PMMA), we can create well-defined, periodic arrays of different structures dictated by the volume fraction of each block. For the purposes of this work, we used block copolymers that self-assemble into PMMA cylinders that can be oriented parallel or normal to the surface. In order to control orientation of the cylinders, we used 3-aminopropyltriethoxysilane (APTES) and a random PS-PMMA copolymer to neutralize the substrate before depositing the block copolymer layer and annealing. The self-assembled PMMA domains can be infiltrated using metalorganic precursors to create periodic hybrid nanostructures after etching using toluene or O2 plasma to remove the polymer coating.

To examine an application for this work, we studied the photoremediation of heavy metal ions from aqueous environments. ALD-coated ZnO and TiO2 PET fibers were compared to fibers with nanostructured ZnO and TiO2 using block copolymer self-assembly. Due to the electronic bandgap of TiO2 and ZnO, UV light can excite electrons from the valance band of the material into the conduction band where they become available to reduce heavy metal ions (like As3+ and Cr6+) from solution. The nanostructures on the samples were characterized using scanning electron microscopy, as well as energy dispersive x-ray spectroscopy to confirm successful photodeposition. The concentrations of heavy metal ions in solution were measured using ICP-OES to compare the performance of the nanostructured fibers to the ALD-coated samples.

This work serves as a demonstration of the nanoscale templating process using block copolymer lithography on fibers. This opens the door to other applications including textile electronics, filtration, and structural coloration.

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Poster Number: 110

Combining Digital Textile Printing with Laser Engraving: The Effect of Surface Contour Modification on Color Properties of Pile Fabric

This research combines two digital technologies for customizing textile substrates: carbon dioxide CO2 laser treatment and digital textile printing. Because color yield depends on the texture in contact with the dye, it was anticipated that variation in the pile height of a pile fabric would influence colorimetric attributes of the substrate. The precedent studies focused on inkjet printing quality and color attributes on woven, knitted, and nonwoven fabric constructions and their surface characteristics. However, limited studies have concentrated on inkjet printing on pile fabric. In this research, the influence of the textured surface of a pile fabric on its instrumental color measurements will be investigated. Moreover, this study will provide a fundamental proof of concept demonstrating the effectiveness of combining these two technologies for creating multiple variations in texture and color on a given substrate. The objective of this research was to assess the color quality of inkjet-printed colors on cotton velvet fabric with pile height variance created by treatment with different laser intensities. To develop samples, CO2 laser technology was used for engraving the surface of 100% cotton velvet fabric and creating pile height variance. After exposure to the laser treatment, seven solid colors were printed in stripes on the surface of the treated fabric with reactive dyes. Following printing, samples were post-treated in a steamer and washed out. After sample development was completed, the colorimetric properties of the fabrics were measured with a spectrophotometer. The experiments revealed that the changes in surface morphology of cotton velvet fabric printed by a digital printer with reactive dye achieved variable reflectance values, chroma, color strength, and total color difference. Furthermore, a controlled variation of pile height by adjusting the laser intensity resulted in instrumentally measurable differences in the color quality of inkjet-printed substrates.

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Evaluation of cold weather multi-layer clothing systems on moisture management and thermal comfort

The current sweating guarded hot plate protocol involves evaluating single layer fabric samples under certain conditions for heat loss and drying time. Military ensembles for cold weather combat are multi-layer clothing systems. The effects of layering in the system can be observed using the hot plate method. In order to mimic how the layers interact with the human body, a new testing protocol needed to be established. The protocol included the standard conditioning time of the fabric to the hot plate, sweating time of water released through the pores and onto the fabric, and drying time of the fabric. It was concluded that both the ordering of the layers in the system and the fabric construction parameters of the layers affect the heat loss and drying time. Fabrics of different construction parameters behaved differently, some having increased heat loss and decreased drying time and others having decreased heat loss and increased drying time. A base layer that is standard in the sweating thermal manikin protocol was introduced to the hot plate method in order to evaluate the fabric's ability to wick sweat along the surface. This fabric eliminated any differences among fabric multi-layer ensembles when used as the base layer of the system. This phenomenon calls to a bigger question of the accuracy of standardized test methods in relation to the thermo-physiological response of human skin.

