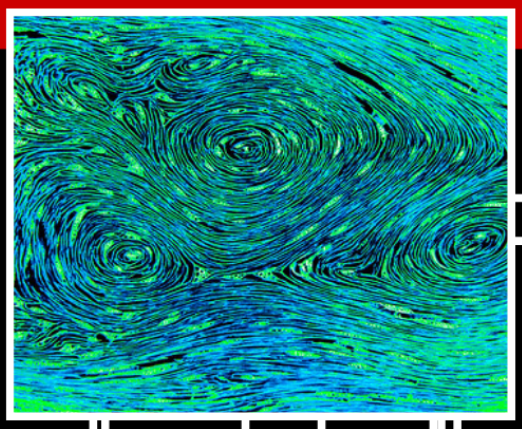
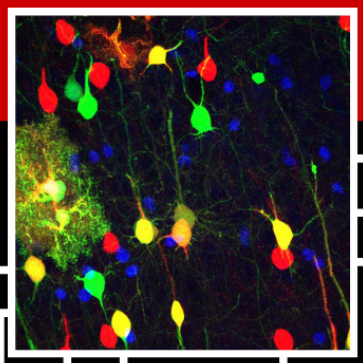
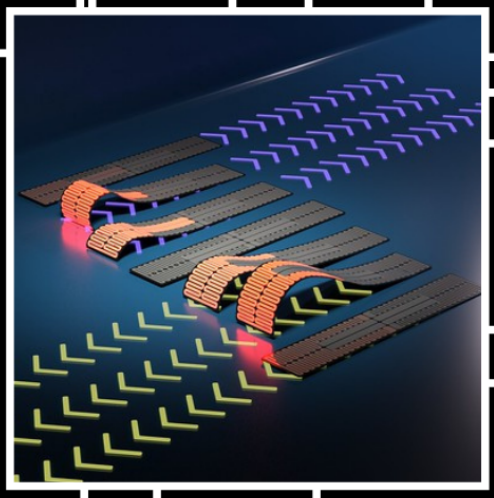
NC STATE UNIVERSITY

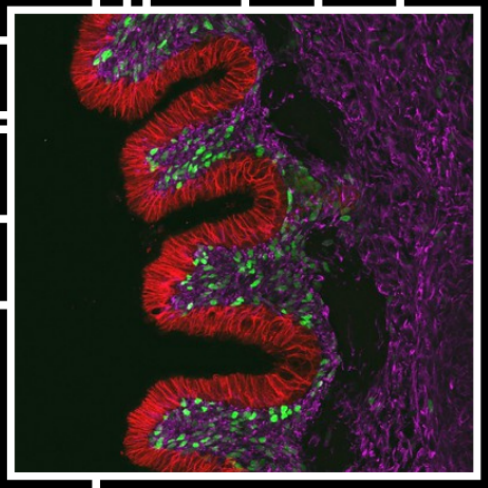
ABSTRACTS

17th Annual Graduate Student Research Symposium









Wednesday
April 3, 2024

McKimmon Center
12:00PM - 5:30PM

17th Annual
Graduate Student Research Symposium
North Carolina State University

ORGANIZERS OF SYMPOSIUM

Graduate School

Dr. David Shafer – Assistant Dean (Primary Organizer and Symposium Lead)
Bridget Foy – Administrative Assistant
Gregory Hedgepeth – Director of Marketing and Communications
Todd Marcks – Fellowship and Grants Administrator
Darren White – Webmaster

Graduate Student Association

Naimul Haque – Forest Biomaterials (Symposium Lead for GSA)
Cullen Burke – Forest Biomaterials
Joshua Fesmire – Public Administration
Darrell Harry – Materials Science and Engineering
Anurata Hridi – Computer Science
Julia Janson – Crop and Soil Science
Rajan Paudel – Plant Pathology
Madi Polera – Biology
Duc-Huy (Huy) Pham – Industrial and Systems Engineering
Erik Rosenstrom – Operations Research
Sydney Shuping – Animal Science
Calyssa Stevenson – Horticultural Science
Dushyanth Kumar Tammineni – Food, Bioprocessing, and Nutrition Sciences
Clara Tang – Microbiology
Moritz Woelk – Chemical Engineering

Abstract Book Cover

Mariam Giurgis - Animal Science

AGENDA

12:00 - 1:00 p.m.	Poster Set Up (All set up their posters).....	Area 1
1:15 -1:30 p.m.	Welcoming Remarks and Symposium Overview ..... Ms. Margaret Baker, GSA President Dr. Peter Harries, Dean of the Graduate School Dr. David Shafer, Assistant Dean of the Graduate School	Area 1
1:30 - 4:00 p.m.	Poster Session and Competition	Area 1
4:15 -5:30 p.m.	Announcements of Awards and Reception ..... Dr. Peter Harries, Dean of the Graduate School Ms. Margaret Baker, GSA President Dr. David Shafer, Assistant Dean of the Graduate School	Room 2

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Poole College of Management

Wilson College of Textiles

ABSTRACTS

College of Agriculture and Life Sciences

Aygul Akhmadullina
Graduate Program: Human Nutrition
Advisor: L. Suzanne Goodell
Poster Number: 5

Nutritional Interventions in Autistic Children: Caregivers Expectations and Claimed Effects

Caregivers of autistic children often use nutritional interventions, including feeding and supplementation practices, to alleviate or improve autism symptoms. However, the efficacy of these interventions lacks sufficient evidence. The objective of this study was to examine nutritional practices caregivers use with autistic children, their expectations, and whether their expectations align with claimed effects. This mixed-method study extracted data from a public Facebook autism support group. Posts and comments discussing nutritional interventions were collected using nutrition-related keywords. The sample totaled 2677 participants. The unit of analysis was a caregiver-child pair. Data were aggregated to calculate the percentage of caregivers using nutritional interventions and the shares of caregivers reporting specific expectations and claimed effects from those interventions. Results showed that a third of participants (32.4%) had experience using nutritional interventions with their children. Caregivers expected to see improvement in their children's physiological (29.4%) and behavioral symptoms (17.5%). Almost a fifth of caregivers (19.4%) mentioned restricting foods to their autistic children, with the most commonly discussed food restrictions being dairy (9.2%) and gluten (7.2%), the interventions that do not have sufficient supporting evidence to testify their efficiency in easing autism symptoms. Caregivers restricting gluten claim they observed improved behavior (24%), intellectual abilities (15%), and speech (13%). Similar improvements were reported for dairy restriction (21%, 10%, 13%, respectively). Three quarters of caregivers (75.4%) give supplements to their children and report various improved physiological (23%) and behavioral (20%) symptoms. Given the prevalence of nutritional practices among caregivers of autistic children, caregivers must be educated to prevent interventions that are not proven to be effective in easing autism symptoms. The results of this study can also be used to educate medical personnel on caregiver motivations to help with fostering rapport with patients and shaping caregiver behaviors.

Emily Allego, Joslene Morgan, Joseph Barycki, and Melanie Simpson
Graduate Program: Molecular and Structural Biochemistry
Advisor: Joseph Barycki
Poster Number: 7

The Dynamic Duo: A Tale of Determining How Two Proteins Work Together

Glutathione (GSH) is an essential tripeptide that is responsible for maintaining redox homeostasis and is an essential cofactor in several biosynthesis and detoxification pathways. The disruption of glutathione metabolism has been linked to the progression of cancer, and neurodegenerative conditions, such as Alzheimer's. The devo synthesis of glutathione takes place through the action of two enzymes, glutamate cysteine ligase (GCL) and glutathione synthase. The rate-limiting step of glutathione synthesis is catalyzed by GCL, which is widely expressed and composed of a heterodimer. The heterodimer consists of a catalytic subunit (GCLC) and a modifier subunit (GCLM). GCLC contains all of the catalytic function of the heterodimer and upon GCLM binding, GCL activity is rapidly enhanced and is pivotal to modulating glutathione levels. However, the formation of the heterodimeric holoenzyme is not well understood and there are no determined structures of human GCLC or GCLM. Understanding this interface is critical for designing modulators of the enzyme that could impact human disease progression. Here, we have utilized the predictive power of AlphaFold and a homology model of human GCLC to design point mutations within both proteins along the proposed heterodimer interface. Previously it has been proposed that intersubunit disulfide bonds are driving holoenzyme formation, so we mutated all cysteines in GCLC and GCLM. We found that C553A mutant GCLC and C194A GCLM are compromised in its ability to form the holoenzyme, leading to decreased GSH production in yeast. In contrast, mutating C257 to an alanine in GCLC leads to stronger holoenzyme formation. These findings suggest that C553 and C194 are important for the holoenzyme, but cysteines are not the driving force of formation. Our next step is to characterize residues predicted by the AlphaFold model to determine what residues are vital at the heterodimer interface. Taken together this data will allow us to understand the dynamic interface between GCLC and GCLM and design modulators of the holoenzyme.

Abasiama-Arit Aniche, Katherine McKee, and Jackie Bruce
Graduate Program: Agricultural and Extension Education
Advisor: Katherine McKee
Poster Number: 9

Effect of Cultural Norms and Traditional Beliefs on the Lived Experiences of Women in Agriculture in Rural Communities

This study examined the effects of cultural norms and traditional beliefs on the lived experiences of women in agriculture in rural communities in Nigeria. Semi-structured interviews with rural Nigerian women and men yielded thematically examined qualitative data. The results revealed that cultural and traditional practices significantly impact the involvement, economic and social progress of women in agriculture in rural communities in Nigeria. Conservatism, patriarchy, and subsistence farming are central cultural norms and traditional beliefs in these communities. These norms and beliefs institutionalize discrimination against women, exclusion of women from decision-making, relegation of women to domestic duties, restriction of women's access to productive resources and economic opportunities, perpetuating their dependence on the men. Women's groups act as a support system because they enable women to voice their concerns in various forums. The study recommends interventions that promote gender justice and education and resource access to empower women and improve their livelihoods.

Rebekah Brown
Graduate Program: Food Science
Advisor: Jonathan Allen
Poster Number: 24

Gate-To-Gate Life Cycle Analysis of Processed Sweet Potatoes: Identifying Gaps and Mitigation Strategies

From the leaves to the root, the sweetpotato holds economic potential in the food systems of the United States as a nutrient-dense superfood used on its own or as a value-added derivative in other consumer products. As the utilization of the sweetpotato is expanding to more markets; processing technologies, shelf stability, and valorization approaches for the crop are also changing. However, comparative processing models measuring sustainability are scarce and their relation to environmental impact factors is a major gap in the literature. The purpose of the study is to conduct a gate-to-gate comparative life cycle assessment (LCA) measuring the inputs and outputs of a variety of sweetpotato consumer products such as canned, par-fried, chips, flour, microwave-processed, weaning foods, etc. to determine the environmental impact and make suggestions for waste reduction, valorization, and process efficiencies. The study follows the ISO Standard 14040 Environmental Management, LCA, Principles and Framework which begins by defining a goal and scope of the LCA, inventory analysis, impact assessment, and interpretation. Data collection is primary data through direct measurement or using secondary data through publications in peer-reviewed literature. The unit flows of the system are modeled using OpenLCA and established environmental flows in databases such as Ecoinvent and Agri-Footprint. Environmental characterization factors are provided through the EPA's Tool for Reduction and Assessment of Chemicals and Other Environmental Impacts (TRACI) to determine processes that contribute most to the impact categories such as ozone depletion, acidification, climate change, and human health impacts. The results are expected to show hot spots in transportation, packaging, and production choice as they are anticipated to contribute most to emissions and long-term waste reduction. The research also points to significant gaps in the literature regarding sweetpotato growing conditions, processing methods, and how climate change may impact the environmental footprint of this nutrient-dense commodity.

Chloe Brubaker
Graduate Program: Food Science
Advisors: Marvin Moncada, Bill Aimutis and Dana Hanson
Poster Number: 25

Turning Challenges into Value: Utilizing Air Classification to Improve Sustainability of Pulse Proteins

As interest in plant-based foods has increased among consumers, pulses have received particular attention from the food industry for their naturally high protein levels, bioactive compounds, agronomic benefits, and functional properties. Most commonly, pulses are milled, defatted, and protein extracted. Most traditional extractions involve use of solvents, alkalinization/acidification agents, and drying. These popular methods present several challenges, including nutrient loss, functionality degradation, complex processing, and high cost. In this study, the under-utilized technology of air classification was evaluated to produce highly functional chickpea (Cicer arietinum L.) protein concentrates. Air classification is a commercially scalable dry fractionation method where solvent use and drying needs are eliminated. This sustainable process retains native protein structure, retains bioactive compounds, and allows for valorization of the entire pulse. This technique is underutilized largely due to its limitations regarding protein purity. This study aims to achieve a comprehensive understanding of air-classified pulse protein functionality to optimize its value in food formulation. Air-classified chickpea protein concentrate (ACPC) was produced from commercially defatted chickpea flour. ACPC functionality was compared against commercially available chickpea protein concentrate (CPC) and isolate (CPI). Although it is generally accepted that ACPC boasts superior functionality to its traditional counterparts, the performance of ACPC in extrusion processing has remained undefined by the food industry. Cornerstone to high protein plant-based food production, extrusion improves digestibility and linearizes proteins to form fibrous structures similar to muscle tissue. Preliminary data shows superior functionality of ACPC vs. its traditional counterparts (as previously demonstrated by pulse protein literature). Lower protein materials (ACPC and CPC) are expected to outperform CPI in extrusion processing due to functionality benefits from endogenous starch and native state proteins. Extruded chickpea products will be further evaluated in a "meat analogue nugget" style food model system and compared to similar in-market products.

Taylor B. Burrell and Stephanie H. Ward
Graduate Program: Animal Science
Advisor: Stephanie H. Ward
Poster Number: 27

Effects of Trace Mineral Source on Growth and Performance of Holstein Calves Raised in Automated Milk Feeder

The objective of this study was to evaluate the effect of trace mineral source fed in milk replacer on the growth and performance of Holstein calves raised in an automated milk feeder (AMF; DeLaval CF1000+, DeLaval, Tumba, Botkyrka, Sweden). At birth, calves were assigned to either 1) Control, (CON, n =20) 28% Fat, 20% Protein milk replacer with an inorganic trace mineral blend or 2) Glycine Chelated Mineral, (GLY, n = 20) the same milk replacer with an organic trace mineral. Milk replacer was blended to provide 50 ppm of Mn and Zn,10 ppm of Cu, and 100 ppm of Fe. After birth, calves were placed in hutches for 7d then transferred into their respective treatment pens until weaning (56 d ± 1.2). Daily intake of starter feed and milk replacer were recorded by the AMF. Growth parameters were measured bi-weekly during the pre-weaning phase and weekly for three measurements following weaning. Blood was collected bi-weekly from birth until the final day on the trial and was analyzed for trace mineral concentrations. The MIXED procedure of SAS (Cary, NC) was used to evaluate the fixed effects of treatment, time (day or week), sex and interactions on daily milk and feed intake, growth parameters and blood trace mineral concentrations. The GLM procedure of SAS (Cary, NC) was used to evaluate the fixed effect of treatment and sex and interactions on average daily gain and feed efficiency. Significance was declared at $P < 0.05$ and trends at $P < 0.10$. Means were separated by LSD. Calves raised on AMF fed GLY had similar growth and performance data as calves fed on CON, with the exception of a greater overall feed efficiency in CON calves.

Nicole L. Burroughs[1], Rodrigo R. Granjel[2], and William K. Petry[3]
Graduate Program: Microbiology[1]; Basque Centre for Climate Change (BC3)[2]; Plant and Microbial Biology[3]
Poster Number: 28

Testing Coexistence Theory to Explain the Maintenance of Diversity in Microbial Communities

Microbial communities often contain strikingly high diversity, with many ecologically-similar taxa appearing to stably coexist. For almost a century, coexistence theory has been able to predict whether a pair of microbial taxa will coexist or whether one will competitively exclude the other. Yet explaining the diversity of even modestly more diverse microbial communities has remained out of reach—our tools for analyzing coexistence are almost exclusively limited to interactions between only two species. Recent theoretical advancements have made it feasible to determine stable community diversity and composition for multi-species communities, conceivably increasing our ability to accurately reflect the complexity of natural systems. Our objective was to test multi-species coexistence theory with experimental data on the interactions between protist species isolated from the fluid-filled leaves of the pitcher plant, Sarracenia purpurea. We parameterized a multi-species Lotka-Volterra model using laboratory growth and competition assays between all protist species pairs, determined the stable community using invasion graph analysis, then tested the prediction by assembling the predicted community and verifying that all members could coexist. Our preliminary results confirmed the ability of classic coexistence theory to explain the outcome of pairwise competition. Moreover, we were able to parameterize a multispecies competition model to predict composition and abundance of a three-species community at equilibrium, providing a first empirical test of the emerging coexistence theory for diverse communities.

Esdras M. Carbajal Melgar
Graduate Program: Crop Science
Advisor: Susana R. Milla-Lewis
Poster Number: 31

Optimizing Tissue Culture Protocols in Warm-Season Turfgrass Species for Genetic Engineering Applications

Genetic engineering holds immense promise for enhancing breeding efforts in important crops. In turfgrass, it offers opportunities for improved stress tolerance, disease resistance, and overall turf quality. However, the successful implementation of genetic engineering techniques relies heavily on the development of efficient tissue culture protocols. In 2022, the Turfgrass Breeding and Genetics Program at NC State University initiated efforts to optimize tissue culture methodologies tailored to warm-season turfgrass species to ensure the reproducibility and scalability for genetic engineering applications. In this study, we optimized the efficiency of callus formation and organogenesis in zoysiagrass. In 2023, zoysiagrass seeds were transversally cut and cultured in MS media in combination with four levels of synthetic auxins [1mg, 1.5mg, 1.75mg, and 2mg] and four levels of cytokinins [0 mg, 0.01 mg, 0.05 mg, and 0.1 mg] for a total of 16 treatments. The combination of 1.5 mg auxin with 0.05 mg cytokinins was the best treatment with a 67% success rate for callus formation. Meanwhile, the treatments with the lowest concentration of auxin [1 mg] and highest concentration of cytokinins [0.1 mg] exhibited the worst performance with only an 11% success rate. The effect of MS media supplemented with 1 mg 6BA with 0.2 NAA and three levels of gibberellins (0 mg, 0.1 mg, and 0.5 mg) on organogenesis rates on matured callus of zoysiagrass was also evaluated. Statistical analysis showed differences among treatments in root and shoot formation per callus. A total of 1,387 plants were recovered from all treatments. Protocols that successfully induced somatic embryogenesis in zoysiagrass were identified. In the future, this research will explore innovative gene delivery mechanisms and genome-editing tools that will contribute to creating genetically modified turfgrasses with improved agronomic traits.

Samantha Carroll, Shannon Henriquez Inoa[1], Rong Yin[2], Amanda Cardoso[1], and David Suchoff[1]
Graduate Programs: Crop Science[1]; Wilson College of Textiles[2]
Advisor: David Suchoff
Poster Number: 33

Evaluating Plant Population Impacts on Fiber Hemp Yield and Quality

Demand for local fiber hemp (Cannabis sativa L.) by textiles and nonwoven industries is not being met. Although hemp is an ancient crop, farmers need modern agronomic recommendations to meet this strong and growing demand. Fiber hemp shows a high degree of phenotypic plasticity; low plant populations result in thick, woody stems, whereas high plant populations lead to thin stems with better fiber quality. Seeds represent the highest input cost for producers. Consequently, a tension exists between planting at a high rate to produce appropriate stem diameter and fiber quality, and minimizing crop inputs. We examined five plant populations (from 300,000 to 1.5 million plants/ac) to determine the optimal plant population for fiber yields and quality while also maximizing farmer profit. We measured stem height and diameter weekly throughout the season and at harvest to monitor the plastic response. Harvest measurements indicated a reduction in final stem height as well as stem diameter in response to increasing plant densities. Additionally, as plant density increased, so did plant mortality (self-thinning). Surprisingly, final stands appeared to plateau at approximately 750,000 plants/ac. We have found that higher planting densities result in shorter, thinner stems with higher amounts of harvestable stems as well as higher self-thinning rates. Processes to uncover the relationship of our plant populations in respect to their final bast fiber yield and quality are currently underway.

Christina Chapman
Graduate Program: Nutrition
Advisor: Natalie Cooke
Poster Number: 35

Learning by Example: A Qualitative Assessment of Undergraduate Nutrition Science Students' Career-Related Learnings from Alumni Videos

Employability skills, encompassing cognitive, interpersonal, and applied abilities, have undergone a historical evolution. Educational institutions play a pivotal role in integrating employability skills into curricula through experiential learning, project-based learning, and collaborative activities. By aligning educational experiences with industry demands, these interventions bridge the gap between academic preparation and professional expectations, fostering a workplace equipped with the skills, knowledge, and confidence needed for successful careers. The purpose of this project is to determine themes in students' career-related Packback discussion posts and responses in order to understand the impact of a course-based approach to career preparation. The Packback assignments require students to watch video interviews from alumni from the nutrition science undergraduate program, identifying key themes, and formulating questions that integrate information from related articles, fostering collaborative discussion among peers. Researchers utilized a secondary data collection and extraction method with qualitative thematic analysis to find patterns and themes using inductive coding. Participants included students enrolled in NTR 302: Introduction to Nutrition Research, Communication, and Careers from seven semesters (Fall 2019 to Spring 2022). For each of the seven semesters, two participants were randomly selected to create a subsample of data, which included 14 participants in total. This was done to ensure that saturation was not reached before all seven semesters were analyzed. Four subsets (n=56) of data, which consisted of 572 questions and 1,109 responses were analyzed. The following preliminary themes emerged: (1) nutrition undergraduate students are concerned about their success in the "real world;" (2) nutrition undergraduate students seek strategies to become a standout applicant; (3) nutrition undergraduate students have limited awareness of career opportunities with a nutrition degree; and (4) there are a variety of methods to build undergraduate students' Career Decision Self-Efficacy. The results highlight the benefit of integrating reflective opportunities into students' career development within the classroom setting. Advisors and instructors can use this information to offer targeted guidance, bridging the gap between academic preparation and industry demands, ultimately enhancing students' preparedness for the workforce.

Hyunjun Choi
Graduate Program: Animal Science
Poster Number: 37

Effects of Dietary Supplementation of Myristic Acid on Jejunal Mucosa-Associated Microbiota, Intestinal Health, and Growth Performance of Nursery Pigs

The study aimed to investigate the effects of myristic acid on jejunal mucosal microbiota, intestinal health, and growth performance of nursery pigs. Thirty-six newly weaned pigs (6.6 ± 0.4 kg BW) were assigned to 3 treatments (n = 12) using a randomized complete block design with initial BW and sex as blocks. Pigs were fed for 35 d in 3 phases (10, 10, and 15 d, respectively). Treatments were 1) NC: basal diet; 2) PC: NC + 0.03% bacitracin in all phases; and 3) MA: NC + myristic acid compound at 0.20% in phases 1 and 2 and 0.12% in phase 3. Growth performance and fecal score were measured for each phase. Jejunal mucosa, jejunal tissues, and ileal digesta were collected. The PC increased ($P < 0.05$) the relative abundance (RA) of Lactocillus sp, Bifidobacterium boum, and Mitsuokella multacida compared with the NC. The MA increased ($P < 0.05$) RA of Bifidobacterium dentium and Megasphaera sp compared with the NC. The PC increased ($P < 0.05$) Simpson index and the MA increased ($P < 0.05$) Chao1, Shannon, and Simpson indexes compared with the NC. The PC tended to decrease IL-8 ($P = 0.053$) and protein carbonyl ($P = 0.075$) in jejunal mucosa than the NC. The MA tended to decrease IgG ($P = 0.051$) and IL-8 ($P = 0.090$) in jejunal mucosa than that of the NC. Compared with the NC, the PC improved ($P < 0.05$) ADG in phase 1 and ADFI in phase 2, whereas the MA improved ($P < 0.05$) ADG and ADFI in phase 3. The MA tended to improve ADG ($P = 0.072$) and ADFI ($P = 0.053$) compared with the NC in the entire period. In conclusion, supplementation of both bacitracin and myristic acid improved the intestinal health and growth performance of nursery pigs.

Magdalina J. Cummings[1], Sudikshya Paudel[1], River Price[1], Steven L. Young[2], and Xiaoqiu Wang[1]
Graduate Programs: Animal Science[1]; Department of Obstetrics and Gynecology, Duke University School of Medicine[2]
Advisor: Xiaoqiu Wang
Poster Number: 43

Uterine Ablation of Tet Methylcytosine Dioxygenases Impairs Endometrial Decidualization and Placentation

DNA methylation heightens with reproductive aging, particularly in the aged uterine endometrium during pregnancy. The ten-eleven translocation (TET) enzyme family (TET1, TET2 and TET3), responsible for DNA demethylation via iterative oxidization, is downregulated in the endometrium of both physiologically aged and genetically aged mouse models. Thus, we hypothesize that the two highest expressed Tet genes, Tet2 and Tet3, are critical for maintaining proper DNA methylation during pregnancy and that the uterine ablation of these Tet genes may lead to compromised processes akin to those observed in aged uteri. To investigate the functional role of TET2 and TET3 in the uterus, mice carrying the Tet2f/for Tet3f/fallele were bred to Pgrcre/+ mice to generate Pgrcre/+Tet2f/f (Tet2d/d) and Pgrcre/+Tet3f/f (Tet3d/d) mice. The 6-month breeding trial indicated a significant reduction ($P<0.0001$) in total pups born, total pups per litter, and number of litters to both conditional knock out (cKO) mothers (i.e., Tet2d/d and Tet3d/d; n=6) as compared to control mothers (n=6). Interestingly, these cKO mothers showed decreases ($P<0.01$) in litter size from their 1st pregnancy to their last. Although the number of implantation sites was not affected by Tet2 or Tet3 deletion, these females displayed decreases ($P<0.001$) in the decidual bulb weight as well as the size of the labyrinth and junctional zone at gestational day (GD) 9.5, suggesting decidualization defects. In addition, the ability of the endometrial stromal cells to undergo an artificially induced decidualization was severely compromised ($P<0.01$) in Tet2d/d uteri. At GD 3.5, Tet2d/d uteri exhibited dysregulated progesterone and estrogen signaling and heightened DNA methylation. To compensate, Tet1 and Tet3 expression levels rise in the Tet2d/d uteri. Thus, we generated a double cKO mouse of Tet2 and Tet3 gene to further explore the relationship between the members of the Tet family. The Tet2d/dTet3d/dfemales were infertile with failed blastocyst implantation. These novel findings suggest that TET deficiency impairs endometrial receptivity and stromal cell decidualization, leading to defective placentation and pregnancy loss. Future studies will investigate the epigenetic mechanisms regulating uterine aging via both enzymatic and non-enzymatic function of TETs.

Leah Dexter-Boone, Lisa Dean, and Lucy Caldwell
Graduate Program: Food Science
Advisors: Lisa Dean and Haotian Zheng
Poster Number: 46

Sensory Attributes and Chemical Composition of Raw and Roasted Peanut Seeds of Runner, Spanish, and Valencia Market-Types

The roasted peanut flavor is a contributing factor to the purchasing decisions of consumers for peanut products. In 2022, the production value of the peanut crop was 1.5 billion dollars.With the issue of climate change increasing, the peanut crop may lose productivity in regions at risk for droughts and rising temperatures. New heat tolerant and drought resistant peanut cultivars are under development, but they also need to have the typical sensory and chemical profiles of current ones. The objective of this research was to establish baseline values for total fat, total protein, and sugars of raw and roasted peanut seeds of current cultivars of the runner, Spanish, and Valencia market-types, and sensory profiles on the roasted peanuts. Sugars, total protein, and total oil were measured in different sizes of raw and roasted peanut seeds (N = 68) in triplicate at a minimum. Roasted peanut pastes were evaluated in triplicate by a Spectrum MethodTM trained panel (N = 6-7). A mixed model and Tukey's test were used to separate the means of the chemical data and sensory attributes. Principal Component Analysis (PCA) was used to visualize the discrimination among the samples based on the overall sensory profiles. Total protein and total oil ranged from 22.90-25.43 g/100g (wet weight (ww)) and 47.56%-54.86% (ww) respectively. Six sugars were quantified, and total sugar was 29.62-38.33 mg/g (ww). PCA reduced twelve peanut sensory attributes to two principal components (PCA1 and PCA2), which explained 33.8% and 22.9% of the variation. The sensory attributes displayed in the two principal components were roasted peanutty, sweet aromatic, dark roast, raw beany, woody/hully/skins, cardboardy/stale, plastic chemical, fruity-fermented, sweetness, bitterness, astringency, and ashy. Understanding the flavor and chemical profiles of the current market-types are key components to evaluate climate change resistant cultivars for acceptable roasted peanut flavor and nutrient levels.

Hector Fajardo[1], Shin-Ah Lee[2], Arghajeet Saha[3], Elise Morrison[2], Rebecca Muenich[3], Natalie Nelson[1], and Daniel Obenour[4]
Graduate Programs: Biological and Agricultural Engineering[1]; Environmental Engineering Sciences, University of Florida[2]; Biological and Agricultural Engineering, University of Arkansas[3]; Civil, Construction, and Environmental Engineering[4]
Advisors: Natalie Nelson and Daniel Obenour
Poster Number: 53

Nutrient Source Apportionment Through Process-Based Modeling and Isotopic Source Tracing in a Sparsely Monitored Agricultural Watershed.

Understanding nutrient source apportionment at a watershed scale is important because it helps us more effectively design and apply integrated watershed management strategies. Particularly in agriculturally-intensive areas, understanding the relative importance of fertilizer, animal manure, and wastewater treatment plant discharge can inform nutrient loss mitigation practices. Process-based models are used to characterize nutrient cycling, sources and transport processes, but they are often parameterized without empirical measurements of dominant nutrient sources. Similarly, multiple stable isotopes can provide information on the origin and proportion of a nutrient in receiving waterways, but these measurements do not directly provide information on transport pathways linking nutrient sources and downstream waters. Therefore, nonpoint source pollution dynamics could be better understood through the comparison of both techniques, mechanistic modeling and multiple stable isotopes. In this study, we used the Soil and Water Assessment Tool (SWAT) model to characterize nitrogen and phosphorus sources in the Kendrick Creek watershed in eastern North Carolina, a rural area dominated by field crop production. In addition, we collected water samples for multiple isotope analysis to characterize potential nutrient sources and attribution in downstream waters. The analysis was also informed by monthly flow data (three sites) and water nutrient concentrations (five sites) from different tributaries in the watershed. We present a comparison of source attribution results obtained by SWAT versus the stable isotopes and discuss their relative advantages and limitations. For SWAT, nutrient sources included fertilizer, animal manure, and wastewater treatment plant discharge, which were apportioned based on multiple model runs under varying hypothetical loading conditions. For the stable isotope data, a Bayesian mixing model was used for empirical nutrient source apportionment. The contrast of mechanistic and empirical methods for nutrient source attribution helps us understand nutrient dynamics while reducing uncertainties at the watershed scale. This will improve our watershed management and planning through the identification of areas and moments with higher risk of nutrient export.

Jillian C. Ford
Graduate Program: Agricultural and Extension Education
Advisors: Misty D. Lambert, Travis D. Park, Joseph Donaldson, and Barbara Fair
Poster Number: 57

School-Based Agricultural Education Teacher Perceptions of Supervised Agricultural Experience

School-Based Agricultural Education (SBAE) consists of three components: Supervised Agricultural Experience (SAE), leadership development (FFA), and classroom instruction. SAE is the work-based learning component and is often believed to be the least implemented of the three. To address previously indicated barriers of SAE implementation and better serve all students, the National Council for Agricultural Education created a committee that established the SAE for All model in 2015, but little is known about its diffusion among SBAE teachers. This descriptive survey sought to determine SBAE teachers' perceptions of SAE. The Qualtrics survey was disseminated by state agricultural education leaders to SBAE teachers in 34 states, garnering 505 usable responses. Participants were asked to indicate their level of agreement to 21 statements about SAE on a five-point likert scale from (1) strongly disagree to (5) strongly agree. Participants agreed that they believed SAE was important and should be a graded component of classes. Participants also agreed that there were still barriers to implementation, especially lack of time due to large class sizes, additional responsibilities and lack of resources outside of school for students. Participants indicated that they were providing more SAE opportunities for students on campus. To support the diffusion of SAE for All across the country, state and national SBAE stakeholders could offer concrete examples of SAE for All implementation, clearer guidance for balancing supervising student SAE projects with other responsibilities, and consider creating funding for SBAE teachers to continue to add SAE opportunities on school campuses to create equitable opportunities for all students. Teacher educators should continue to teach the basics of SAE for All as well as providing pre-service teachers with tools to effectively implement SAE in their classrooms like scenarios related to supervising student projects or communicating the value of SAE to administrators.

Susmita Gaire, Xingwang Yu, Beatriz T. Gouveia, Esdras M. Carbajal, Robert E. Austin, and Susana R. Milla-Lewis
Graduate Program: Crop and Soil Sciences
Advisor: Susana R. Milla-Lewis
Poster Number: 58

Validating Genomic Regions Associated with Winterkill in a 'Raleigh' St. Augustinegrass F2 Mapping Population

Despite the favorable traits like shade tolerance and low input requirements, cultivating St. Augustinegrass, a warm-season perennial turfgrass, in transitional climates like North Carolina is challenging due to its poor freeze tolerance. In addition, climate change-induced winter temperature fluctuations worsen adaptation and survival by affecting acclimation and de-acclimation processes. Genetic diversity within the St. Augustinegrass germplasm pool offers the potential for enhancing freeze tolerance, nonetheless, these resources have yet to be fully exploited in breeding programs. Previous studies identified quantitative trait loci (QTL) associated with winterkill in the 'Raleigh' × 'Seville' mapping population. However, these genetic regions need validation in different populations and environments before they can be used in marker-assisted breeding. This study aims to discover and confirm QTL linked to winterkill in an F2 population of the freeze-tolerant 'Raleigh' cultivar. The 184 progenies and four controls (commercial cultivars 'Raleigh', 'Seville', 'Palmetto', and 'CitraBlue') were planted in a replicated field trial at the Upper Mountain Research Station (Laurel Springs, NC) in August 2021, July 2022, and May 2023. Phenotypic data on percent green cover (PGC), winterkill, and fall color were collected visually. The percent green cover was also evaluated through analysis of digital images collected with an unmanned aerial system (UAS). A strong correlation (r=0.859) was found between UAS-based and visual PGC. The genotype by environment interaction was highly significant for all traits, indicating the differential effect of year on genotypes for our traits of interest. A genetic linkage map was constructed using genotype by sequencing-derived single nucleotide polymorphism markers. Subsequently, QTL associated with winterkill were identified and evaluated for overlap with previously identified QTL. This study aims to provide valuable insights into improving freeze tolerance in St. Augustinegrass, ultimately enhancing its adaptability for transitional zones and colder climates.

Cassandra Gluck and Shannon Pratt-Phillips
Graduate Program: Animal Science
Advisor: Shannon Pratt-Phillips
Poster Number: 61

Effect of Iron Supplementation on Ferritin, Hemoglobin and Hematocrit Concentrations in Horses

According to the National Research Council's Nutrient Requirements of Horses, a 500 kg horse requires 400 mg of iron daily. The purpose of this study was to determine the effects of iron supplementation on parameters of iron and glucose metabolism. 12 mixed-breed mature horses that had been previously kept on pasture were used. Horses were housed individually and fed approximately 2% of their body weight of grass hay and an iron-free vitamin-mineral supplement, consuming an average of 600 mg of iron daily (Hay Phase). After 28 days, jugular venous samples were collected and analyzed for serum ferritin (Fer), hematocrit (Hct) and hemoglobin (Hb). Horses were then assigned to a control treatment where horses continued on the same hay diet (CTRL; n=4), or an iron-supplemented diet (IRON; n=8), where horses were given a daily oral iron supplement. After an additional 28-d, blood samples were taken (Supplement Phase). Analysis of variance for repeated measures was performed to determine the effect of treatment (IRON, CTRL) and time (Phase) on Fer, Hct and Hb. Correlation analysis determined the relationship between Fer with Hct and with Hb. While there was no effect of iron supplementation, both Hct and Hb decreased over time ($P<0.05$) though values were still within reference ranges (Hct: 26.6-44.2%, Hb: 10.1-16.4 g/dL; Hct: Hay: 36±4.8%; Supplement: 36.3±3.9%; Hb: Hay: 12.5±1.5 g/dL; Supplement: 12.6±1.4 g/dL). Of general interest is the overall high ferritin concentrations in all horses (445.7±166.3 ng/ml) compared to published reference ranges for mature horses (43-261 ng/ml) following the hay phase. There was also a moderate but significant relationship between Fer and Hct ($P=0.012$; Pearson $r=0.69$) and Hb ($P=0.013$; $r=0.69$) following the hay phase. Findings suggest that relatively high intake of inorganic iron had a small but significant impact on body iron status, and no effect on hemoglobin or hematocrit.

Vamery González-Hernández and Alonso Ramírez
Graduate Program: Biology
Advisor: Alonso Ramírez
Poster Number: 62

Assessing the Effects of Urbanization on Organic Matter Decomposition Using Cotton Strip Assays in a Tropical Watershed, Puerto Rico

Urbanization alters the physical and chemical environment of stream ecosystems, having major negative impacts on ecosystem function. Organic matter decomposition in urban streams is affected by altered flow regimes and warm temperatures associated with urbanization. Our objective was to assess how urbanization affects organic matter decomposition in a tropical watershed using cotton strips assays, which reduces variability in leaf litter quality and vulnerability to flashy streams. We studied the Río Piedras watershed, a highly urbanized system in the San Juan Metropolitan area, Puerto Rico. We deployed cotton strips in six study streams, forming an urban gradient (~12-77% impervious cover). We placed the strips in three pools per stream, had three collection dates, and measured the loss of tensile strength and microbial respiration rates. Temperature was measured every hour using HOBO sensors. Our urban gradient reflects a temperature gradient from highest temperatures in the most urbanized areas (35°C) to lowest in least urbanized (24°C). While we did not see any relation between the cotton strips' tensile strength loss and temperature, we did see a relation with the watershed variables (i.e. impervious surface). The cotton strips tensile strength loss did not show any relation to microbial respiration measurements. Our study shows how urbanization alters organic matter decomposition rates and microbial activity in urban streams. Urbanization effects were highly variable within each stream, highlighting the importance of assessing urban effects within and among streams.

Brianna Haynes, Gina Fernandez, and Penelope Perkins-Veazie
Graduate Program: Horticultural Science
Advisors: Gina Fernandez and Penelope Perkins-Veazie
Poster Number: 71

Multivariate Analysis of Fruit Composition Diversity Among the North Carolina Strawberry Germplasm Collection

Genetic diversity in fruit composition is fundamental for the success and resilience of breeding programs. In this study, 16 commercial strawberry (Fragaria x ananassa) cultivars and 252 genetically unique lines from the North Carolina strawberry breeding program were evaluated for fruit composition. In 2022, mature fully-red strawberries of these lines were harvested from a greenhouse at Piedmont Research Station (Salisbury, NC) between April and June. At least 15 fruit per genotype were collected, stored at -20ºC, and thawed to determine soluble solids content (SSC), titratable acidity (Tacid), and pH. Strawberry juice was extracted with acidified methanol (0.1 ml/1.6 ml total) and supernatants used to determine monomeric anthocyanin content (TMAC) using the pH differential method on a microplate reader. Multivariate agglomerative hierarchical clustering utilizing Euclidean distance and Ward.D2 cluster method was used to determine genetic relationships among the genotypes. Strawberry values ranged from 5.1 to 16.4% for SSC, 0.31–2.01% for Tacid, 3.11–4.22 in pH, and 12.18 to 158.67 mg pelargonidin 3-glucoside equivalents/100g fwt TMAC. No significant correlations among the fruit composition variables were found. Four distinct clusters in the strawberry germplasm were formed based on overall fruit composition profiles of each genotype. The majority of commercial cultivars were in Cluster 1, and fruit were lowest in both %SSC and TMAC. Cluster 2, the largest cluster, contained 116 genotypes and fruit in this cluster exhibited the highest TMAC levels. Highest fruit pH and %SSC and lowest %Tacid were found in fruit from Cluster 3 (73 genotypes). Lastly, Cluster 4, consisting of 35 genotypes, was characterized by having the highest average %Tacid values and lowest pH values of all clusters. The variability and groupings of genotypes will help guide future breeding decisions regarding improved fruit composition attributes.

Edmaritz Hernandez Pagan[1], Kanjana Laosuntisuk[1], Allison Haynes[1], Laura Dale[1], Michael Kudenov[2], and Colleen Doherty[1]
Graduate Programs: Biochemistry[1]; Electrical and Computer Engineering[2]
Advisor: Colleen Doherty
Poster Number: 73

Bioengineering a Plant System to Sustainably Harvest Rare Earth Elements (REE) from Secondary REE Sources

Rare Earth Elements (REE) (i.e., lanthanides, yttrium, and scandium) are critical for developing modern electronics, green technologies, and defense systems. However, due to their dispersed nature in the earth's crust, frequent co-occurrence with radioactive materials, and similar chemical properties, acquiring and purifying REEs is costly and environmentally damaging, limiting access to these crucial elements. Plants could be resources for bioengineering REE mining systems to recover REEs from secondary sources (e.g., coal combustion products and industrial byproducts). While there is limited information on how REEs impact plants at a cellular and molecular level, certain plants with high REE tolerance and hyperaccumulation have been identified. The objectives of this investigation are to (1) characterize the REE tolerance and accumulation in aerial tissue of REE hyperaccumulator plants, specifically, Phytolacca and Lemna species (2) identify REE Binding Proteins and Peptides from REE tolerant and hyperaccumulator plants to increase REE uptake and selectivity to high-value REEs, and (3) develop an imaging system to enable in vivo high-throughput detection of REE uptake in plants. Candidate proteins and peptides are being identified from known REE-binding protein orthologs from REE-tolerant and hyperaccumulator plants and the transcriptional response of these plants when grown with REE-containing media. The luminescent properties of REEs enable the in vivo detection and the identification of REE-binding proteins and peptides through metal binding tests. ICP-MS measurements are then implemented to confirm the REE accumulation in the plant tissue quantified through the imaging system. The bioengineered plant system will facilitate the recovery of targeted REEs from secondary REE resources, increasing the availability of these critical elements and repurposing industrial waste in an environmentally sustainable manner.