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Consumers' Adoption of AR-based Virtual Fitting Rooms: From the Perspective of Interactive Media Effects

Virtual Fitting Rooms (VFRs), simulation technologies that enable consumers to virtually try on inventories, have received tremendous attention from online retailers as the way to provide in-store like fitting experience. VFRs have recently evolved into a new format that primarily utilizes Augmented Reality (AR) for the basis of virtual fitting. Unlike typical VFRs, the unique features of AR-based VFRs, derived from its interactivity and augmentation, have great potential to provide an immersing shopping experience to consumers. However, despite the great potentials of AR-based VFRS, its adoption is still in the preliminary stage. In addition, although AR-based VFRs have the potential to significantly affect consumers' online shopping experiences with enhanced interactive features and the ability to better immerse consumers, research is limited in examining and explaining the mechanism behind consumers' adoption process of this technology. With this in mind, by taking the media-effect approach, the Theory of Interactive Media Effects (TIME) was adopted in this study to investigate the relationship between consumers' perceived media characteristics, telepresence, attitudes, and adoption intention toward AR-based VFRs. Additionally, the mediating effect of telepresence and the moderating effects of fashion consciousness and technology anxiety were examined.Data were collected from 352 university students and analyzed using structural equation modelling as well as multi-group comparisons.Empirical results suggest significant positive influences of media characteristics, including perceived interactivity and augmentation, on telepresence, which, in turn, influenced attitudes and adoption intention toward AR-based VFRs. Additionally, significant moderating effects were revealed from fashion consciousness and technology anxiety on consumers' VFR adoption.

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Development of Test Image and Quality Evaluation Metrics for Inkjet Textile Printing

This project aims to develop a robust quality evaluation metric for textile inkjet printing. Inkjet printing technology was originally used for paper printing, and thus standards and evaluation procedures are well established in paper printing. Over the past few years, inkjet printing has witnessed a significant position in the textile industry. However, many of the production procedures are based on paper printing while characteristics and the interaction between colorants and textile fabrics are significantly different to those with paper. Color (re)production in textile printing is also quite different from that in paper printing, for example, it is very common to print pictorial images on paper, while repeat colorful patterns are more common in textile printing. Thus, it may not be suitable or effective to utilize the existing test images for papers and the associated evaluation methods for textile prints.

There are two evaluation approaches that are commonly adopted in textile printing industry: subjective and objective. Subjective evaluations are easy to conduct but their results are highly dependent on the testing image used. Objective approaches are more repeatable, but there may be too many existing metrics to employ and therefore the quality evaluation results may be dependent on the metric selected. In order to develop a robust evaluation technique for use in textile printing we aim to incorporate strong elements from subjective and objective methods while overcoming their disadvantages and biases. The results of a survey involving experts from printing industry will be used to identify important evaluation metrics. A testing image incorporating common themes in textile printing will then be developed and tested using different printers and settings to examine the effectiveness of the methodology developed and the suitability of the new evaluation image.

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The Value of Fair Trade Fashion Through the Eyes of Female Consumers

Fair trade is defined as workers earning fair wages for them to live comfortably in their region while making sure they are treated properly and working in safe conditions. Fair trade is important because to have a sustainable economy, people need to be treated well and respected for their craft. Consumers see businesses that support fair trade as reputable and trustworthy. Currently, there is limited research on fair trade fashion and motivations of consumers to continually purchase fair trade. The main purpose of this study is to uncover consumer behavior and motivations of female consumers who purchase fair trade fashion, while also investigating their participation in pro-environmental behaviors, concern for the environment, and whether they experience community within fair trade. Using a qualitative approach, seven female consumers of fair trade fashion were interviewed through semi-structured, in-depth interviews. Each interview lasted between 20-50 minutes, and included questions regarding the purchase behaviors, environmental concerns, pro-environmental behaviors, and sense of community with fair trade. The interviews were audio-taped, and afterwards transcribed verbatim for data analysis. Results from the qualitative portion of this study surfaced four themes: (Theme 1) What's in Your Closet? (Theme 2) Nurture for Nature, (Theme 3) The Gift of Giving, and (Theme 4) Disconnected. Theme 1 reveals fair trade fashion consisted of 30-50% of the participants' wardrobe. Theme 2 shows female participants engaged in environmental behaviors such as recycling, using reusable totes, etc. Theme 3 reveals that many of the participants felt excited to give fair trade items as gifts and would intentionally buy a piece to share the story with that person. Theme 4 disclosed that many of the participants believed there was not a formal community surrounding fair trade.