Blake Horton
Graduate Program: Biochemistry
Poster Number: 74

The Disruption of the Arabidopsis Thaliana Circadian Clock under Simulated Microgravity

For the future long-term spaceflight, it is crucial to understand plant growth and the response to altered gravity. In microgravity, fluid dynamics is altered, and biochemical processes that depend on processes like diffusion may also be disrupted. One biochemical process that is highly dependent on precise kinetics is the circadian clock. This endogenous timekeeping mechanism is responsible for the precise coordination of a plant's internal biochemical and molecular processes with the external environment that surrounds it. The plant's anticipation and response to the changes in its enviornment tied to the 24-hour day/night cycle are beneficial for optimal performance and survival. The circadian clock's tightly regulated network of transcriptional and translational feedback loops rely on precise diffusion and kinetics making it an ideal model for styuding the effects of microgravity on biological processes. Therefore, we wanted to ask whether reduced gravity affects the circudian clock? To examine the effect of microgravity on the circadian clock, we utilized the Randon Positioning Maching (RPM) to simulate microgravity. A time course was carried out utilizing the RPM to harvest Arabidopsis root and shoot samples every 2 hours or 48 hours, allowing the observation of the transcriptional response of circadian genes to simulated microgravity. RNA isolated from shoot tissue from each time point was used for transcriptional analysis to observe the effect of mircrogravity on the core circadian clock genes and downstream clock-related targets. RNA-seq analysis of this time course provides a comprehensive observation of the molecular effects of the plant's response to simualated microgravity. We observe disruption of the normal rhythmic expression of core circadian clock genes and downstream clock-related targets. RNA-seq anaylsis of this time course provides a comprehensive observation of the molecular effects of the plant's response to simulated microgravity. We observe disruption of the normal rhythmic expression of core circadian clock components such as CCA1 and LHY, which exhibit an altered phase of expression. Consequently, downstream clock controlled genes also show disruption expression. Transcriptome analysis shows a global shift in circadian rhythmicity in response to simulated microgravity.

John Ivarsson[1], Abby Bennett[1], Francesca Ferrara[2], Renee Strauch[1], Andrea Vallase[3], Alessandra Pecorelli[3], Mary Ann Lila[1], and Giuseppe Valacchi[3,4,5]
Graduate Programs: Food, Bioprocessing, and Nutrition Sciences, Plants for Human Health Institute1; Department of Chemical, Pharmaceuticals and Agricultural Sciences, University of Ferrara[2]; Department of Environmental and Prevention Sciences, University of Ferrara[3]; Animal Science, Plants for Human Health Institute[4]; Department of Food and Nutrition, Kyung Hee University[5]
Advisors: Giuseppe Valacchi and Mary Ann Lila
Poster Number: 79

Wild Blueberry Gut-Derived Metabolites Influence on UV-Induced Cutaneous OxInflammation and Degradation Using Novel Ex-Vivo Co-Culture Model of Human Skin Explants and Endothelial Cells

As the first line of defense to our environment, the skin is equipped with a variety of physiological mechanisms to prevent oxidative damage from outdoor stressors. With consistent exposure to the environment, understanding ways to augment our skin defenses is paramount in protecting from premature aging. In this study, we investigated the ability of five dietary phenolic metabolites, derived from blueberry consumption, to successfully defend the skin from UV light exposure through a novel ex-vivo co-culture model of human skin explants and endothelial cells. Skin explants, in transwell inserts, were exposed to UV, and subsequently returned to endothelial cells with or without metabolite treatments. Co-culture treatment with the bioactive metabolites at physiological concentrations (hippuric acid 3000nM, isoferulic acid 1000nM, salicylic acid 130nM, benzoic acid 900nM, a-hydroxyhippuric acid 400nM) was able to prevent UV induced cutaneous damage. Specifically, the pretreatment was able to reduce skin lipid peroxidation end product 4-hydroxynonenal, and pro-inflammatory enzymes, cyclooxygenase 2 and NADPH oxidase 4. Furthermore, pretreatment with the metabolites prevented UV-induced release of inflammatory cytokines such as IL-1ß and IL-8 as well as, the release of nitric oxides. In addition, the metabolites showed an impressive ability to prevent the loss of cutaneous structural proteins including involucrin and collagen 1. Of note, endothelial cells cultured with UV exposed explants exhibited increased oxidative stress demonstrated by heme oxgenase-1 up-regulation which was significantly prevented in the metabolite treated models. These findings highlight the ability of dietary polyphenol metabolites to aid and supplement cutaneous defenses against environmental pollutants. In addition, the study proposes an ex-vivo model of studying the role of dietary metabolites in cutaneous physiology and environmental endothelial dysfunction.

Julia Janson
Graduate Program: Soil Science
Advisor: Matt Ricker
Poster Number: 82

Impacts of Saltwater Intrusion on Coastal Soil Carbon Stocks and Greenhouse Gas Emissions

Climate change is driving sea level rise at unprecedented rates and is being further compounded by the post-glacial subsidence of coastal lands. As a result, counties along the Inner Banks of North Carolina are experiencing increasing levels of soil salinization due to saltwater intrusion (SWI). Additionally, in the past much of the Inner Banks was occupied by wetland ecosystems that have been ditched and drained to create the fertile farmlands known today. Because of the history of the region, many soils remain rich in organic matter, with carbon percentages regularly measuring 5% or more, despite continued agricultural use. Currently, coastal soils undergo nuisance flooding by saltwater one to two times per year as the water is pushed back up the ditches and onto the fields by storm events. Over the next two decades, flooding frequency is expected to increase to an average of 10 inundation events per year. The impacts of SWI and salinization on soil properties and carbon have been studied in coastal wetlands, marshes, and grasslands, but croplands have often been overlooked. In this study, we wanted to understand how SWI impacts soil properties from initial exposure through stages of chronic flooding. To do this, we sampled carbon-rich soil from fields that have not experienced SWI and exposed them to controlled flooding events with saltwater from the Pamlico Sound. Soils were flooded ten times over a ten-month period and were monitored before and after flooding for greenhouse gas emissions using a Picarro analyzer. Sacrificial soil samples were taken after every other flood event to observe changes in soil physical and chemical properties throughout the experiment. Through this, we were able to track a decrease in soil carbon content and increased levels of CO2 emissions from columns immediately after flooding events. These findings are critical for carbon modeling and informing future soil management practices through the continued threats of climate change and sea level rise.

Kristina Jones
Graduate Programs: Biological and Agricultural Engineering
Advisor: Mahmoud Sharara
Poster Number: 85

Cost Benefit Analysis of a Novel Nitrogen Management System in Swine Production Farms

Ammonia (NH3) released on swine farms impacts swine growth performance, caretaker health, and local air and water quality. These emissions are attributed primarily to barns, manure storage and treatment in open lagoons, and land application via spray irrigation. A novel system, Panoxic, utilizes biological treatment techniques coupled with controlled aeration to reduce manure pH and ammonium concentrations. As such, the treatment reduces ammonia emissions, particularly for slurry recirculation through swine housing. This study aims to quantify the environmental impacts and economic feasibility of adopting this technology on a swine production farm in North Carolina. Utilizing a previously developed ammonia emission model (AMOSTO), lowering pH and ammonium concentrations in the liquid phase is predicted to decrease lagoon ammonia emissions by 60%, which correspond to 32.4 and 64.7 Mg-NH3/yr for 6,000 and 12,000-head farms, respectively. Decreased ammonia concentrations entering anaerobic digesters may increase biomethane yields by 19%, valued between $8,063 and $20,905 for a 6,000-head farm, depending upon the carbon credit utilized. A budget for a model swine farm was developed to determine the economic impacts of increased productivity, revealing expected net annual revenue for 6,000 and 12,000-head farms increase by approximately 27.6% and 39.0% after treatment adoption. Cumulative annual benefits were estimated to be between $109,523 and $122,365. Full-scale installation and laboratory analyses are expected to yield valuable data for refining these estimates.

Nicolas A. H. Lara[1], Phillip Winslow[2], Luis Rivera Burgos[1], Noah DeWitt[3], Mohammed Guedira[1], J. Paul Murphy[1], and Gina Brown-Guedira[1],[4]
Graduate Programs: Crop Science[1]; North Carolina Department of Agriculture and Consumer Services[2]; Louisiana State University[3]; USDA Agricultural Research Service[4]
Advisor: Gina Brown-Guedira
Poster Number: 95

Untangling Height QTL in Southeastern U.S. Soft Red Winter Wheat

Semi-dwarf wheat varieties were crucial for improving wheat yield during the Green Revolution by reducing lodging and increasing the amount of resources devoted to seed production, increasing net yield. Semi-dwarfing was achieved using Rht-B1 and Rht-D1, which both work by conferring gibberellin-insensitivity. However, a growing body of literature indicates that gibberellin-insensitivity can have unintended side effects such as reduced nitrogen-uptake efficiency. In addition to the homoeologous Rht-B1b and Rht-D1b alleles, a number of loci affecting plant height that do not confer gibberellin insensitivity are present in modern wheat cultivars.

In this study we aim to untangle a collection of qualitative trait loci (QTL) influencing plant height in semi-dwarf red winter wheat germplasm. We used a set of recombinant inbred lines (RIL) derived from fifteen crosses between representative wheat lines from breeding programs throughout the southeastern US; twelve founder lines have Rht-D1b while one does not. We grew approximately 150 RILs from each cross at three location years and measured mature plant height. We also employed genotyping-by-sequencing (GBS) to obtain high-density genotypic data from each RIL. We mapped significant QTL by normalizing location-year data using a linear mixed model to extract BLUEs, then performed GWAS on the entire experiment to identify population-wide height QTL. We also created linkage maps for each cross separately and did composite interval mapping (CIM) to identify significant QTL regions within a cross. Our GWAS analyses identified QTL on multiple chromosomes that coincided with significant QTL in bi-parental populations. Significant peaks on chromosome 6A identified in multiple populations appear to consist of at least two previously identified genes for reduced height–Rht-24 and Rht-25. Our results suggest that dwarfing alleles at these loci are common in this germplasm where they significantly influence height in the presence of major dwarfing allele Rht-D1b.

Kira Lindelof and Alexander Krings
Graduate Program: Plant Biology
Advisor: Alexander Krings
Poster Number: 100

The Role of Seed Storage Time on Germination Success – Is Seed-Banking a Viable Option for an Endangered Southern Appalachian Endemic?

Seed banking is an effective and popular effort to preserve at-risk or threatened plant species. Seed collections from unique parental lineages within and across multiple populations help maintain species genetic diversity long-term and reduce extinction risk. Although there's a push for seed banking of threatened species by conservation biologists and land managers, conventional seed banking requires that seeds remain viable after a) desiccation and freezing, and b) >10 years in storage. An estimated 8% of taxa are expected to violate such requirements, potentially making conventional seed banking an inviable option for long-term conservation of such taxa. Therefore, a strong understanding of the seed biology of at-risk and threatened species is requisite before implementing germplasm storage methods. We examined the role of seed storage time on germination success for two populations of the endangered Roan Mountain Bluet (Houstonia montana Small), an herbaceous perennial endemic to the high-elevation rock outcrops and grassy balds of North Carolina, Tennessee, and Virginia. Seeds were collected in October 2023 and stored in dry conditions for three different time durations: two-weeks post-collection, three-months post-collection, and six-months post-collection. After storage, seeds were placed in cold, moist stratification for 60 days then were transferred to moist filter paper in petri dishes for germination. The percent and time of germination were measured for the 2-week and the 3-month storage treatments, with the 6-month storage treatment still in progress. The results of this study will inform whether seeds of H. montana are suitable for long-term storage or if alternative germplasm storage should be considered.

Madison Love
Graduate Program: Horticultural Science
Advisor: Danesha Seth Carley
Poster Number: 104

Facilitating Pollinator Conservation in Agriculture: Understanding Grower Needs in Obtaining IPM Certification

Due to global concerns over the decline in pollinator populations, Walmart U.S. has initiated a policy requiring all produce and floral products sold in stores to be sourced from vendors who have obtained an Integrated Pest Management (IPM) certification from an approved third-party organization by 2025. The certification process for growers entails comprehensive documentation of operational practices, pesticide use and mitigation, and evaluation of on-farm pollinator habitat. However, this process is cumbersome for growers to conduct alone, necessitating assistance from a third-party such as Extension agents and staff. Furthermore, identifying and expanding existing pollinator habitat is often unfamiliar to growers, presenting a significant barrier in the application process and hindering the expansion of pollinator habitat. This project seeks to assess the needs of growers in navigating the IPM certification process and understanding the barriers they face. Future work will include the development of accessible consulting services that supports North Carolina growers throughout the certification process. These services will also equip growers with the knowledge and skills needed to enhance and expand pollinator habitat.

Sudarshan Reddy Medagam, Qingyang Wang, and Deepti Salvi
Graduate Program: Food, Bioprocessing and Nutrition Sciences
Advisor: Deepti Salvi
Poster Number: 113

Optimization of Novel Edible Coating Based on UV-C Treated Gallic Acid and Chitosan: Antimicrobial Efficacy Against Salmonella Typhimurium

Edible coatings serve as protective barriers against food spoilage caused by microorganisms and water loss. Several edible coatings have demonstrated antimicrobial potential against foodborne pathogens like Salmonella. Knowledge on the effectiveness of antimicrobial coatings with photosensitized ingredients is under-researched. This study aimed to: 1) optimize the composition of edible coating with a photosensitizing ingredient (Gallic acid) and 2) evaluate the antimicrobial effect of the optimized composition against Salmonella Typhimurium. For optimization of edible coating, chitosan concentration (CH: 1, 1.5, 2%), gallic acid concentration (GA: 0.5, 0.75, 1%), and pH (3.4, 4.2, 5.0) with three different levels each were chosen to generate 15 experimental conditions using Box-Behnken Design (BBD). Subsequently, the edible coating solutions underwent a 10-minute UV-C treatment and were then evaluated to identify their optimal formulation based on their antimicrobial and water vapor barrier properties. Later, the antimicrobial efficacy of this optimized composition was evaluated on agar media (in solution and film forms) and on cherry tomatoes and pork meat surfaces (in solution form) against S. Typhimurium. The optimized formulation (1.5% chitosan, 1% gallic acid, pH 3.4) reduced S. Typhimurium by 5.7 log CFU in planktonic and showed the highest moisture barrier properties from optimization studies. The antimicrobial efficacy of this optimized coating solution against S. Typhimurium was further evaluated on different surfaces. When applied to agar media, it inactivated >6.5 log CFU of S. Typhimurium, while on cherry tomatoes and pork meat surfaces, it achieved a reduction of 3.4 and 1.4 log CFU respectively. The results of this study point toward a significant leap in food safety measures. The developed edible coating, with its enhanced antimicrobial properties and water loss prevention, has compelling potential for application across the fresh produce and meat industries, contributing to extended shelf-life.

Ana M. Meza-Salazar and Alonso Ramírez
Graduate Program: Biology
Advisor: Alonso Ramírez
Poster Number: 116

From Hurricanes to Droughts and Rising Temperatures: The Impact of Climate Change on Caribbean Streams

Climate change impacts lotic ecosystems by altering rainfall patterns, elevating temperatures, and intensifying extreme events, significantly impacting ecosystem structure and function. Although research on the effects of climate change continues to increase, most of our understanding comes from temperate regions. This study is an assessment of this knowledge gap. We conducted a literature search spanning 2000 to 2022 on the primary impacts of climate change in the Caribbean region, focusing on its effects on stream ecosystems. The region, renowned for its biodiversity and unique interconnectivity between ecosystems, is a biodiversity hotspot. We found that hydrology and hydrogeology, ecology, and disturbances are among the most studied topics in the Caribbean. Puerto Rico, Costa Rica, and Colombia were leaders in the number of studies concerning climate change, extreme weather events, and water temperature. Reduced precipitation and elevated temperatures in the Caribbean contribute to diminished water flow, disrupting water chemistry, and loss of habitats for aquatic communities. Hurricanes cause disruptions by altering water chemistry and inducing abrupt changes in stream flow and physical conditions. Major disturbances (e.g., hurricanes and droughts) challenge the resilience of aquatic ecosystems, posing significant threats to biodiversity, by disrupting habitats and ecological functions. Our understanding of Caribbean stream ecosystem responses to these climate change effects is limited; however, their potential impacts could profoundly reshape ecosystem dynamics and functionality.

Bethany Mostert
Graduate Program: Plant Biology
Advisor: Deyu Xie
Poster Number: 119

Characterising a New Enzyme in the Artemisinin Biosynthetic Pathway

Malaria places an epidemiological burden on more than 87 countries. Although it is fully treatable, it contributes to more than half a million annual deaths. Artemisinin, which is extracted from the plant Artemisia annua, is a critical medicine for the treatment of severe malaria caused by Plasmodium falciparum.Unfortunately, the artemisinin content varies from plant to plant, which disrupts its ability to meet the demand for treatment. Thus, enhancing metabolic engineering strategies in-planta is critical for increasing drug availability. Cytochrome P450 71AV1 (CYP71AV1), a membrane-bound monooxygenase, oxidises several steps in the artemisinin pathway. Its catalysis requires partner membrane enzymes like cytochrome P450 reductase (CPR1) to pass electrons to its functional heme group. Our lab has identified a gene with 80% homology to the CPR1 amino acid sequence that shares key motifs such as flavin mononucleotide (FMN) and flavin adenine mononucleotide (FAD) binding groups, which are essential for electron shuttling among reducing enzymes. I am characterising this enzyme, hereby CPR2, to understand its possible interaction with CYP71AV1 and consequent involvement in artemisinin biosynthesis. Here, I present the expression and purification of a truncated version of CPR2 from Escherichia coli for the first time. The production of a yellow fraction confirms the presence of FAD and FMN moieties. I also demonstrate that regardless of optical density, E. coli cultures produce the greatest amount of CPR2 when grown at 37□ for a period of five hours or more prior to induction. Enzyme assays have been performed with purified CPR2 and Cytochrome c as substrate. The resulting data from both qualitative (colour changes) and quantitative results show that CPR2 has reducing capabilities in-vitro. Next, I will perform enzymatic, biophysical, and genetic/transgenic experiments to characterise CPR2 and its partner complex in-vitro and in non-native and native hosts such as yeast, tobacco, and A. annua.

Heeduk Oh[1,2], Molla F. Mengist[1], Guoying Ma[1], Jessica Spencer[2], Penelope Perkins-Veazie[1,2], and Massimo Iorizzo[1,2]
Graduate Programs: Plants for Human Health Institute[1]; Horticultural Science[2]
Advisors: Penelope Perkins-Veazie and Massimo Iorizzo
Poster Number: 122

Unraveling the Genetic Basis of Organic Acids and Sugars in Blueberry

Blueberry (Vaccinium corymbosum L.) production increased almost 5-fold during the last 20 years largely due to their pleasant taste and flavor, and the multiple health benefits associated with their consumption. Non-volatile chemical compounds such as sugars and organic acids play a significant role in the perception of blueberry taste and consumer preferences. High organic acids and high sugars generally have been associated with low and high consumer liking, respectively. Despite their importance, the genetic mechanisms controlling the accumulation of these metabolites remain largely unknown. To fill this gap, we evaluated fruit pH, titratable acidity (TA), total soluble solid content (TSS), organic acid content, and sugar content at the time of harvest in a mapping population including 330 F1 genotypes ('Reveille' x 'Arlen') over two years (2021 and 2022) and performed quantitative trait loci (QTL) analysis. Organic acids (citric, shikimic, malic, and quinic) were determined using high-performance liquid chromatography (HPLC) and the soluble sugars fructose, glucose, and sucrose were estimated using near-infrared spectroscopy (NIRs). Extensive variation for all the chemical attributes/compounds was observed in this population. Citric acid was the predominant organic acid and fructose and glucose were the dominant sugars in this population. Eighteen QTLs for pH, TA, and organic acids (citric, quinic, and shikimic) were identified. Six QTLs for pH, TA, and citric acid, two for quinic acid, and two for shikimic acid consistently spanned on the same chromosomal regions on chromosomes 3, 4, and 5, respectively, across two years. No significant QTLs were identified for TSS or soluble sugars. Comparative transcriptome analysis enabled identification of candidate genes for these QTLs and functional characterization is underway. Our results provide a basis for the development of a marker-assisted selection strategy to select blueberry cultivars with the desirable taste.

Seongmin Park
Graduate Program: Crop and Soil Science
Advisor: Stephanie Kulesza
Poster Number: 127

The Effect of Topdressing Poultry Litter In-Season on Corn and Soybean Growth in Piedmont and Coastal Plain Soils

More than 8 million tons of poultry litter is produced annually in North Carolina. Considered an affordable alternative fertilizer, there is a high demand for poultry litter application prior to warm season crops, such as corn (Zea mays L.) and soybean (Glycine max L. Merr.), but applicators of poultry litter can face scheduling challenges due to cleanout schedules and nonoptimal field conditions as a result of rain in the spring. Therefore, a field study was undertaken to determine the effect of topdressing poultry litter at different growth stages on corn and soybean yield and quality. This experiment was conducted at two sites, Piedmont and Coastal Plain. Treatments included control and four rates of fresh litter (4, 9, 18, and 36 Mg ha-1) applied at three different growth stages of corn (planting, V2, and V5) and soybean (planting, V2, and R1). At Coastal Plain, while corn yield significantly increased in treatments with 4 and 9 Mg ha-1 compared to the control ($p < 0.01$), yields were similar at rates of 9, 18, and 36 Mg ha-1, and there was no yield response in soybean at this location. At Piedmont, corn yield increased with the application up to 16 Mg ha-1, at which point a decrease was observed. For soybean, the highest yield was observed at a rate of 4 Mg ha-1, yet yields decreased with rates exceeding 4 Mg ha-1. Notably, the rate of 36 Mg ha-1 resulted in a significant reduction in soybean yield compared to the control ($p <0.01$), indicating that application can negatively affect this crop. There was no impact of application timing on crop yields or protein content, indicating application in-season could be a viable alternative to preplant application. Also, an inverse effect was observed, where the application of the litter beyond a specific threshold led to a reduction in yield. Therefore, these findings suggest that the topdressing the poultry litter could not only prove effective in enhancing crop productivity but provide flexibility in managing the scheduling conflicts that arise with poultry litter application. However, adherence to appropriate application rates is imperative to prevent yield reduction and the potential loss of nutrients from the litter

Christopher S. Pascual, Steven G. Hall, and Lirong Xiang
Graduate Program: Biological and Agricultural Engineering
Advisors: Steven G. Hall and Lirong Xiang
Poster Number: 129

Arduino-Based Automated Supplemental Lighting System for Optimum Plant Growth and Yield in Controlled Environment

Light is a limiting factor in plant growth. It serves as the primary energy source for photosynthesis, enabling plants to produce food. In controlled environments such as greenhouses, the covering material significantly reduces the sunlight intensity by 30-70%. This creates a suboptimal environment for crops, especially during winter or when it is rainy and cloudy, resulting in poor development and reduced yield. This study aimed to design an Arduino-based automated supplemental lighting system (SLS) to optimize plant growth in controlled conditions. The experiment was conducted indoors at 20-22oC using a hydroponics growing system and lettuce (Lactuca sativa L.) as the test crop. The plants were grown under two levels of light intensity using light emitting diode (LED): one with SLS (200 µmol.m-2.s-1 + SLS) or T1, and the other without SLS (200 µmol.m-2.s-1) or Control. Both treatments maintained a 14-hour photoperiod, and the SLS was set at 150 µmol.m-2.s-1. The experiment ran for 45 days from sowing, during which leaf length, width, number of leaves, and biomass weight were measured to evaluate plant growth performance. The SLS was programmed to activate automatically when light levels dropped below 200 µmol.m-2.s-1, simulating the overcast weather conditions. The addition of SLS resulted in lettuce plants developing 66.67% more leaves, 24.62% wider leaves, and 121.08% more biomass. In contrast, the plants without SLS had slightly elongated leaves, which made them irregular and lanky. These findings suggest that the use of supplemental lighting can significantly improve the growth and yield of plants like lettuce. The Arduino-based SLS is a simple and standalone unit that can be programmed and manipulated for the lighting needs of various plants to optimize growth and yield in controlled conditions.

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Graduate Program: Biological and Agricultural Engineering
Advisors: Mohamed A. Youssef and Chad A. Poole
Poster Number: 131

On-Farm Water Capture and Use Benefits for Crop Yield and Water Quality in North Carolina

Agriculture in North Carolina and other humid regions in the United States is largely dependent on precipitation during the growing season, which is becoming increasingly unpredictable with the changing climate. On-farm water capture and use is a system that stores drainage and surface runoff during wet periods for use as supplemental irrigation during dry periods of the growing season. The objective of this research is to experimentally quantify the crop yield and water quality benefits of this water conservation practice. A water capture and use system with a 2.83-hectare storage reservoir is being evaluated at the Peanut Belt Research Station, in Northeast NC. During the 2022 and 2023 growing seasons, irrigated and non-irrigated corn and cotton yields were measured. The yield of irrigated corn was more than twice the yield of the non-irrigated corn in 2022, and in 2023, there was a 59% average increase in corn yield from the irrigated plots. In 2022, supplemental irrigation did not significantly impact the cotton yield due to the timing of precipitation throughout the crop's development. However, in 2023, yield from the irrigated cotton plots was an average of 83% higher than that of the non-irrigated cotton plots. Nitrogen, phosphorus, and sediment concentrations have been monitored along with flow into and out of the pond since May 2022. In the first year of monitoring (May, 1 2022 - April 30, 2023) pollutant loads were significantly reduced. The sediment load decreased by 97.9%, which was primarily attributed to physical settling. Total phosphorus load was reduced by 67.8% and was driven by settling of particulate phosphorus and assimilation of orthophosphate. Nitrate assimilation was the main contributor to the total nitrogen reduction of 40.9%. Monitoring of yield and water quality at this research station is ongoing to evaluate benefits and determine the most influential factors in the usefulness of this agricultural water management practice. Water capture and use systems have the potential to increase crop yield resilience to unreliable precipitation and to improve the quality of aquatic environments downstream of farms.

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Graduate Program: Agricultural and Extension Education[1]; University of Tennessee[2]
Advisor: Joseph L. Donaldson
Poster Number: 134

Comparing Virtual and In-Person Delivery of a Summer Agricultural Research Program For Women Undergraduates

Research indicates that Research and Extension Experiences for Undergraduate (REEU) programs, funded by USDA and other sources, are valuable for exposing undergraduates to agricultural research and extension careers while helping them to develop career-ready skills. This study describes Explore BiGG (bioinformatics, genetics, and genomic sciences) Data, a summer research program for women undergraduates. BiGG is aimed at both supporting the BiGG workforce and increasing women's participation in food, agricultural, and natural resource careers. BiGG was delivered virtually in 2020 and 2021 (N=10) and in-person in 2022 and 2023 (N=12). This convergent, mixed-methods study used questionnaires and interviews to compare student outcomes in both virtual and in-person formats. The student outcomes studied were academic and career plans, mentoring, and career readiness skills including problem-solving and project management. Results indicated that outcomes were similar for both virtual and in-person programs. However, a key difference was that in-person participants had significantly more experience than virtual participants in sharing their research in journal articles and professional presentations. While the amount of time that participants reported spending with their research mentors was similar for both delivery modes, in-person participants were more satisfied than virtual participants with their experiences in working with research mentors. Virtual REEU programs may be a cost-effective pathway for enfranchising additional students with agricultural research and extension career experiences. Yet, student preference for in-person experiences must be considered in planning worthwhile REEU programs.

Elisabeth Q. Ramsey[1], Catherine E. Sanders[1], Alexa Lamm[2], Shuyang Qu[3], Fallys Masambuka-Kanchewa[3], Mike Retallick[3], and Kevan Lamm[2]
Graduate Programs: Agricultural and Human Sciences[1]; Agricultural Leadership, Education, and Communication, University of Georgia[2]; Agricultural Education and Studies, Iowa State University[3]
Advisors: Catherine E. Sanders and Annie Hardison-Moody
Poster Number: 135

Navigating Pork Perspectives: Insights into Tailored Communication with Diverse Audiences

In response to growing concerns and scrutiny surrounding the pork industry, this research explored tailored communication strategies for addressing diverse consumer landscapes. The study was guided by an audience segmentation framework, which explains how effective communication channels, message alignment, and trustworthy sources can enhance communication efforts with various demographic and psychographic groups. Data were collected at a midwestern swine conference in September 2023 through focus groups exploring pork industry stakeholders' beliefs about consumer perceptions of the pork industry. Three research questions guided the study: 1) How do participants describe their experiences when communicating with diverse audiences?; 2) What challenges did participants describe for communicating with diverse audiences?; and 3) What cultural aspects were influential in participants' communication with diverse audiences? Four themes emerged from thematic analyses. First, speaker credibility played a pivotal role, emphasizing the impact of individuals' expertise in shaping perceptions. Second, the language around production and harvest demonstrated the significance of adapting terminology based on the audience. The third theme highlighted the need for evolving communication channels, emphasizing the shift from traditional face-to-face interactions to digital strategies. Lastly, the theme of cultural foodways and rituals underscored the disconnect between industry perceptions and the cultural significance of pork in non-Western diets. Participants identified awareness gaps among industry stakeholders, especially regarding consumers' cultural foodways and the central role of pork in non-Western diets. The findings emphasized the necessity of targeted communication strategies through a diverse range of channels, including face-to-face interactions, social media, and family-centric approaches. Findings demonstrate the need for future investigations into how consumers from minority groups engage with pork, with the ultimate goal of developing effective communication strategies tailored to diverse audiences. This study contributes valuable insights into the pork industry's communication strategies, paving the way for informed and culturally sensitive engagements with consumers.

Lisa Rayburn[1], Brian Jackson[1], Joshua Mays[2], Walt Webb[3], James Hewitt[3], David Childers[3], and Gina Fernandez[1]
Graduate Program: Horticultural Science[1]; TriEst Ag Group, Inc.[2]; Lewis Nursery and Farms[3]
Advisors: Gina Fernandez and Brian Jackson
Poster Number: 136

Can Pine Bark Serve as an Alternative to Coco Coir for Long-Cane Raspberries in the Southeastern U.S.?

Raspberries are a high-value crop that are not commercially grown in the hot, humid climate of the southeastern United States. Interest has grown in the use of an annual production system using raspberry plants produced by a nursery in a cooler climate then shipped and grown out for harvest in the southeastern US. This system, known as long-cane production, involves growing plants in soilless substrate in containers in high tunnels allowing growers to time production during the moderate temperatures of spring. This system is widespread in Europe where coco coir is the industry standard. Growers in the US are concerned about the rising cost and supply chain constraints of coco coir. For these reasons, we are looking at the viability of using a locally produced pine bark substrate instead. The objective of this study was to compare performance of plants grown in coco coir versus a local pine bark alternative. Research was conducted on-farm over two growing seasons. Total yield and berry size were measured and fruit was collected to be analyzed for quality characteristics. Plant tissue, solution and soilless media samples were collected regularly for analysis. Plants were destructively sampled at the end of the season to determine if there were differences in morphological characteristics. Total yield, fruit size and fruit quality characteristics were comparable between the two treatments. There were no negative impacts on plant nutrient status or growth between treatments. Substrate analysis indicated that pine bark had less water holding capacity than coco coir and thus requires more frequent irrigation than coco coir. The locally produced pine bark substrate is cheaper, costing about 25% the cost of coco coir, offering growers a cost savings. These data indicate that pine bark can serve as a viable alternative to coco coir for the production of long-cane raspberries.

Liz Riedel
Graduate Program: Biological and Agricultural Engineering
Advisor: Michael R. Burchell
Poster Number: 137

Evaluation of Existing Technologies in Rural Wastewater Treatment Plants to Improve Nutrient Removal

As eutrophication of surface waters continues to be a serious concern, it is crucial to investigate the often overlooked point source nutrient loads from rural wastewater treatment plants (WWTP). In North Carolina, there are about 425 municipal or domestic minor WWTP (< 1 MGD). The majority of these minor WWTP do not have strict discharge or monitoring requirements for total nitrogen (TN) and total phosphorus (TP). Furthermore, most minor WWTP have aging infrastructure resulting in reduced treatment efficiency. The aim of this study is to determine the quantity of nutrients being discharged from six rural wastewater treatment systems in North Carolina, thus providing valuable insights to inform decisions regarding upgrades for these facilities. Five of the six systems are traditional wastewater treatment package plants designed for maximum ammonium removal. The sixth WWTP was designed based on ecological engineering principles and consists of a series of constructed wetlands. Results from the first six months of data collection show low effluent ammonium (NH4-N) levels but relatively high concentrations of TN because nitrate (NO3-N) is produced during treatment processes. Total phosphorus concentrations varied across the six sites but were often higher than proposed discharge limits. Sample data from the constructed wetland treatment system showed the lowest effluent concentrations of TN and TP. The high treatment efficiency demonstrated by this system suggests that constructed wetlands could serve as a viable supplementary upgrade to existing package plants or as a promising alternative for new treatment plants. Ultimately, the results of this research can be used to enhance nutrient removal in rural wastewater treatment systems and improve the overall health of watersheds in North Carolina.

Chris Stainback
Graduate Program: Crop Science
Poster Number: 153

Fungicide Evaluations for Foliar Leaf Spot Disease Management

Foliar leaf spot diseases such as Rhizoctonia solani and Cercospora nicotianae have increased in severity over the last decade in North Carolina. A recent survey of County Agents suggests that yield losses from R. solani may exceed six percent across the state and 30% in isolated situations. Alternatives to azoxystrobin fungicides are needed to address this growing issue. In 2022 and 2023, field trials were established to screens seven foliar fungicide products that are new or not currently labeled for commercial tobacco production. Pseudomonas chloroaphis, bacillius subtillis strain AFS032321, inpyrfluxam, pydiflumetofen + difenoconazole, picoxystrobin + cyproconazole, azoxystrobin + flutriafol, azoxystrobin + flutriafol + fluindapyr were evaluated. Azoxystrobin and mancozeb were included for comparison. Treatments were applied in sequential applications four, six, and eight weeks after transplanting. Foliar leaf spot pressure was low in 2022; however, based on data collected in 2023, preliminary results indicate that products such as inpyrfluxam, azoxystrobin + flutriafol, picoxystrobin + cyproconazole and azoxystroin + flutriafol + fluindapyr may help manage foliar leaf spot disease. Cured leaf yield improvements as well as disease severity and incidence relative to the non-treated control has commonly been observed in 2023. Results will be included in the presentation.

Cody Stainback
Graduate Program: Crop Science
Advisor: Matthew Vann
Poster Number: 153

Fungicide and Starter Fertilizer Placement at Transplanting

Starter fertilizer and fungicide products are commonly included in transplant water solutions. It has been hypothesized that a different placement strategy is needed in order to minimize chemical and soluble salts injury. Research was initiated in 2022 and 2023 in order to compare the efficacy of traditional in-furrow fungicide placement versus that of the sidedress placement. Two placement techniques were evaluated, a traditional in-furrow application that places solution in the planting furrow and a sidedress application that places solution 5 cm away from the seedlings. Within each placement technique three treatments were subsequently evaluated: oxathiapiprolin (0.07 kg ai/ha) + mefenoxam (0.21 kg ai/h), 9-45-15 starter fertilizer (kg/ha), and oxathiapiprolin + mefenoxam + 9-45-15. A non treated control was included for comparison. Two weeks after transplanting, visual injury (45-48%) and chemical residues were highest in treatments receiving oxathiapiprolin + mefenoxam in-furrow (45-48%). Sidedress placement of this fungicide combination reduced injury to 16 and 5% and the residues of mefenoxam to <20 mg/kg. Oxathiapiprolin residues were below the Limit of Quantification. Within the same data collection timing, the non-treated plots contained the largest plants based on dry mass and stem height measurements. Plant recovery was observed four weeks after transplanting, as chemical injury was not detected and in-furrow placement of starter fertilizer resulted in plants that were taller with a higher dry weight mass than the chemical only treatment or treatments applied sidedress. By six weeks after transplanting there were no differences in growth or biomass accumulation recorded across treatments. Preliminary results indicate that sidedress applications of fungicides and starter fertilizers may reduce injury, however, plant recovery of those inputs may be delayed relative to in-furrow placement. Moreover, the addition of 9-45-15 in-furrow may promote plant recovery from fungicide injury. Results from 2022 and 2023 will be included in this presentation.

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Graduate Program: Plant Biology[1]; Microbiology[2]; Molecular Biology and Genetics, Aarhus University[3]
Advisor: Heike Sederoff
Poster Number: 163

Symbiotic Interactions Between Plants and Microbes Have Unique Signatures of Circular RNAs

When plants experience phosphate and nitrogen deficiency which limits their growth and development, they can recruit soil bacteria and fungi for help. Plant and microbe establish a symbiotic relationship where the plant provides carbon-rich molecules to the microbes and in exchange receives nitrogen assimilated from air (N2-fixation) from the bacteria and phosphate from otherwise inaccessible soil compartments through specialized fungi. To successfully establish these symbiotic relationships, the plants need to be able to distinguish these beneficial microbes from pathogens and modify their metabolism and defense pathways to feed and accommodate the microbes. One way to study the changes occurring to the plant in response to environmental changes is to sequence all RNA that is present at or after that stimulation. Using the model legume plant Lotus japonicus, we studied the changes in linear and circular RNA (circRNA) caused by the different symbiotic microbes in the plant. While linear RNA provides information about the activation and inactivation of different responses in the plant, circular RNA can originate from this linear RNA and is a recently recognized regulator and modifier of their respective cognate RNA function and expression. We were able to identify more than 13,300 novel circRNAs in Lotus japonicus roots as well as unique patterns of circRNA in response to different microbes and nutrient levels in the plant. The goal of this research is to develop novel targets for improving nutrient use efficiency in crops and develop biomarkers for distinction of plant stress.

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Graduate Program: Molecular and Structural Biochemistry
Advisor: Melanie A. Simpson
Poster Number: 164

Phosphorylation of UDP-glucose 6-dehydrogenase Enhances Tumoroid Formation and Global Glycosylation in Prostate Cancer

Dysregulated synthesis and composition of extracellular matrix (ECM) components, including glycosaminoglycans (GAGs), are known features of cancer progression. The initiation of GAG production and subsequent elongation is dependent on levels of the precursor UDP-glucuronate (UDP-GlcA). UDP-GlcA production is catalyzed by UDP-glucose 6-dehydrogenase (UGDH), a crucial enzyme implicated in the progression and severity of epithelial cancers. UDP-GlcA availability is tightly regulated but mechanisms governing its partitioning remain unclear. Thus, as the sole producer of UDP-GlcA, UGDH presents an attractive target for the control of biosynthetic processes that drive invasion and metastasis. To investigate the role of UGDH in driving UDP-GlcA partitioning and subsequent glycosylation, we inspected the structure of the enzyme and identified a putative phosphorylation site near the interface between dimeric units of the homohexameric UGDH assembly (Ser 316). To test functional consequences of S316 phosphorylation, we performed site-directed mutagenesis to generate UGDH phosphodeficient (UGDH S316A) and phosphomimetic (UGDH S316D) point mutants. The mutants were purified and characterized in vitro and exhibited similar activity and thermal stability relative to WT UGDH. To examine cellular impacts of S316 phosphorylation, expression constructs were stably selected in prostate cancer cell lines. Three-dimensional proliferation assays were conducted to assess the effects of S316 phosphorylation status on tumoroid formation. Global glycan expression was evaluated via click chemistry detection of azido-modified sugars. Cells expressing the phosphomimetic UGDH S316D mutation exhibited increased tumoroid formation and elevated global glycan expression. Cells expressing the phosphodeficient UGDH S316A mutation had markedly less tumoroid growth and reduced glycan expression. These results indicate a novel function of phosphorylation status at UGDH S316 may be to direct UDP-GlcA into biosynthetic pathways, thereby contributing to cell aggregation and anchorage-independent growth. Evaluating these findings in vivo will further elucidate the mechanistic role of UGDH in cancer progression and metastasis.

Anna Yaschenko, Chengsong Zhao, Jose Alonso, and Anna Stepanova
Graduate Program: Plant Biology
Advisor: Anna Stepanova
Poster Number: 178

Utilizing SynBio to Decipher the Effect of Promoter Architecture on Gene Expression

Understanding gene expression regulation is central to the development of biotechnological solutions for several pressing agricultural problems. The advent of synthetic biology methods has opened the door to programmable genetic constructs in plants that confer tunability and spatiotemporal regulation to gene expression. However, the relationship between promoter elements within the promoter of a gene and that gene's expression levels is not well defined. To explore this relationship, we have built synthetic promoters harboring up to ten transcription factor (TF) binding sites using GoldenBraid technology and subcloned these promoters upstream of a reporter gene. This was done by inserting one to ten copies of a protospacer, a 23bp recognition sequence for a dCas9-based synthetic TF, into a 1kb neutral promoter sequence that has no known TF binding sites in plants. We assembled the reporter gene to express a mCherry-Luciferase fusion protein as a readout and transiently co-expressed it along with a dCas9 activation system in Nicotiana benthamiana to test the effects of protospacer position, orientation, angular phase shift, copy number, and spacing on reporter expression. We find that protospacers in either the sense or antisense orientation confer comparable levels of gene expression and that the angular phase of the protospacer in relation to the transcription start site (TSS) has no prominent effect on the level of reporter expression. Experiments testing protospacer position indicated that the ideal location of the TF binding site is about -150 base pairs (bp) upstream of the TSS and 119 upstream of the TATA box. Surprisingly, increasing protospacer copy number is linearly correlated with a boost in gene expression only for up to four copies of the protospacer, with a sharp drop in reporter activity seen for five or more copies of this cis-element. Increasing spacing between protospacers was correlated with a boost in expression until about 123 bp, after which expression slowly decreased to the level of one protospacer suggesting that distant placement of the cis-element is not effective at supporting transcription initiation. Taken together, these results shed light on the rules of nature dictating promoter architecture that, in turn, determine gene expression levels, ultimately paving the way to the creation of tunable expression systems.