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The Development and Evaluation of Biodegradable Knit Structures for Sustainable Footwear

The global footwear market is currently valued at $222.4B, and the sustainable footwear market is steadily growing in consumer demand. The development of synthetic yarns and the introduction of knit footwear in 2012 has greatly contributed to sustainability initiatives in the United States. However, the popularity of synthetic and recycled manmade fibers in knitting such products has ultimately only prolonged the lifecycle of plastic before it enters the landfill. The goal of this research is to develop and evaluate knit structures made from natural yarns that are comparable to the properties of knit fabrics commonly found in footwear. In particular, hemp, cotton, and wool fibers will be the focus of fabric development. While cotton and wool are popular across the textile market, hemp is slowly gaining popularity following the introduction of the Farm Bill (2018) and North Carolina Senate Bill 315 (2019), officially authorizing and regulating statewide hemp farming. Thus far, a casual espadrille shoe has been made using hemp and cotton. The evaluation of the various knit structures from this prototype will allow for further understanding of the necessary components in such a product. The twofold approach of simultaneously integrating the historically strong North Carolina Agricultural and Textiles industry through the development of engineered biodegradable knit structures will allow for the re-introduction of natural fibers to worldwide textile and footwear markets.

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Development of a Contact Transfer Test to Evaluate Firefighter Dermal Exposure to Fireground Contaminants

Firefighters have been shown to be 1.3 - 2.0 times more likely to develop various types of cancer, including but not limited to skin, prostate, and testicular cancers. At fire scenes several carcinogenic chemicals can be found in smoke and soot. Chronic exposure to these chemicals is believed to be a potential cause of firefighters' increased cancer incidence. Polycyclic aromatic hydrocarbons (PAHs) are an example of carcinogenic chemicals frequently found at fire scenes and have been found on the gear and skin of firefighters. To evaluate firefighters' potential dermal exposure to fire ground contaminants a contact transfer method will simulate the transfer of PAHs from turnout gear to human skin. All materials in the contact transfer test must indicate sufficient extraction of PAHs. The skin surrogates must exhibit analogous permeability and absorption to porcine skin. Using a porcine flow-through cell diffusion test, the absorption and permeability of SynDaver skin and Strat-M® Membrane will be compared to porcine skin, the most similar animal skin model to human skin. Static and dynamic contact transfer tests using lab contaminated turnout gear and skin surrogates will represent firefighters wearing, donning and doffing their gear during and after fire response. Contact test samples will be extracted and analyzed via pressurised solvent extraction in tandem with UV-DAD/FLD-HPLC. Recovery of the EPA's 16 priority PAHs using pressurized solvent extraction showed promising extraction for outer shell turnout gear (77-95%), for the skin surrogates extraction efficiencies were underwhelming for SynDaver tissue plates (32-80%). The porcine flow-through experiment showed that SynDaver tissue plates were more permeable than porcine skin but followed the same trend of absorption.The low extraction efficiency for the SynDaver skin could be explained by the chemical passing through the skin surrogate resulting in lower extraction efficiencies.

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Extensible Microfiber Robot Based on Dielectric Elastomer Fabricated by Microfluidic Process

Artificial muscles are robotic devices, either as implantable tissues or non-implantable devices, which can generate motion upon receiving input energy, such as electric voltage. The traditional techniques of artificial robotic devices, such as electromagnetic motors, are bulky, heavy and rigid. Using soft artificial muscles, one can develop advanced flexible devices that help mimic the marvelous variety of motions found in nature. Dielectric elastomers (D-EAP) are particularly attractive as smart polymers because they can deform upon an electric stimulus and at the same time possess many important features that make them comparable to natural muscles. The ongoing curiosity in the development of D-EAP fiber robots originates from a profound interest in finding artificial means by which to mimic the ability of flexible and fibrous mammalian muscles to generate fast, strong, and repeated locomotion while being superbly resilient, tough, adaptable, and responsive. These properties are significantly different from those found in many simple machines. However, the reported research focusing on D-EAP fiber robots are very limited and still in the early stage. The studies attempting to achieve decreased size in fiber robots are even more rare, which has significantly limited the exploration of their applications. Here, we proposed a microfluidic fabrication process allowing the manufacturing of micro-level D-EAP based fiber robots. Microfluidics is an approach to extrude materials in liquid states through the shape defined channels to form a continuous fiber device in microscale. During this process, the desired dimension and configuration of the D-EAP based fiber robot can be precisely tuned by changing the technical parameters, such as the spinneret shape and fluid dynamics. This research will address a critical ongoing need in miniaturization of D-EAP based fiber robots for potential applications in wearable robotics and microscale soft robots.