College of Design

Ned Babbott
Graduate Program: Graphic and Experience Design
Advisor: Jarrett Fuller
Poster Number: 11

The Design of Health-Reporting Platforms For Users with Multiple Chronic Conditions

Chronic illness prevalence in the United States has reached epidemic proportions. A recent public health report estimated that over a full quarter (27.2%) of the US population lives with Multiple Chronic Conditions (MCCs). On average, this population spends more effort interacting with medical systems and moving between various physicians and care teams in the course of diagnosis and treatment. While patients attempt to provide detailed histories, the multifaceted and pervasive nature of chronic ailments creates difficulties when reporting back symptom data to clinical settings. Additionally, the CDC has identified difficulty articulating ailments as a significant barrier to care.

Medical tracking tools claim to ease data entry and improve quality of life for the chronically ill. However, Health Informatics research on symptom tracking indicates that poorly-designed interfaces actually complicate an already difficult task. Moreover, medical tracking interfaces frequently lack visual or functional components that this user population needs. Users consider the interfaces cumbersome, or the experience reinforces stigma in chronically ill people. Both physicians and patients see the potential benefits of improved tracking, and User Experience Design holds great promise to find solutions which streamline data collection to enhance patient-doctor communication.

Drawing on cognitive frameworks and medical models of chronic care, this investigation explores the design considerations for people with Multiple Chronic Conditions. Resulting explorations consider the affordances of visual prompts, verbal inputs, wearable devices, and semantic analysis to encourage accurate collection and communication of symptoms. The studies reinforce the Health Informatics and HCI positions that these technologies only succeed if they are intuitive, simple to learn, and unequivocally alleviate patient effort. UX and UI solutions which pragmatically engage with the expectations and lived experience of people with MCCs hold the potential to inform Health Informatics design for chronically ill populations.

Ian Boyd
Graduate Program: Art + Design
Advisor: Patrick FitzGerald
Poster Number: 17

Remote Sensing: Multisensory Feedback for Augmentation

Many traditional artistic mediums, especially in the context of those housed in gallery spaces, often prioritize sight and exclude the other senses. Ropes and barriers, tools of preservation for the pieces, are a physical barrier that places limits on our sense of touch to experience the work. Other barriers may be less implicit, such as a restriction of the medium itself. How would we interpret a painting aurally? These inadvertent restrictions have the unintended effect of distancing the viewer from complete sensual immersion. John Dewey's theory of aesthetic experience posits aesthetic value can be determined by its ability to transform passive art to an engaged, immersive experience. By comparing Dewey's theory of aesthetic experience with Roland Barthes' writings on the individual reader's authorship through the experience of the text, we create a framework in which the user has increased agency to craft their own immersive experience. Remote Sensing: Multisensory Feedback for Augmentation seeks to establish the value multisensory feedback can bring to traditional mediums through the creation of an experiential installation that uses oil paintings as a foundation on which to build a system of multisensory augmentation. As the user hovers, points and gestures above the surface of the painting, the system receives positional data from body trackers, creating a real-time network of responsive feedback. This system allows the user to experience the painting through a multisensory overlay of aural tones, vibration and projection. Remote Sensing seeks to subvert the idea of how we interact with both the gallery and the pieces within, creating a greater sense of immersion and agency through the incorporation of the senses.

Ethan Brain
Graduate Program: Art + Design
Advisor: Tania Allen
Poster Number: 19

Abe Kōbo & Technological Violence, Analyzing Abe Kōbo's Literature in the Age of Hostile Technology

This thesis uses Abe Kōbo's novel The Face of Another as a comparative literary framework and lens for analysis to investigate underlying systemic and symbolic technological violence in the age of the internet. The paper offers a series of distinct sideways glances at technological violence, ultimately creating a formal critique on the underlying violent structures of contemporary cyberspace, hardware, and software. In addition, this thesis argues that dominant tech companies, governments, and university systems continue to propagate and manufacture the illusion of tech neutrality. Treating technology as a neutral force creates passivity and inaction, which prevents true revolution against the violence of technology in the life of the populace -- specifically regarding human labor exploitation, invasive surveillance, impacts on war, violations of privacy, and cybercrime. Abe Kōbō's novel The Face of Another is centered around narratives of alienation from modern society and speculations about the future of the modern identity. Therefore, it provides a key source for analysis and comparison in order to deconstruct and digest the complexities and state of modern technology.

Kevin FitzGerald
Graduate Program: Doctor of Design
Advisor: M. Elen Deming
Poster Number: 56

Examining the Effects of Framing on the Design and the Collaborative Governance of the Digital Library of the Middle East

This research design is a research case study that examines the design and establishment of the Digital Library of the Middle East (DLME) and explores the interaction between framing and design, and how frames and frame creation affect design processes that involve open, complex, dynamic, and networked problems (Dorst, 2015). Through a Framework Analysis of case data, operative frames will be identified to reveal contexts that mobilized stakeholders to conceive, design, fund, and develop the DLME, a digital, open standards-based, and federated archive of cultural artifacts from the Middle East Northern Africa (MENA) region. The DLME represents a significant achievement that has helped to secure the conservation and accessibility of important historical and cultural artifacts that are at risk of loss. By highlighting the relationship between frames and frame creation in the design process and the establishment of ongoing DLME governance, the research will identify significant development opportunities.

Juwan Ha, Seungmin Lee, and Soolyeon Cho
Graduate Program: Design
Advisor: Soolyeon Cho
Poster Number: 66

Development of Roof Top Unit (RTU) Prediction Model Based on Limited Experimental Data

Unlike large-sized commercial buildings, Small to Medium-sized Commercial Buildings (SMCBs) typically have a reasonably consistent HVAC system and control configuration. Generally, SMCBs are equipped with RTU air conditioning systems capable of multiple-staging control for space heating and cooling. Therefore, advanced optimal control technologies like Model Predictive Control (MPC) for RTUs are crucial for enhancing the energy efficiency and flexibility of actual SMCBs. Meanwhile, existing research applies MPC to actual buildings' RTU systems to improve energy efficiency and flexibility. However, the development of MPC requires accurate model prediction, which in turn necessitates a lengthy period for collecting experimental data. This limits the generalization and fast application of MPC in actual buildings. Consequently, this research aims to develop a model with high predictive performance even within a limited experimental period by combining a performance dataset based on RTU manufacturers with measured data from actual buildings. This approach proposes fast application and scalable control solutions for MPC technology in real buildings.

Paula Leon Delgadillo
Graduate Program: Industrial Design
Advisor: Kelly Umstead
Poster Number: 97

Improving Menstruation Experiences: Increasing Awareness Around Reusable Menstrual Cups

Menstruation is a natural part of life that happens to a quarter of the global population. Disposable menstrual products, commonly used, pose environmental challenges, generating substantial waste and potential health risks due to chemical ingredients. A viable alternative is the menstrual cup, a reusable device with a lower environmental impact and safer materials. This research aims to address the lack of awareness that affects individuals who menstruate, largely due to the persistent absence of knowledge, stigmas, and taboos that surround menstruation. Utilizing literature analysis and qualitative interviews with 27 participants and 2 menstrual health specialists from different countries, this study identified challenges faced by menstrual cup users, emphasizing the need for improved education and enhanced cleaning experiences. Findings reveal major concerns from users when having to clean their cups in public settings, they reported shameful experiences accompanied by a lack of hygiene, safety, resources, and privacy that had led to the discontinued use of the product. BLEAN emerges from the realization that menstrual cups remain in the shadows and introduces a portable, space-saving cleaning device that helps individuals reduce stressors, fear, and anxiety experienced when cleaning their cups in public settings. The innovative design offers a compact solution with two washes, allowing users to clean their cups thoroughly within the stall, revolutionizing the cleaning process in various environments. The initiative extends beyond the product, incorporating educational tools to empower individuals with menstrual knowledge, reducing stigma, and promoting a healthy relationship between users and their bodies. BLEAN's impact is envisioned to transcend the realm of menstrual hygiene, potentially improving user experiences and fostering awareness. Making the cleaning process more accessible and less daunting is one of the main objectives of this project, which aims to encourage widespread menstrual cup adoption, aligning with principles of inclusivity, sustainability, and menstrual dignity for all.

Mustafa Ozcicek
Graduate Program: Design
Advisor: Derek A. Ham
Poster Number: 123

Sketching on Intelligent Mediums

Receiving constructive feedback is crucial yet challenging in design education due to factors such as anxiety, communication barriers, and time constraints. This study leverages advancements in AI, particularly through large language models like GPT-4, to explore AI's role in providing feedback during the early stages of the creative process. I developed a drawing app with an on-demand feedback component for this case study, aiming to facilitate a more interactive and constructive feedback process. Participants, students from NC State University, College of Design, used the app to complete a graphic design-related task and then participated in semi-structured interviews. With an innovative example of integrating AI in design education to address the challenges in obtaining quality feedback, this study offers valuable insights for shaping future design studio classes.

Isha Sudhakar Parate
Graduate Program: Graphic and Experience Design
Advisors: Helen Armstrong, Deborah Littlejohn, and David Oh
Poster Number: 126

Unveiling Crime Narratives: Navigating Uncertainties and Patterns Through a Map Interface

Crime analysis is inherently data-centric, presenting distinctive and substantial challenges in its pursuit. Studies highlight the profound impact of location on human behavior, showcasing the influence of specific features. Delving into the theories of crime hot-spots and hot-spot mapping visualizations, Spencer's Concentration, Mapping and Action framework and other such studies emphasize the correlation between layering data on a map and discerning criminal patterns.

There exists a rich opportunity to develop visualizations and interfaces that holistically present crime details, incorporating uncertainties for nuanced analysis. Within the framework of Artificial Intelligence and Large Language Models, the focus on anticipatory design aims to alleviate cognitive load. Each study employs a Map interface, harnessing cutting-edge technologies to craft a highly adaptable tool. This innovative tool seeks to empower criminologists by metaphorically providing a 'replay' button, enabling remote scrutiny of a crime scene. The interface prompts consideration of uncertainties and facilitates pattern recognition, fostering insightful analysis.

In the pursuit of advancing crime analysis methodologies, it is crucial to explore interdisciplinary collaborations that integrate perspectives from criminology, data science, and technology. This interdisciplinary approach not only enriches the development of adaptive tools but also ensures a comprehensive understanding of the complex interplay between crime, environment, and data. Embracing this holistic perspective can lead to innovative solutions that not only meet the challenges of crime analysis but also contribute to a more effective and informed approach in the realm of criminology.

Maren Parsell
Graduate Program: Design
Poster Number: 128

Design Innovation Integration: Challenges and Opportunities in Currently Funded NIH Grant Proposals

Design Innovation (DI), encompassing human-centered design, design thinking, and related approaches, has proven successful in aligning innovations with targeted populations' needs across various consumer markets. However, adoption of DI in the health sciences is still nascent and lags behind the shift to patient-centered healthcare culture, empowered healthcare consumer expectations, and the proliferation of digital health technologies. Importantly, DI practices are inconsistently applied to interventions currently funded by the National Institutes of Health (NIH), one of the most selective and largest funders of biomedical research in the world. Through an embedded case study approach, this investigation analyzes data from funded NIH grants utilizing DI practices and interviews with stakeholders. It provides concrete, contextual, in-depth knowledge of the current state of DI application, evaluation, and adoption within health science projects that have met the highest rigor and validity standards of the NIH. This study lays the groundwork for evidence-based best practices, evaluation criteria, and educational curricula to expand use of DI practices in the health sciences.

Sarah Take
Graduate Program: Art + Design
Advisor: Tania Allen
Poster Number: 157

Exhibiting Science: Promoting STEM Through Interaction and Play

Research shows that the amount of Americans who greatly trust scientists has been declining in the past few years. Researchers of education have also found that incorrect, preconceived notions about scientific phenomena often form outside the classroom, and that classroom education does little to correct these false notions. At the same time, science museums, especially those that contain interactive exhibits, have become more popular to the masses over the past couple decades. So if formal, or school-based, education doesn't promote effective science education, it then follows that science centers are uniquely positioned to provide the hands-on, experiential education that a classroom cannot. If museums are going to be the place where education is happening, then it is critical that they be able to assess the effectiveness of their exhibits. This project attempts to compile a series of best practices for designing and evaluating exhibits, particularly STEM-based ones. These best practices will be formed through both observations of interaction at multiple museums, and research on supporting frameworks of exhibit design and science education. The final deliverable of this project will be a deck of cards that host guiding questions and methods for exhibit designers to use during the iterative processes of both exhibit design and evaluation.

Natalie Thibault
Graduate Program: Industrial Design
Advisors: Kathryn Wozniak, Kelly Umstead, and Kathryn Asad
Poster Number: 158

From Bio-Leather to Baby Steps: Designing Environmentally Responsible and Developmentally Appropriate Toddler Footwear with Bacterial Cellulose

Toddler footwear represents a unique opportunity for industrial design and material innovation, with a pressing need in the current market for design solutions that support natural foot movement and growth while aligning materials to the industry's rapid product lifecycle. This project uses a multidisciplinary approach, integrating industrial design, microbiology, and textile science to address the unsustainable nature and design misalignment of toddler footwear utilizing bacterial cellulose (BC).

Bacterial cellulose is a versatile and promising addition to material science with applications in the medical, fashion, electronics, and packaging industries. BC has characteristics like low production footprint, high purity, crystallinity, strength, abrasion resistance, and flexibility while being biodegradable and biocompatible. This project explores BC as a sustainable, bio-based material, covering the full scope from raw material cultivation and manipulation to the development of innovative footwear fabrication methods, all tailored to the material's distinct properties. By prioritizing circular design principles, this project seeks to develop environmentally responsible and developmentally appropriate toddler footwear through stakeholder interviews, iterative design, and user-centered prototyping and testing.

Lin Whipkey
Graduate Program: Design
Advisor: Jianxin Hu
Poster Number: 169

A Case-Study-Based Investigation on the Planning and Design of Tiny Home Communities in North Carolina

Since the turn of the millennium, "living tiny" has been gaining popularity. Studies show significant motivations for living tiny – people desire a simple lifestyle, less financial stress, and more mobility. Especially in the current housing market of high prices and low inventory, tiny homes can significantly impact housing affordability. This research aims to promote the development, planning, and designing of tiny home communities by conducting case studies in North Carolina. The study involves three aspects of tiny home communities: feasibility study, site planning, and building design. A multiple case study methodology is employed by selecting tiny home community cases from the State of North Carolina. The study has been conducted at six tiny home communities containing two mixed-housing-type communities, two tiny home-on-wheels communities, and two tiny home-on-foundations communities. The developers/property owners/administrators of communities were interviewed, and questions related to land zoning, finance, insurance, site planning, and individual buildings were asked during the meetings. Each interview lasted between 45 to 75 minutes. Officials or planners of the municipalities related to these six communities were interviewed, and questions related to local land usage ordinances and zoning were asked at the meetings. The interviews lasted 30-50 minutes. All interviews were conducted via Zoom meeting, and permissions were obtained from the participants to record the conversations, which were later transcribed into written format. Other data collection methods include observing the use of green open spaces, parking lots, and other amenities and collecting zoning records, local ordinances, zoning documentation, site plans, and floor plans. After the preliminary data analysis, development guidelines on the ordinance and zoning standards of tiny homes are recommended, and prototypes of tiny home community sites and building plans are generated.

Matthew A. Wright
Graduate Program: Art + Design
Advisor: Tania Allen
Poster Number: 173

From Rotoscope to Renaissance: Emerging Media Technologies and Live Performance

Live performance is the genesis of human entertainment. The concept of live entertainment has been revamped throughout history as technologies have evolved. This project seeks to explore and identify novel ways for artists to amplify the delivery of a live performance. The space for investigation exists where artists are exploring how to be effective in live environments that are both in-person and online. In a landscape where artists are growing their followings and may need to accommodate for the also-growing costs and logistics for venues, figuring a way to simultaneously perform online and in-person is increasingly necessary. This project pairs emerging media integration and live performance through the Sony mocopi motion capture system. Dancers from Panoramic Dance Project and independent rap artist Alicia Marie were used as subjects for the project, sharing their personal experiences with technology as performers and acting as the live models tracked with mocopi. Using a custom live avatar, choreographed performances show how audiences could enjoy a moving show in person and an equally engaging experience digitally that is distinct from the in-person interaction because of the augmented integration offered through mocopi or similar equipment.

College of Education

Cassandra F. Rubinstein[1] and Emily G. Braren[2]
Graduate Programs: Teacher Education and Learning Sciences, Educational Equity[1]; Teacher Education and Learning Sciences, Social Studies Education[2]
Advisors: Amato Nocera[1] and Paula McAvoy[2]
Poster Number: 20

Ethnic Studies Policies: The Role of Political Ideologies and Local Voices on Curriculum Mandates

In the wake of anti-CRT legislation, school curriculum has come under scrutiny across the nation, with local and state voices weighing in. Given the growing backlash, there is a need to better understand how various localities negotiate the adoption of race-evasive legislation, particularly in states where legislation has been put in place to combat educational censorship. This paper employs theories of hegemonic Whiteness and Critical Discourse Analysis (CDA) to examine school board deliberations regarding the resolution to ban Critical Race Theory (CRT) in educational curricula in a California school district. Although the discursive strategies employed by board members in favor of or against the anti-CRT resolution varied, the findings reveal how the power given to the school board gives members the latitude to institute their own unfounded, value-laden visions for education that affect the lived realities of students and educators in their district. This study affirms not only how the organizational principles and practices of the school board are an imperfect means to meet the needs of all individuals affected by educational policies, but also how hegemonic Whiteness can be preserved in education through nuanced discourse surrounding norms and conventions of equality, equity, and curriculum. Thus, there is a continued need to understand how institutionalized racism plays a persistent role in local political contexts in the present day.

Robin Bulleri
Graduate Program: Teaching and Learning in STEM
Advisor: Soonhye Park
Poster Number: 26

Instructional Strategies in AP Science Classes: A Systematic Literature Review

The Advanced Placement (AP) program has experienced rapid increase in enrollment in the past ten years. However, little is known about how instructional strategies in AP science courses impact student learning. The purpose of this study was to characterize instructional strategies and strategies and note any prevalent instructional strategies. Study inclusion criteria consisted of empirical articles, which aligned with the research questions, published in a scholarly journal within the last ten years in English. Participants included in the articles included Advanced Placement science classes in high school. Thematic analysis was used to find themes in the data. Findings indicate that instructional strategies can be categorized as diverse learners, inquiry, or other considerations. Recommendations for future research include exploring how instructional strategies improve student outcomes. Further examination of instructional strategies with students from various backgrounds and in various teaching contexts would be helpful. Lastly, very few articles address issues of race, equity, or culturally-relevant teaching practices, leaving a noteworthy gap in the literature.

Victor Cadilla and Jennifer B. Ayscue
Graduate Program: Educational Evaluation and Policy Analysis
Poster Number: 30

Can Two-Way Dual Language Immersion Programs Help Integrate Schools? An Examination of North Carolina

Despite the nation's student population becoming more diverse in the past forty years, schools across the nation have become more segregated. Judicial retrenchment on supporting integration efforts in recent decades have pushed integration advocates to find novel ways to reach their goals. One underexplored approach is the use of two-way dual language immersion programs (TWIs) to foster integration across racial, ethnic, and linguistic groups. TWIs are language instruction programs that teach in both English and a target language (i.e., Spanish, Mandarin) in classes that are designed to be linguistically diverse. We contribute to an emerging body of research on school integration with a mixed methods study of Spanish TWIs in North Carolina that sought to understand the extent to which TWIs in North Carolina are racially, ethnically, and linguistically diverse and what attracts families to them. Our quantitative analysis shows that elementary school Spanish TWIs in North Carolina enroll significantly larger shares of Hispanic students and multilingual learners and significantly smaller shares of Black and White students compared to non-TWI schools. We also find that Black students and low-income students tend to be under-enrolled in TWIs. Qualitatively we find that families are attracted to TWIs because of the perceived benefits of learning multiple languages and attending classes with culturally diverse groups of students. Notably, reasons for enrolling and challenges that were faced differed between English and Spanish-speaking families. In addition to contributing to scholarship on school integration, this investigation holds practical implications for how districts can integrate schools in a political environment that demands race-neutral approaches.

María Heysha Carrillo
Graduate Program: Educational Equity
Advisor: Crystal Chen Lee
Poster Number: 32

Navigating Borders: A Qualitative Case Study on Latine Students' Use of Border Pedagogy Practices in the New Latinx South

This qualitative case study examined how eight transnational Latine students leveraged border pedagogy practices through writing during a nine-month-long project. This research illustrates a literacy project serving as a platform for students to employ straddling, translanguaging, and testimony within a critical literacy framework that reimagines texts to promote socially just perspectives. These frameworks position Latine students as capable meaning-makers, fostering identity negotiation, critical consciousness, and challenging deficit perspectives. Deductive analysis revealed how students used border pedagogical practices in different ways toward their identity development, including embracing fluid identities, revealing tensions, and highlighting border crossing complexities. Findings showcase the richness within multicultural contexts, revealing how constructing hybrid identities involves navigating language, traditions, and stereotypes, embracing intersectionality, and demonstrating adaptability. By integrating these practices, border pedagogy creates inclusive, empowering environments validating diverse navigational experiences across cultures. Findings hold significance for education policy and practice by demonstrating how supporting hybrid languages and ways of being is vital for a pluralist, sustaining, and socially just education.

Laura Chalfant
Graduate Program: Science Education
Advisor: Soonhye Park
Poster Number: 34

Exploration of the Use of Teacher Time-Outs to Develop Reflection-In-Action in Preservice Science Teacher Education

This study aims to understand how preservice teachers (PSTs) and science teacher educators utilize reflection-in-action through the time-out protocol and examine the impact of the protocol on PSTs' microteaching experience. This paper seeks to understand how time-outs, or allowing PSTs to stop during a microteaching lesson, to reflect-in-action can enhance their learning and understanding of pedagogical concepts. Students' microteaching lessons were analyzed for use of the time-out protocol, and selected students were interviewed to ascertain their perceptions of the intervention on their microteaching experience. The findings indicate that the time-out protocol facilitates discussions about lesson modifications, student misconceptions, and pedagogical choices, leading to a deeper understanding of teaching practice. The findings contribute to the limited research on time-outs in science education and highlight the potential benefits of integrating this approach into teacher preparation programs. This research is valuable to science teacher educators because time-outs could be a useful tool to strengthen the PCK of preservice science teachers and enhance preservice teacher education by externalizing pedagogical decision-making and promoting reflection-in-action. Science education researchers will benefit from this research because, while somewhat explored in the mathematics education literature, research on time-outs is not widely represented in science education.

Austin Gragson and Rachel Rowan
Graduate Program: Educational Evaluation and Policy Analysis
Advisor: Michael Little
Poster Number: 63

Racial Segregation in Publicly Funded Preschool Programs: A Systematic Review

Research on preschool programs has demonstrated positive impacts on the academic and social development of children who attend them, especially for low-income students. However, research has also shown that access to high-quality preschool programs is not equal, and often lower-income students or racial minorities are more likely to attend lower-quality preschool programs, even in universal access systems. Although segregation in publicly funded preschool programs has been studied since the 1990s, no systematic review has been found in the literature. The current study aims to systematically review the literature on publicly funded preschool programs and segregation. We found that studies frequently focused on the developmental outcomes of students in these programs, structural factors of segregation, and other student characteristics, among other themes discussed. We also found few studies incorporated sophisticated quantitative methodologies when examining segregation in publicly funded preschool programs, and no studies reviewed focused on qualitative methods. Future directions for this body of research should include more diverse methodologies exploring this phenomenon as well as incorporating common reporting standards to allow for comparisons between studies and contexts.

Amanda JF Hall
Graduate Program: Learning and Teaching in STEM, Science Education
Advisor: Soonhye Park
Poster Number: 67

Mentor Teachers' Perceptions of Mentoring for Reform-Oriented Science Teaching Before and After Implementing Educative Mentoring Concepts

As science education shifts towards reform-oriented approaches, this qualitative research study addresses the challenge of effectively implementing these approaches in the classroom and the potential role of educative mentoring in supporting this shift by exploring the perceptions of experienced reform-oriented science teachers regarding mentoring practices. The study engages ten experienced biology and chemistry teacher mentors recognized for their constructivist and student-centered teaching methods through in-depth interviews conducted before and after educative mentoring professional development and subsequent implementation. The study examines how these mentors' perceptions of effective mentoring evolve and align with the principles of educative mentoring. Results indicate that these experienced mentors consistently emphasized the importance of relationships, alignment of teaching and mentoring, and commitment to the pedagogy. Furthermore, after applying the components of educative mentoring to the mentor teachers' perceptions, it became evident that their views were inherently aligned with the educative mentoring model. The findings underscore the insights provided by the mentors' perceptions, contributing to a deeper understanding of the practical implementation of educative mentoring. The research's alignment of reform-oriented science teaching with educative mentoring emphasizes the significance of offering educators educative mentorship as they adopt new pedagogies, contributing to the evolution of effective support systems in science education.

Tyler Harper-Gampp
Graduate Program: Learning and Teaching in STEM
Advisor: Cesar Delgado
Poster Number: 70

Exploring Middle School Students' Scale Cognition During Virtual Reality-Supported Science Instruction

The Next Generation Science Standards (NGSS) identify "scale, proportion, and quantity" as a crosscutting concept that pervades science. However, existing literature has demonstrated that people of varying ages and expertise have difficulty discerning the size and scale of multiple entities referenced throughout the NGSS. This might be attributed to learners' scarce embodied experiences with entities at the extremes of scale. VR's immersive capabilities have the potential to address this issue, but limited research exists on its application in K-12 settings. Therefore, this study investigates the impact of Scale Worlds (SW), an immersive virtual environment, where students can grow to the size of the Sun, shrink to the size of an atom, and explore all orders of magnitude in between. A nine-day co-designed instructional unit integrating size and scale reasoning with human impacts on Earth systems in middle school agriculture science was implemented across two classes, with one class integrating VR. Using an explanatory sequential mixed methods design, this study investigates students' scale reasoning using the Assessment of Size and Scale Cognition (ASSC), a previously validated instrument, at baseline and conclusion followed by semi-structured interviews. Preliminary quantitative results show that students in both classes significantly improved following the intervention ($p < 0.01$). Accuracy of absolute size estimate ($d = 0.45$), relative size estimate ($d = 0.11$), and aggregate performance ($d = 0.24$) were greater among students who utilized VR but did not reach statistical significance. This study demonstrates the intervention's ability to improve students' size and scale reasoning and suggests that the integration of VR increased overall knowledge gains, especially students' ability to accurately estimate absolute size.

John Hensley
Graduate Program: Teacher Education and Learning Sciences, Social Studies
Advisor: Meghan Manfra
Poster Number: 72

Dodging Bullets on a Dying Planet: Creating an Emancipatory Civics Curriculum for Gen Z

Acknowledging the poor record of current public school civic education to provide students with the skills and concepts necessary to navigate a hyper-partisan, polarized political context, this research will identify challenges in creating and implementing a transformational, emancipatory civics curriculum for emerging adults grounded in developing a critical consciousness in students that will allow them to take meaningful political actions. Life History Theory from developmental psychology is used to explain critical differences between current Gen Z emerging adults and other generational cohorts. A learning ecology approach is used to identify a full range of both endogenous and exogenous influences on students still developing a civic identity. Action research methodology is employed to identify both challenges and best practices in creating and disseminating this new curriculum. Hermeneutic phenomenology is used to better understand how emerging adults perceive and make sense of concepts like citizenship, civic duty and civic engagement.

Kelsey A. Jenkins
Graduate Program: Higher Education Administration
Advisor: Krispin Barr
Poster Number: 83

Transgender Student's Mental Health Challenges and Their Experiences at University Counseling Centers

As a result of marginalization, stress, microaggressions, and stereotypes, transgender and gender-diverse students often grapple with worse mental health compared to their peers. This takes a toll on their academic journey and success in college. In a recent survey by the Trevor Project, 81% of LGBTQ young people said they wanted mental health care. In this group of individuals, 56% were unable to obtain mental health care (The Trevor Project, 2023). A direct correlation exists between 56 percent of LGBTQ youth wishing to receive mental health treatment in the past year and being unable to do so because they fear they will not be given permission by their caregivers or that their providers will out them (The Trevor Project, 2023). The suicide rate among transgender individuals is over 40%, with the risk of suicide being highest among transgender youth (Austin, 2022). Consequently, nearly one in five transgender youth and gender-diverse youth attempted suicide in 2022, according to the Trevor Project survey.

This research examines transgender and gender-diverse mental health challenges and their experiences at university campus counseling centers in the United States. This research argues that numerous changes can be made to ensure the voices of transgender individuals are heard, including inclusive non-discrimination policies, access to safe spaces and safe group counseling on campus, improvements to mental health resources on campus, and specialized counselors aware of gender-minority issues within the counseling center.

It is crucial for policymakers and university counseling directors to put into place non-discrimination policies, offer easily accessible counseling, develop safe spaces, and encourage inclusive autonomy for transgender and gender-diverse students in higher education to foster their mental well-being.

Haleema Khalil and Crystal Chen Lee
Graduate Program: Teacher Education and Learning Sciences, Literacy and English Language Arts Education
Advisors: Crystal Lee and Jackie Relyea
Poster Number: 91

Enhancing Educators' Support of Muslim Students in the English Language Arts Classroom

Many English language arts (ELA) teachers have limited texts and resources that are representative of accurate portrayals of the Muslim culture. Despite there being more Muslims in the US now, Muslims are met with content that contains either the dominant narrative alone or a misrepresentation of the Muslim culture. When seen in literature, the portrayal of Muslims often involves a discriminatory perspective, contributing to their sense of alienation and rejection in Western societies. These characters have been boxed into certain stereotypes that have been perpetuated by media and pop culture for years. Therefore, a large problem that exists now is a glaring lack of corresponding changes in the educational curriculum, continuing to neglect the portrayal of favorable narratives from the Muslim world. This presentation aims to suggest how teachers can bring in multiple narratives to help deconstruct the biases about Muslims. In addition, the presentation will foster a conversation about teacher perceptions of Muslim representation in media and literature and how they can better support their students in the classroom. The presentation will address, "How can teachers be better prepared to teach their Muslim students?" To answer the question above, this presentation aims to advocate for the integration of Muslim literature into curriculum and discuss strategies to support Muslim students in the classroom.

Devan MacKenzie and Samantha Marshall
Graduate Program: Teacher Education and Learning Sciences
Advisor: Samantha Marshall
Poster Number: 106

"This is Information our Students Need to Know": Mathematics Teachers' Learning and Sensemaking of Culturally Sustaining Pedagogy Amongst Political Strife

Educational scholars advocate for the use of pedagogies that are culturally and linguistically affirming. While many teachers share this goal, there is uncertainty about the roles of culture and justice in classrooms, particularly in courses imagined as "objective," such as science and math. Additionally, teachers often perceive a disconnect between their pedagogical responsibilities (to teach their course content) and the social justice-oriented teaching strategies. In this paper, we examine the discourse of an affinity group of math teachers voluntarily working together to learn about culturally sustaining pedagogy. Using critical discourse analysis, we found that teachers struggle to balance teaching about subject content and social justice. However, our research also highlights the importance of teacher affinity groups, which provided crucial learning opportunities for this group of math educators, and gave them a space to navigate culturally sustaining pedagogy in math, while acknowledging the challenges of its implementation. In the discussion, we consider our findings in light of the rising political tension in education, especially considering the vilification of teachers and schools by conservative politicians and parents. Still, affinity groups can foster strength and perseverance for teachers working toward social justice.

Jeanne McClure
Graduate Program: Teacher Education and Learning Sciences, Learning Design and Technology
Advisor: Shiyan Jiang
Poster Number: 111

Unraveling the Magic of Question Design in Sparking Student Minds

This study explores the nuanced relationship between the design of educational questions and student engagement from a linguistic and cognitive standpoint. Utilizing the revised Bloom's taxonomy, the Interactive - Constructive - Active - Passive (ICAP) framework, and measures of lexical diversity (LD), this research aims to unveil how question structure impacts cognitive engagement (CE) and lexical diversity in student responses within a Machine Learning Curriculum. By examining self-reported student responses, the study identifies patterns of engagement and vocabulary use, providing insights into the effectiveness of different types of questions. Preliminary findings suggest that questions designed to elicit higher-order thinking skills, as outlined by Bloom's taxonomy, tend to promote greater cognitive engagement and lexical diversity. The study further investigates the role of question complexity and module sequence on sustaining student engagement over time. Results indicate a complex interplay between question design, cognitive engagement levels, and lexical diversity, highlighting the importance of carefully crafted questions in stimulating deeper learning processes. This research contributes to a better understanding of educational strategies that can enhance student engagement and comprehension, offering valuable implications for educators, curriculum designers, and ed-tech platforms in optimizing AI curriculums for a diverse student population.

Hamid Sanei
Graduate Program: Learning and Teaching in STEM
Advisor: Hollylynne Lee
Poster Number: 143

Enhancing Data Literacy and Storytelling through Tangible Data Engagement: An Inclusive and Equitable Approach in Data Science Education

Data physicalization represents a groundbreaking shift in the realm of data representation, transcending the limitations of traditional visualization methods by integrating tangible, physical elements into the encoding of data. This innovative approach, extensively discussed in foundational research (e.g., Hogan et al., 2013; Jansen et al., 2013), underscores the critical role of materiality and contextual interaction with data. It offers an intuitive and accessible means for individuals to engage with data, making complex information more understandable and relatable. By leveraging multisensory and motor skills, data physicalization aligns with human cognitive processes, significantly enhancing the comprehension and retention of data. This immersive technique enriches the user experience and fosters meaningful, multisensory interactions with data, establishing itself as an invaluable tool in both educational and professional settings.

The current research delves into the effects of data physicalizations on college students' engagement, understanding, and storytelling with data. It posits that transforming abstract datasets into physical models can substantially improve students' comprehension and retention of complex data concepts. The study is designed to merge theoretical frameworks with practical applications, employing a qualitative, phenomenological approach to uncover new insights into data science education and further develop teaching and learning strategies. The methodology encompasses the collection of participant-generated content, observational data, and the conduct of in-depth interviews to document the experiences of students interacting with tangible data thoroughly. This comprehensive approach aims to provide a detailed understanding of the educational benefits of data physicalization, ensuring the transparent and ethical dissemination of research findings.

The importance of this research extends beyond academic curiosity, holding significant potential to revolutionize educational practices and curriculum development. By integrating innovative pedagogical tools that enhance data literacy and storytelling skills, this study seeks to contribute valuable insights into how tangible data interactions can shape future educational methodologies and curriculum design. The exploration of data physicalization's benefits underscores the pivotal role of innovative pedagogical tools in fostering a deeper understanding of data literacy and storytelling abilities among students. Through this investigation, the research aims to illuminate how data physicalization can serve as a powerful catalyst for educational transformation, promoting a more engaging, inclusive, and effective learning environment that prepares students to navigate the complexities of data in their professional and personal lives.

Erik J. Schettig
Graduate Program: Learning and Teaching in STEM
Advisors: Aaron Clarl, Daniel Kelly, Cameron Denson, Tamecia Jones, and Angela Wiseman
Poster Number: 146

Student-Centered Learning in STEM Degree Programs: A Longitudinal Study on Patterns of Retention and Persistence

This study investigates the patterns of retention and persistence among students enrolled in STEM degree programs after experiencing an introductory engineering graphics course incorporating elements of a student-centered approach through supplemental active learning. The research addresses a critical gap in understanding how students with experiences in such environments experience retention and persistence in STEM disciplines. Findings suggest that student-centered learning environments, characterized by active learning, collaboration, and real-world application of course content, positively influence student retention and persistence. Key factors contributing to retention and persistence include increased self-efficacy, academic success, and engagement with course materials.

The study employs a longitudinal approach, analyzing data collected over three semesters from a large sample of STEM degree students. The goals of the study include contributing to the growing body of literature on STEM education by highlighting the importance of creating supportive and engaging learning environments. Results from the study have implications for curriculum development and instructional practices aimed at enhancing student retention and persistence in STEM degree programs. Additionally, the study underscores the need for further research to explore how different educational contexts and institutional practices influence student outcomes in STEM education.

However, the study also identifies limitations, including external factors beyond institutional control and the narrow focus on STEM degree programs within a single institution. Despite these limitations, the research provides valuable insights into the effectiveness of student-centered learning approaches in promoting long-term student success in STEM disciplines.

Elizabeth A. Shaver
Graduate Program: Teacher Education and Learning Science
Advisor: Meghan M. Manfra
Poster Number: 147

Help! I'm a First Year Teacher (Again): One Graduate Student's Action Research Study into Improving Her Own University Classroom Instruction

This study is an action research study of my own practices that seeks to reflect on my own practices and gain knowledge from the wisdoms of practice of experienced elementary instructors. This study is an opportunity to improve my own practices as a university instructor of elementary social studies methods and to position myself more clearly as a capable practitioner and theorist (Edwards, 2005; McNiff, 2016). As teachers, we often must reinvent ourselves when assigned to new classes and curricula, and I have learned that graduate and early-career university instructors are no different. The research presented in this poster presentation represents an initial analysis of data collected through the first two phases of the study that includes analysis of my own syllabi, as well as interviews, observations, and syllabi from three current elementary education instructors.

Simone Spencer
Graduate Program: Higher Education Administration
Advisor: Krispin Barr
Poster Number: 152

Black Women with White Supervisors: Career Making or Spirit Breaking

Kimberle Crenshaw coined the term "intersectionality" which describes how multiple marginalized identities within a person compound and create a new human experience. Black women are the blueprint example when discussing these terms because they are a part of the two largest, historically oppressed groups in the United States. Being Black and a Woman provides a specific experience that one would not be exposed to by being a part of exclusively one of these groups. Currently, higher education news is flooded with Black Women who are leaving the field by quitting, suicide or being forced out of their leadership positions. No other group experiences turnover in the field of higher education as much as Black Women. This research will use interviews with Black Women who have been or are currently working in the field of higher education. These interviews will explore the trauma and workplace struggles that Black Women experience while working in higher education under White supervisors and peers.

Kelly Womack-Adams
Graduate Program: Teacher Education and Learning Sciences
Advisors: Temple Walkowiak and Jessica Hunt
Poster Number: 172

"How you gonna solve it?": The Use of Black Language in a First-Grade Mathematics Classroom

The teaching and learning of mathematics involves more than simply solving equations or memorizing tables. Teachers must make use of language to explain complex concepts and students must make use of language to understand those concepts and reason through ideas. Many of the numerous languages and dialects in the US make their way into the mathematics classroom. However, the typical mathematics curriculum is written in and taught using White Mainstream English (WME). This can cause miscommunication within a classroom that predominantly uses a different dialect, like Black Language (BL). Through a mixed-methods, microethnographic approach, the language use of a Black, first-grade mathematics teacher and their predominantly Black class was studied. The goal of this study was to understand the presence of BL within the early mathematics classroom space. Observations were conducted during a unit on addition and subtraction story problems. Transcripts of select observations were analyzed using critical discourse analysis to understand the student and teacher patterns of language use. Student patterns of language use indicated that they used BL to navigate peer relationships and used both BL and WME when discussing mathematical concepts. The teacher patterns of language use also demonstrated they used BL to connect and build relationships with their students and they used code-switching between BL and WME for mathematics instruction. The use of code-switching was mainly to interpret and restate problems and questions for students. Interestingly, the teacher's language was predominantly WME when disciplining and/or redirecting students. This emphasized how WME was a language of authority in the predominantly Black classroom. Since language use is integral to mathematics teaching and learning, an increased understanding of languages and dialects in the classroom will lead to more equitable teaching and increased understanding.

College of Engineering

Muhammad Abdelraziq
Graduate Program: Electrical Engineering
Poster Number: 1

The Next-Generation Public Charging Infrastructure and Cyber-Information Network for Enhanced Inclusion and Independent Living of Power Mobility Device Users

A survey conducted in 2000 estimated that 1.7 million people with mobility disabilities used wheelchairs or scooters to alleviate their mobility challenges.One may expect that the use of PMDs would reduce or eliminate the mobility or accessibility challenges amongst individuals affected by mobility disabilities. However, the rehabilitation literature shows that PMD users travel in their devices 3.6 times less than an average person walks and about less than 30% of those using manual wheelchairs. The lack of ergonomic charging infrastructure is the primary unmet need prohibiting a wider outdoor use of PMD devices. Another reason is inaccurate battery monitoring or management systems (BMS), where 50% of wheelchair users experienced at least one stranded situation due to battery management inaccuracies. While further exploring the source of these limitations, we identified that PMD power- and energy-related issues are among the top challenges singled out by users and caregivers.We transformed commercially available Power WheelChairs (PWCs) into" Smart PWCs" by integrating computers and sensors into them. Following this concept, our proposed system comprises hardware subsystems (Charging System and the Data Acquisition and Sensing System (DASS)) and software subsystems (Advanced SoC Estimator, App, AI Training Module, and AI-Based Energy Estimator - Route Planner). The software subsystems are hosted in the Cloud on servers, inside the DASS Unit (Advanced SoC Estimator), and on the user's mobile device (HMI). The advanced SoC Estimator accurately tracks the battery State of Charge (SoC), while the DASS unit records PWC sensor measurements every time the unit leaves home. Periodically, data is uploaded via WiFi to the Cloud to retrain and update the Graph Neural Network inside the AI-Based Energy Estimator - Route Planner. Smart charging station features include an LCD to display the charger status and charging information and a charging meter to calculate the energy consumption per charging cycle. The charging station uses a Raspberry Pi (RPi) for IoT connection, while the App can connect to the Internet through cellular or WiFi networks. When nearby, the charging station and App utilize direct wireless communication (Bluetooth) to initialize the charging conditions. In the following text, the hardware subsystem will be referred to as Public Charging Infrastructure, while the software and communication elements will be referred to as Cyber Information Network.

Apoorv Agarwal
Graduate Program: Electrical Engineering
Advisor: Subhashish Bhattacharya
Poster Number: 2

Solid State Transformer for a Space-Critical Capacitor Charging Power Supply System

Enhanced Geothermal systems (EGS) offer the most resource potential of geothermal energy. More than 100 GWe of economically viable capacity may be available in the continental United States. However, these EGS resources are locked within the high-strength, hard crystalline rock - where the conventional tools in the drilling industry suffer from a limited lifetime of drill bit and bit-bearings. The Electric Impulse Drilling (EID) is a promising alternative to enable cost-effective and fast drilling. EID employs high-voltage impulses to split rock without any mechanical wear. Capacitor charging power supplies (CCPS) enable EID, repeatedly charging a high-voltage (HV) capacitor and releasing the stored energy into the load. The CCPS-EID system has to be integrated into the drill string for its end application. The current solution implements a turbine-driven generator and a CCPS system comprising a step-up low-frequency (LF) transformer and a rectifier unit. However, fitting it in the drill string is challenging due to the bulky size of the LF transformer and rectifier. To improve the power density, we propose a Solid State Transformer (SST) based CCPS system composed of an AC-DC converter and a DC-DC converter employing high-frequency (HF) transformers. The work proposes a DC-DC converter employing an Input Parallel Output Series- Phase Shifted Full Bridge converter. The proposed DC-DC converter possesses a low output current ripple to improve the lifetime of the HV pulsed capacitor. Also, mechanical wear issues on the turbine-generator set due to the fast-pulsing nature of the CCPS application are analyzed. The intermediate DC-link capacitor is provided as a buffer element to minimize these disturbances. The sizing of the capacitance for two different charging methods is presented and compared. A scaled-down hardware prototype is built to validate the design. The low volume and weight of the proposed SST design help realize the space-critical CCPS-EID system.

Nafi Ahmed
Graduate Program: Industrial Engineering
Advisor: Rohan Shirwaiker
Poster Number: 3

Development and Implementation of Advanced Data-Driven Digital Twin for Biofabrication

Biofabrication, which integrates biological sciences with advanced manufacturing, is vital for innovations in tissue engineering and regenerative medicine. One primary consideration in this domain is ensuring consistent, scalable, and adaptable processes that are amenable for clinical translation. Traditional biofabrication approaches heavily depend on empirical, trial-and-error methodologies. This causes substantial material wastage, higher costs, and prolonged research and development timelines. Furthermore, the complex interplay of physical and biological factors in biofabrication processes poses difficulties in predicting outcomes and ensuring consistent quality. The proposed research aims to address these challenges through the development and implementation of an advanced data-driven digital twin technology for biofabrication. This digital twin will serve as a sophisticated virtual model that accurately reflects the multi-faceted physical and biological dynamics of biofabrication processes. By leveraging the digital twin technology, the research seeks to transition from the existing trial-and-error paradigm to a more robust and predictive approach. The digital twin will integrate advanced data analytics, machine learning algorithms, and computational simulations to create a feedback loop between the virtual and physical models. This loop will facilitate real-time monitoring, control, and optimization of biofabrication processes. The digital twin will encapsulate critical process parameters, mechanical properties, and biophysical interactions within the biofabrication environment. It will employ predictive modeling to anticipate process outcomes and adaptively suggest modifications to enhance quality and efficiency. The anticipated outcomes of the research include a reduction in material wastage, lower production costs, and a shorter timeline for the development of biofabricated products. Additionally, the digital twin will enable a more profound understanding of the biofabrication process, thus expediting the translation of biofabricated products from the laboratory to clinical applications. In essence, the research will yield a transformative tool for the biofabrication industry, enhancing the predictability and control over complex biofabrication processes.

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Poster Number: 4

Identification of Congestion Onset: Probe Data Approach

Traffic congestion has been escalating as a critical problem for cities, leading to increased driver stress and environmental degradation through air and noise pollution. This research explores ways in which probe data can be used to sense the onset of congestion caused by traffic or incidents, either in advance, in the case of building traffic, or when it happens, in the case of incidents. The underlying motivation is to protect system productivity, and increase safety, through early detection. We define the “onset of congestion” and emphasize its importance in traffic management. It highlights the significance of analyzing percentile distributions of travel times on arterials to detect early signs of congestion, a novel approach distinct from freeway monitoring. The work is being conducted using probe and ATSPM data for a busy arterial in Concord, NC. The arterial is bisected by I-85 and the right-hand side leads to the Charlotte Speedway. The probe data were obtained from Wejo for a month in 2022 during racing season. A VISSIM model was created and carefully calibrated so that we could see what probe penetration rate would be needed to gain a clear picture of transitioning performance. The juxtaposition of cumulative distribution functions from both real-world and simulated data underscores our findings. Analyzing probe data unveils insights into traffic system performance, revealing patterns not captured by traditional signal or detector analysis. Especially, lower percentile travel times emerge as early indicators of congestion shifts, offering more precise insights than higher percentiles. Despite varying rates at individual intersections, the consistency across overall travel rate distributions highlights the dynamics of traffic complexity, advocating for an integrated approach to congestion management that acknowledges both global trends and local variances.

Ryan G. Bing
Graduate Program: Chemical and Biomolecular Engineering
Advisor: Robert M. Kelly
Poster Number: 16

Turning Plants into Industrial Chemicals: Metabolic Engineering of Lignocellulolytic Extremely Thermophilic Bacteria

The world is searching for alternatives to non-renewable fossil-derived commodities. As the most abundant biomass on earth, plants are an attractive sustainable feedstock choice. However, deconstruction of the complex polymers contained in plant biomass (lignin, cellulose, hemicelluloses, etc.) and subsequent conversion to industrially relevant products has proven difficult. Combining deconstruction and conversion into a single step with engineered microbes, known as consolidated bioprocessing, is desirable for improving process efficiency and reducing costs associated with chemical, mechanical, and enzymatic pretreatments of plant biomass. Members of the family Caldicellulosiruptoraceae are extremely thermophilic (Topt > 70°C; Tmax = 90°C) bacteria that natively harbor large sets of multi-domain enzymes that excel at deconstruction of polysaccharides contained in plant biomass. However, they do not natively produce industrial products. One of these bacteria, Anaerocellum bescii, has been the target of metabolic engineering efforts to produce commercially important products. Here, fermentation product titer and selectivity of non-native volatile products (ethanol, acetone) were significantly improved through strategic metabolic engineering. Ethanol titer of > 5 g/L and selectivity of up to 80% theoretical yield were achieved. Additionally, novel insights were gained for how A. bescii responds to and manages redox-stress induced by ethanol production. Moving beyond ethanol to a redox-balanced volatile product, acetone, a detailed technical economic analysis of industrial scale bioconversion of soybean hulls and transgenic poplar to acetone and hydrogen by A. bescii was conducted. This leveraged extreme thermophily, volatility of acetone, and native hydrogen production to enable 'bioreactive distillation', where products are separated via the fermentation vapor phase. This showed the feasibility of thermophiles at industrial scale, and set tangible engineering targets for acetone production at 20 g/L and 0.2 g/L/h. Overall, this work moves consolidated bioprocessing with A. bescii a step closer to industrial relevance.

Gregory Bremser
Graduate Program: Operations Research
Advisor: Brandon McConnell
Poster Number: 21

Analyzing Scheduling Policies and Performance Impacts with Discrete Event Simulation of a Small Veterinary Practice

Pet ownership has increased in American households year over year since 2016, which has led to an increased demand for veterinarian services. Concurrently, the rate of new veterinarians joining the workforce has remained stagnant. With the increased demands, veterinary clinics require great efficiency in planning clinic operations to provide high-quality care, increase profits, and decrease staffing-related stress. Simulation can be used to cheaply and safely experiment with staffing levels and appointment schedules in a virtual environment to assess the impact of potential changes. This research uses data from a veterinary clinic in Ankeny, Iowa, to build a discrete event simulation using data collected both in-person and from the clinic's enterprise software. The model evaluates various appointment schedules at the current and alternative staffing policies. Experimentation provides insight into how the clinic would perform with changes in staffing and scheduled appointments. The results show that with proper adjustments, the clinic can improve profitability, and there are alternative scheduling strategies that increase employees' flexible work schedule opportunities to improve employee satisfaction.

Partha Pratim Das and Subhransu Satpathy
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Poster Number: 44

Next-Generation Fault-Tolerant Motor Drives for Transportation Applications

Global climate change and the depletion of fossil fuels are increasing interest in electric transport systems. One of the main concerns of electric transport systems is their reliability against common failures. One solution to the reliability issue of motor drives is to use multi-phase machines. The capability of operating at a lower power level in the event of one or more phase failures is the reason behind the increasing popularity of multi-phase machines. Symmetrical Six-Phase (SSP) Permanent Magnet Synchronous Machine (PMSM) is one of the most common multiphase PMSMs for its easy construction and low DC bus capacitor requirements for drives. In SSP-PMSM, two three-phase windings are spatially shifted by 600. Moreover, GaN-based Three Level (3L) SSP-PMSM drives have a 75% lower DC bus capacitor requirement and a 7% lower heatsink size requirement compared to its three-phase counterpart. The common mode voltage of SSP-PMSM drives can be made zero by interleaving. The aim of this work is to design a drive that can operate seamlessly in the case of one or multiple-phase failures. My research focuses on efficient healthy-state operations, different kinds of faults and their diagnosis techniques, and reliable post-fault operations of 3L-SSP-PMSM drives.

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Poster Number: 50

Cell-Derived Matrix Hydrogels Allow for Generation of Human Vasculature-on-Chip Systems

Decellularized extracellular matrix (dECM) scaffolds and hydrogels are commonly used in in vitro and in vivo tissue engineering techniques to recapitulate the native microenvironment more faithfully, but the use of human dECMs has been limited due to the availability of human tissue. Cell-derived matrix (CDM) can be generated from a variety of human cell types in vitro and provides a platform to study the biophysical and biochemical properties of ECM. In this study, we utilize CDM from human dermal fibroblasts to develop a CDM composite hydrogel for use within three-dimensional microphysiological models of the vasculature. We assess the composition of the CDM through multiple processing steps towards hydrogel formulation using proteomic. We then characterize several hydrogel formulations by assessing the gelation kinetics measured by absorbance, the mechanical properties measured by nanoindentation, and the microstructure analyzed by scanning electron microscopy (SEM). We demonstrate the utility of these CDM composite hydrogel formulations to foster endothelial cell attachment and growth as two- and three-dimensional substrates. Further, we pattern these CDM composite hydrogels for use within microfluidic devices to fabricate two different vasculature-on-chip platforms that incorporate human endothelial cells. Interestingly, we found that CDM composite hydrogels are enriched in proteins associated with vascular morphogenesis, and functional analysis demonstrates pro-angiogenic signatures in endothelial cells cultured in these hydrogels. The results of this study suggest that human-derived CDM composite hydrogels could address technical gaps in the development of human organs-on-chip and serve as substrates to promote endothelial cell migration and proliferation.

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Poster Number: 54

Energy Systems Capacity Expansion Planning Under the Risk of Hurricane Damage

In energy systems long-term planning, also known as capacity expansion planning, an energy system optimization model (ESOM) is often used to identify the least-cost mix of system resources to meet the projected energy demand while taking into consideration government policies, fuel price trajectories, technology capital and operational expenses, among other factors. As with any model using future data estimates, uncertainty plays a critical role in the system results, and therefore, stochastic programming techniques are frequently used to increase the robustness of the model solution. In this case, the ESOM minimizes the expected system cost over a set of possible scenarios (e.g., high/medium/low fuel costs) instead of using a single input scenario. Despite the substantial damages caused by extreme weather events to power and energy systems, these are rarely incorporated into the scenarios of capacity expansion studies. In this project, we use stochastic programming to better understand the changes in electricity costs and system planning infrastructure, given the incorporation of hurricane scenarios in an ESOM for the North Carolina energy system. Besides being one of the states most affected by hurricanes on the US-East coast, North Carolina has recently approved the House Bill 951, which establishes a target of 70% reduction in CO2 emission (from electrical energy generation) from 2005 levels and carbon neutrality by 2050. This new law significantly changed the capacity expansion planning of the state, creating the need for faster decommissioning of coal plants and greater investments in transmission and storage to support the higher levels of solar and wind energy penetration. Under this new planning framework with accelerated renewable energy integration, our model simulations could contribute to a better understanding of the risks of hurricane damage to the North Carolina system, providing possible strategies to minimize its impact if necessary.

Isabella Gransbury
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Advisor: Veronica Cateté
Poster Number: 64

Investigating A New Pair Programming Collaboration Method For Block-Based Programming Environments

A common collaboration method used in computer science (CS) education is pair programming. During traditional pair programming, one student, the Driver, physically programs, while the other student, the Navigator, instructs the Driver to complete the program. Previous work investigating pair programming has shown it increases K-12 students' confidence, enjoyment, and positive attitudes. However, additional research shows that pair programming can be inequitable and ineffective in K-12 CS education within certain student pairings. This research investigates student behavior and attitudes while using a new collaboration method called Puzzle, which allows both students to act as Drivers. With Puzzle, each student has half of the available actions in a block-based programming environment. The division of these actions is meant to act as a structure to help engage students in collaborative behavior such as asking questions and explaining thought processes. A study using the case study method was employed to investigate collaborative behaviors of various student pairs using Puzzle. All student pairings completed the same computer science activity while their audio was recorded. Using a conversational framework that evaluates the pairs' distribution of talk, content of talk, and student positioning, we determined patterns of collaboration that occurred among the pairs. The results indicate there may be a pattern of conversation that indicates when a group is behaving more collaboratively. Additionally, we investigated the effect of the Driver-Navigator pair programming and Puzzle method on student attitudes. During the week-long study, we distributed a pre and post survey that examined student attitudes toward collaboration, computer confidence, and programming interest. Data analysis indicates no significant difference in student attitudes overall and between the two groups. Further research is needed to determine the long-term effects of the Puzzle method on student collaborative behaviors and attitudes towards computer science.

Joshua Grassel
Graduate Program: Operations Research
Advisor: Adolfo R. Escobedo
Poster Number: 65

Predicting the Composition of Solid Waste at the County Scale

This research introduces a novel two-phase strategy for predicting municipal solid waste (MSW), separating the prediction of the waste composition from the total quantity generated. The primary goal is to facilitate more informed decisions in solid waste management (SWM) and to support the transition towards a circular economy by providing MSW predictions broken down by material. Utilizing publicly available data encompassing demographic, economic, and spatial predictors in conjunction with waste sampling reports, this study employs a Least Absolute Shrinkage and Selection Operator (LASSO) regression model to estimate the MSW composition across 43 comprehensive material categories. The composition prediction model has potential for predicting MSW composition distinctly from the MSW quantity. The model's capability is demonstrated through case studies, showcasing its potential to provide detailed waste estimates at the county level.

Ethan Houser
Graduate Program: Industrial and Systems Engineering
Advisor: Sara Shashaani
Poster Number: 75

Robust Screening and Partitioning for Feature Selection

Feature selection is the process of eliminating irrelevant or redundant covariates in a dataset to construct interpretable prediction models. Feature selection optimization is often done greedily or inefficiently. To improve robustness, previous work has re-framed this problem as a simulation optimization solved with genetic algorithms. However, a more cost-effective search would utilize past information to direct the search in future iterations. We propose a stochastic search using a new algorithm based on nested partitioning informed by an initial rapid screening phase. Our experiments compare the performance, provide practical guidelines, and illuminate steps towards rigorous analysis in future research.

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Poster Number: 76

Sustainable Conversion of Carbon Dioxide and Methane via a Thermochemical Cyclic Redox Scheme

Carbon dioxide is a major greenhouse gas contributing to global climate change. As such, efficient and economically viable carbon dioxide utilization technologies are highly desirable. Dry reforming of methane (DRM) offers an opportunity to utilize CO2 to produce syngas. However, DRM generates syngas with an H2/CO ratio of ~1 and this limits its applications for downstream chemical production. To overcome this limitation, we propose an open-loop hybrid redox process (HRP) concept that utilizes a redox catalyst (RC) and works in two separate steps where methane is partially oxidized (by consuming oxygen from the RC) in the first step to yield syngas with an H2/CO ratio of ~2. The consumed RC then reacts with CO2 in the second step to yield CO. The utilization of CO2 via these RCs depends significantly on heuristics and trial-and-error approaches. Consequently, there is a pressing requirement for computational tools validated through experiments, which can efficiently limit the design space for CO2 utilization catalysts. In our approach, we customize the oxygen partial pressure to align with the targeted reactions. For example, various compositions of LaFe1-xMnxO3−δ were synthesized to tailor the oxygen partial pressures and the results showed that, unlike standalone redox pairs (Fe/FeO and Mn2O3/Mn3O4) favoring complete CH4 combustion, perovskite RCs preferentially oxidize CH4 to syngas. The addition of 1 wt% ruthenium (Ru) significantly improved redox kinetics without altering thermodynamics. Ru-impregnated perovskite RCs, including LaFeO3, LaFe0.625Mn0.375O3, and LaFe0.5Mn0.5O3, exhibited excellent performance with high syngas yield (92– 100%) and CO2 conversion (95–98%). During long-term testing, Ru-impregnated LaFeO3 and LaFe0.5Mn0.5O3 maintained stable performance over 100 cycles, while others experienced activity loss. Detailed characterizations indicated that stable performance was observed when the RCs did not undergo phase segregation or when the segregated metal cations could be thermodynamically reincorporated during the CO2 splitting step. This work validates a model-guided mixed oxide design strategy, demonstrating its effectiveness in optimizing redox catalysts for CO2 utilization. Additionally, it unveils the deactivation mechanism for a mixed oxide-based redox catalyst and reports an effective approach to reverse the deactivation, ensuring long-term stability.

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Graduate Program: Civil, Construction, and Environmental Engineering
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Poster Number: 77

Geologic Considerations in Liquefaction-Induced Lateral Spreading Assessment

Liquefaction-induced lateral spreading, which refers to permanent horizontal ground deformations, poses a significant threat to civil infrastructure, particularly in earthquake-prone regions. Despite recent advances, standard predictive models of lateral spreading often harbor considerable uncertainties (i.e., 50 – 200 % error). Absence of direct incorporation of geological conditions, as well as the limited representation of earthquake ground motion characteristics, are key sources of variability in current models. Given that fluvial environments are some of the most susceptible to these deformations, we develop and test several hypotheses based on established fluvial geomorphic facies models. We construct a geospatial analytical framework to evaluate the proposed hypotheses and we validate it using extensive ground deformation data from Christchurch, New Zealand, to identify regions most susceptible to liquefaction and its consequences. Additionally, we designed a novel laboratory experimental setup to assess the effect of subsurface geometry (e.g., inclined strata) resulting from depositional processes on the shear strength of soil deposits. Our findings suggest that specific fluvial environments exhibit varying degrees of vulnerability to liquefaction and its consequences, as a result of varying grain size distribution, interlocking capabilities, and relative age of deposition. For example, we quantitatively demonstrate that there are more liquefaction-induced deformations (1) inside a river bend (point bar) compared to the outside (cut bank), (2) upstream of a point bar rather than downstream, and (3) in regions of active deposition compared to areas of inactive river deposition (e.g., oxbow lake). Furthermore, our laboratory studies indicate a reduction in soil shear strength when soil layers are inclined compared to when they are horizontal and suggest that natural fluvial deposits, which are typically inclined may be more vulnerable to liquefaction than conventional testing methods would indicate. These findings contribute to efforts aimed at improving predictions of lateral spreading and ensuring the resilience of infrastructure in fluvial environments.

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Poster Number: 89

An Agent-Based Modeling Approach to Assess the Socio-Economic and Social Equity Impacts of Dynamic Pricing in Residential Water Management

Climate change, urbanization, aging infrastructure, and rising energy costs require water utility managers to consider policies that manage peak water consumption while meeting the needs of water users with affordable, reliable and safe drinking water. Peak water consumption can exacerbate strains on aging infrastructure and often coincides with peak electricity prices, increasing operation costs for water utilities. Water rates are a part of a demand-side management approach that can elicit water-use behavior changes. As an example, dynamic pricing policies increase the marginal cost of water during periods of peak water use to encourage users to shift their water usage to off-peak times, reducing the strain on infrastructure and the operating cost of the utility. With the adoption of advanced metering infrastructure (AMI) within the water industry, utilities can collect medium-resolution water consumption data to monitor and charge for the timing of hourly water use. However, dynamic pricing can lead to inequitable water costs across a community. Low-income households may have less flexibility in their time-of-use, limiting their ability to respond to dynamic pricing as strategically as high-income households. Households with more inhabitants, which are typically low-income households, typically pay a higher average price than smaller households under conventional tiered pricing policies; this effect can be exacerbated by dynamic pricing. The goal of this research is to assess the differential impact dynamic pricing has on heterogeneous water users. This research develops an agent-based model (ABM) to simulate the response of a community of water users to dynamic pricing. The ABM is applied for a case study, and model outcomes assess the impact that dynamic pricing has on the volume of water consumption, time-of-use, and price of water for households that differ in socio-economic characteristics. This research develops an ABM approach that can be used to quantify inequities in water costs based on household attributes and the ability of water users to respond to demand-side management policies

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Poster Number: 96

Decentralized Decision-Making Framework for Managing Product Rollovers in the Semiconductor Industry

In fiercely competitive industries like the semiconductor sector, companies must continually refresh their product lineup to maintain and grow their market share. This process, wherein a company introduces new product generations while phasing out older ones within a specified timeframe, is referred to as a "product rollover." Executing an efficient product rollover strategy poses numerous operational challenges. On the supply side, semiconductor manufacturing involves intricate production processes with unpredictable yields. Given the very high costs of manufacturing capacity and long lead times for new equipment delivery, short-term capacity expansion is not economical. Additionally, the production capacity needed for new product development must come from existing production lines responsible for current market offerings. Since tech firms compete across various specialized market segments, they typically organize into distinct business units, each focusing on specific market niches. Consequently, these units vie for manufacturing capacity to produce current market offerings and prototypes, and samples for future product generations.

The information crucial for devising an effective product rollover strategy is dispersed among different agents involved in planning, production, and development processes, making a centralized solution impractical. Therefore, this research seeks to formulate a fully decentralized framework where each agent communicates its plans and capabilities to achieve coordinated outcomes. Initially, we construct a centralized model using Lagrangian decomposition methodology, which is subsequently decomposed. We devise a fully separable solution technique based on the Lagrangian dual, along with a method to derive primal feasible solutions from relaxed ones. Computational experiments conducted on randomly generated test instances, mirroring industrial scenarios, demonstrate that the proposed decentralized approaches yield nearly optimal solutions, albeit with longer solution times than centralized models. We conclude by discussing several potential avenues for future exploration

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Poster Number: 98

PINE: Efficient yet Effective Piecewise Linear Trees

Decision Trees are popularly used in statistics and machine learning for various predictive modeling tasks. Piecewise Linear Trees fit linear models to evaluate splits and predict outcomes at the leaf nodes. However, they are computationally expensive, and no scalable implementations currently exist. In this paper, we introduce PINE, an efficient yet effective approach for training piece-wise linear trees, incorporating various algorithmic and system optimizations. These optimizations enable fast and scalable training on parallel CPU machines without sacrificing model accuracy. We also present PINEBoost, which applies gradient boosting to PINE, and compare its performance with existing frameworks. Experimental results demonstrate that PINE and PINEBoost achieve superior accuracy and faster convergence rates across general datasets in regression tasks compared to state-of-the-art Gradient Boosting Decision Tree.

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Poster Number: 108

Injectable Chitosan Hydrogel for Localized Delivery of Cancer Immunotherapeutics

Introduction: Localized delivery methods with slow-release kinetics can avoid systemic exposure and improve cancer treatment. Although direct tumor injection is a clinically relevant approach, intratumoral delivery is extremely difficult, as saline-based solutions are rapidly excluded from the tumor. Utilizing hydrogels as a delivery medium can address this shortcoming. To this end, we developed and characterized an injectable chitosan-based hydrogel, termed XCSgel, for immunotherapeutic intratumoral delivery. We demonstrated its anti-tumor activity in an E0771 triple negative breast cancer murine model.

Materials and Methods: Rheology: XCSgels underwent oscillatory frequency and amplitude sweeps, continuous step-strain tests, and continuous flow viscosity sweeps. In vitro release: Fluorophores and cytokines were released into sink conditions over a week duration. In vivo release: IL-12-AF647 was loaded into two differently composed XCSgels and imaged over a month to quantify release. In vivo treatment: 5x105 E0771 breast cancer cells were implanted orthotopically in C57BL/6 mice. Mice were treated with 20ug or 5ug or 1ug IL-12 in XCSgel, or XCSgel alone. Mice that had eliminated the tumor were rechallenged.

Results and Discussion: The chitosan hydrogel demonstrated shear-thinning, self-healing properties. In vitro fluorophore and cytokine release studies demonstrated sustained, charge-dependent release. In vivo release studies confirmed our ability to tune the release of a model therapeutic from XCSgel. In in vivo treatments, tumors were eliminated in mice treated with 5ug IL-12 in gel, with established immune memory.

Conclusions: A novel, injectable, self-healing chitosan hydrogel provided sustained release of both small and large molecules. This hydrogel can be engineered to provide faster or slower release as needed. In vivo studies demonstrated improved anti-tumor effect. Given the ability of this localized immunotherapy to induce systemic antitumor immunity, it deserves further consideration as a neo-adjuvant treatment prior to breast-conserving surgery.

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Poster Number: 101

The Gas to Grid Connection: Synchronous Stochastic Simulation of U.S. Bulk Electric Power and Natural Gas Markets

In the past decade, natural gas has become the cornerstone of U.S. energy production and usage. It accounts for almost half of end use consumption in the electric power (38%) and industrial (41%) sectors, and the primary source of heating in 60% of households nationwide. NG is also subject to uncontrollable market forces due to extreme weather and world events, including shocks to both its supply and demand as seen in the aftermath of winter storm Uri in Texas in 2021 where production was severely limited due to freeze-offs, the Russian invasion of Ukraine in 2022, and winter storm Elliot in 2022. All of which contributed to elevated NG prices substantially, causing spillover effects to other sectors of the economy. The power grid is particularly vulnerable to these risks as it relies on gas-fired generation during times of peak demand throughout the year. While the U.S. is not electrically connected, each region is joined via a nationwide system of production and pipeline transportation for NG. By modeling these connections through optimization and simulation, we hope to shed light on hidden vulnerabilities from the coupled sectors.

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Poster Number: 110

The Respective and Dependent Effects of Scattering and Bone Matrix Absorption on Ultrasound Attenuation in Cortical Bone

Cortical bone is characterized by a dense solid matrix permeated by fluid-filled pores that range in diameter from the sub-micron level to more than 100 μm. Ultrasound scattering has potential for the non-invasive evaluation of changes in bone porosity, which could be useful in screening for bone diseases, such as osteopenia and osteoporosis. However, there is an incomplete understanding of the impact of ultrasonic absorption in the solid matrix on ultrasound scattering. In this study, maps were derived from scanning acoustic microscopy images of human femur cross-sections. Finite-difference time domain (FDTD) ultrasound scatter simulations were conducted on these maps. Pore density, the diameter distribution of the pores, and nominal absorption values in the solid and fluid matrices were controlled. Ultrasound pulses with a central frequency of 8.2 MHz were propagated through the samples, both in through-transmission and backscattering configurations. From these data, the scattering, bone matrix absorption, and attenuation extinction lengths were calculated. The results demonstrated that as absorption in the solid matrix was varied, the scattering, absorption, and attenuation extinction lengths were significantly impacted. It was shown that for lower values of absorption in the solid matrix (less than 2 dB/mm), attenuation due to scattering dominates, whereas at higher values of absorption (more than 2 dB/mm), attenuation due to absorption dominates. This will impact how ultrasound attenuation and scattering parameters can be used to extract quantitative information on bone microstructure.

Katherine Moody
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Advisor: Yong Zhu
Poster Number: 117

Mechanics of Metal Nanowire Network and Application for Stretchable Electronics

Nanomaterials, such as metallic nanowire (NW) networks, have become an essential material in a large array of applications, more notably flexible and stretchable electronics. Successfully integrating NWs into electronics requires a complete understanding of (1) NW network structure, (2) Interactions that occur between the individual NWs, and (3) Interactions between NWs and the flexible substrate. Here we present an investigation of the behavior of single nanowires and simple networks of a few NWs on a flexible substrate. The single NW/substrate interface was shown to follow nonlinear and bilinear cohesive shear lag models, dependent on the substrate's surface characteristics. NWs axially aligned in the stretching direction experienced sliding after reaching a critical interfacial shear stress between the NW and the substrate. However, NWs aligned in the transverse direction were observed to buckle and fracture as the strain in the substrate increased. In the case of two NWs, it was observed that the individual NWs experienced sliding or buckling depending on their initial orientation. The two nanowires in contact were shown to rotate at the junction and the rotation was reversible for substrate strains of 55%. Building on these results, we developed a multiscale finite element model to predict the mechanical and electromechanical behaviors of the network, which can be compared with experimental results.

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Poster Number: 121

Exploring the Dynamics of Ammonia as a Green, Zero-Carbon Fuel for Future Energy and Propulsion Systems

The future of carbon-free power generation and transportation depends heavily on the utilization of renewable, low or no-carbon fuels. As a zero-carbon fuel that can be efficiently manufactured at a large scale with renewable energy with current technology, ammonia has a great potential to be an effective carrier of hydrogen that can be easily used as fuel in energy production systems. Our research specifically focuses on getting a better understanding on how we can use the thermo-physical properties of liquid ammonia to overcome the limitations uncovered when trying to implement gaseous ammonia into traditional energy production systems in our prior research. In this work we experimentally investigate the structure of the ammonia flames, ammonia flame propagation, ignition delay, flammability limits, and other ignition characteristics. Based on some initial data, we then studied these parameters while applying our understanding of fuel sprays and atomization to improve the ignition and combustion characteristics while also reducing the overall hazardous emissions from burning ammonia. From experiments conducted in a constant volume combustion chamber it was found that the flame speed of ammonia can be increased by up to 45% just by controlling the equivalence ratio inside the chamber. The ignition delay times for a given mixture of ammonia and air can also be reduced by about 20% by atomizing the fuel better using a spray. Due to the nature of liquid ammonia, it is also relatively easy to be pushed into the supercritical regime, which opens up opportunities to more effectively control the vaporization and local fuel-air mixture conditions in our favor to ensure efficient combustion and ultimately cleaner emissions. With our experiments using a hollow cone fuel injector, we were able to spray liquid ammonia into varying ambient environments to study the atomization process in detail. Several conditions to emulate a large scale diesel engine were also tested. Using this data a system to take advantage of a pilot spray of another E-Fuel like methanol to improve performance is also being developed. Finally, we want to ensure a fuel for the future that is safe, green, efficient, relatively cheap, and easy to implement on a large scale into energy and transportation systems that are not so easy to electrify.

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Poster Number: 130

Dynamic Behavior of Ribbed Viscoelastic CNT-PDMS Thin-Films for Multifunctional Applications

Tailored ribbing structures were obtained by large-scale rolling in polymer thin-films by adding CNT inclusions, which significantly improved the mechanical behavior of systems subjected to dynamic compressive strain rates. A nonlinear explicit dynamic three-dimensional finite-element (FE) scheme was used to understand and predict the thermomechanical response of the manufactured ribbed thin-film structures subjected to dynamic in-plane compressive loading. Representative volume element (RVE) FE models of the ribbed thin-films were subjected to strain rates as high as 104 s-1 in both the transverse and parallel ribbing directions. Latin Hypercube Sampling of the microstructural parameters, as informed from experimental observations, provided the microstructurally based RVEs. An interior-point optimization routine was also employed on a regression model trained from the FE predictions that can be used to design ribbed materials for multifunctional applications. The model verifies that damage can be mitigated in CNT-PDMS systems subjected to dynamic compressive loading conditions by controlling the ribbing microstructural characteristics, such as the film thickness and the ribbing amplitude and wavelength. This approach provides a framework for designing materials that can be utilized for applications that require high strain rate damage tolerance, drag reduction, antifouling, and superhydrophobicity.

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Poster Number: 141

COVSIM: A Stochastic Agent-Based Simulation Model for COVID-19 Disease Spread in North Carolina

We document the evolution and use of the stochastic agent-based COVID-19 Simulation model (COVSIM) to study the impact of population behaviors and public health policy on disease spread within age, race/ethnicity, and urbanicity subpopulations in North Carolina. We detail the methodologies used to model the complexities of COVID-19, including multiple agent attributes (i.e., age, race/ethnicity, high-risk medical status), census tract-level interaction network, disease state network, agent behavior (i.e., masking, pharmaceutical intervention uptake, quarantine, mobility), variants, waning immunity, high-performance computing infrastructure, and model calibration. We describe its uses to inform public health decision-making, which has focused on the interplay of nonpharmaceutical and pharmaceutical interventions, equitability of vaccine distribution, school nonpharmaceutical intervention policy, optimality of vaccine distribution timing, and supporting local county decision-makers in North Carolina. This work has led to multiple publications and meetings with a variety of local stakeholders, and has laid the groundwork for current efforts to design optimal dynamic nonpharmaceutical intervention policies.

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Advisor: Rada Chirkova
Poster Number: 145

Knowledge-Graph Compression to Enable Efficient and Effective Rule Mining

Knowledge graphs have been growing in popularity in recent years, due to their successful use in many data-analytics and knowledge-discovery tasks. As the sizes of domain knowledge graphs continue to grow, they can become too large to be processed efficiently by downstream applications. It is thus indispensable in many cases to aim to address the efficiency issue by reducing knowledge-graph sizes via summarization. At the same time, to provide quality results, that is, to be effective, on the knowledge graph summaries, many downstream data-analytics and knowledge-discovery tasks require the summaries to retain as much information from the original graph as possible. It turns out that state-of-the-art data-reduction approaches may generate task-specific or lossy summaries, which may present challenges for the effectiveness of downstream analytics in some cases. As a result, it is important to study trade-offs between the performance and accuracy of data analytics and knowledge discovery on knowledge graph summaries.

To this end, we consider the trade-off between the performance and accuracy of one type of knowledge-graph analytics, inference-rule mining, on summarized knowledge graphs as compared with the original graphs. Toward addressing the trade-off challenge, we present a domain- and task-independent knowledge-graph summarization approach for generating reduced abstract knowledge graphs from a given graph. Through provenance maintenance, the abstract knowledge graphs generated by the approach can be used to completely reconstruct the original graphs, that is, the summarization is lossless. Through various experiments, we provide evidence that our approach can substantially reduce knowledge-graph sizes, thereby improving the rule-mining efficiency. At the same time, the abstract knowledge graphs can still enable effective rule mining due to the lossless nature of the approach. We anticipate that the knowledge-graph reduction provided by the proposed approach could enable efficient, yet effective, results for diverse applications and use cases.

Andrew D. Shelton and Jason R. Franz
Graduate Program: Biomedical Engineering, North Carolina State University and the University of North Carolina at Chapel Hill
Advisor: Jason R. Franz
Poster Number: 149

The Effects of Muscle Fatigability on Gait Instability in Aging and Age-Related Falls Risk

Falls are a severe risk to older adults and a significant public health challenge. Most of these falls occur during locomotor activities such as walking. Muscles in older adults are much more fatigable than those in younger adults, especially during dynamic tasks such as walking. This has the potential to compound the negative impact of age-related declines in balance and independently precipitate falls. The gluteus medius muscle, in particular, is a primary controller for walking stability. Although observational research links fatigue to an increased risk for falls, the disproportionate focus on postural control alone leaves a significant gap in our understanding of how fatigability among older adults affects gait stability. The purpose of this study was to characterize the effects of local gluteus medius muscle fatigability on gait instability in a cohort of older adults. We hypothesized that fatigue of muscles that regulate coronal plane motion would compromise mediolateral walking balance control – evidenced by larger vulnerability to lateral waist-pull perturbations and decreased speed and accuracy when responding to prescribed changes in lateral foot placement. 15 older adults walked while responding to lateral waist-pull perturbations (i.e., a reactive response task) and targeted lateral stepping (i.e., a proactive, goal-directed task) before and after gluteus medius fatigue. We confirmed local fatigue via force and electromyography measures. Using 3D motion capture data, we calculated margin of stability, foot placement accuracy, and time of leg swing deviation. As hypothesized, gluteus medius fatigue elicited increased lateral center of mass displacement and walking instability during the reactive response task. Conversely, fatigue did not affect performance on the proactive, goal-directed task. Gluteus medius fatigability disproportionately affects older adults' ability to balance threats requiring rapid reactive neuromuscular responses.

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Poster Number: 150

Clot-Targeted Nanogels for Anticoagulant and Fibrinolytic Dual-Delivery to Treat Disseminated Intravascular Coagulation

Disseminated Intravascular Coagulation (DIC) is a pathologic state that follows systemic injury and other diseases. Often a complication of sepsis or trauma, DIC causes coagulopathy associated with paradoxical thrombosis and hemorrhage. DIC upregulates the thrombotic pathways while simultaneously downregulating the fibrinolytic pathways that cause excessive fibrin deposition, microcirculatory thrombosis, multiorgan dysfunction, and a consumptive coagulopathy with excessive bleeding. Given these opposing disease phenotypes, DIC management is challenging and includes treating the underlying disease and managing the coagulopathy. Currently, no therapies are approved for DIC. We have developed clot-targeted therapeutics that inhibit clot polymerization and activate clot fibrinolysis to manage DIC. We hypothesize that delivering both an anticoagulant and a fibrinolytic agent directly to clots will inhibit active clot polymerization while also breaking up preexisting clots; therefore, reversing consumptive coagulopathy and restoring hemostatic balance. To test this hypothesis, we single and dual-loaded fibrin-specific nanogels (FSNs) with antithrombinIII (ATIII) and/or tissue plasminogen activator (tPA) and evaluated their clot preventing and clot lysing abilities in vitro and in a rodent model of DIC. In vivo, single-loaded ATIII-FSNs decreased fibrin deposits in DIC organs and reduced blood loss when DIC rodents were injured. We also observed that the addition of tPA in dual-loaded ATIII-tPA-FSNs intensified the antithrombotic and fibrinolytic mechanisms which proved advantageous for clot lysis and restoring platelet counts. However, the addition of tPA may have hindered wound healing capabilities when injury was introduced. Our data supports the benefits of delivering both anticoagulants and fibrinolytic agents directly to clots to reduce the fibrin load and restore hemostatic balance in DIC.

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Advisor: Detlef Knappe
Poster Number: 155

Behavior of Per- and Polyfluoroalkyl Substances (PFAS) during Thermal Reactivation of Spent Granular Activated Carbon (GAC)

Thermal reactivation of spent granular activated carbon (GAC) is a management strategy that permits GAC reuse. The fate of per- and polyfluoroalkyl substances (PFAS) during thermal reactivation of spent GAC is poorly understood. This study aims to identify thermal reactivation conditions that effectively mineralize adsorbed PFAS. Thermogravimetric analysis (TGA) experiments with PFAS, PFAS/hydroxide mixtures, and PFAS/natural organic matter (NOM) mixtures in the absence and presence of GAC were conducted at three heating rates to determine the thermal stability of 4 perfluoroalkyl carboxylic acids (PFCAs), 3 perfluoroalkyl sulfonic acids (PFSAs), and a fluorotelomer sulfonic acid (FtS). Off-gases from TGA experiments were collected with XAD sorbent tubes, an impinger sampling train to trap gaseous compounds soluble in water amended with 0.1 M sodium hydroxide, and a SUMMA canister to capture volatile fluorinated compounds that passed through the impinger train. Impinger solutions and TGA pan residues were analyzed for anions and cations using ion chromatography (IC). Targeted PFAS analysis of impinger solutions was performed with liquid chromatography-tandem mass spectrometry (LC-MS/MS). Targeted and non-targeted analysis of (semi-)volatile fluorinated compounds was conducted by high-resolution gas chromatography-mass spectrometry (GC-HRMS). Results to date show that thermolysis of all tested PFAS in the absence of GAC was complete at temperatures used to reactivate GAC. In contrast, thermolysis of two adsorbed PFAS was not complete at 800°C. Salt forms of PFAS were thermally more persistent than acid forms, and PFSAs were more persistent than PFCAs. Results from IC, LC-MS/MS and GC-HRMS analysis accounted for 11-106 % of the fluorine content of the initially added PFAS and show that the addition of a base or NOM and the presence of GAC enhance the mineralization of some PFAS. The degree of mineralization to fluoride ions was 1-77 % for non-adsorbed PFAS and 46-106 % for adsorbed PFAS.

Anastasia Timofeeva
Graduate Program: Mechanical Engineering
Advisors: Kara Peters and Mark Pankow
Poster Number: 159

Dynamic, In-situ Characterization of Failure Modes in Fiber Spinning

Polymer fibers for nonwoven material applications are often produced using the fiber spinning process. Additionally, fiber spinning can be combined with web formation and bonding processes called spunbonding. These processes require development of a specific recipe of the production parameters such as pressure, temperature, throughput, spinning speed and the polymer material(s) that would lead to an optimum quality of the fibers. Defects that can occur in fibers could lead to potential failure of fibers as well as the nonwoven materials produced from them. Fiber quality can be measured offline; however, this process is time-consuming and is not efficient for assessing production irregularities as they could only occur in specific sections of fiber and not throughout the whole length of it.

This study focused on the development of a non-destructive, high-speed polarization imaging technique for the evaluation of the internal structure and stress fields in the fibers. This technique measures the birefringent response of the samples in a single shot, with the acquisition rate directly dependent only on the frame rate of the camera. Additionally, an object detection algorithm was implemented for automatic detection and classification of defects in polymer fibers. The combination of the imaging technique and the machine learning allow for in-situ measurement and near real-time assessment of the fiber quality. This technique can also be applied at the product development stage, as it can directly display the development of the stress fields around the defects (if any are present) and the evolution of crystallization as the fiber is being extruded.

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Advisor: Emily Berglund
Poster Number: 165

Operating water distribution systems for equitable access to clean water

Water distribution systems (WDSs) are designed to deliver high-quality water to all residents. Unpredicted changes in water demands and hydraulics can increase residence time in pipes, leading to growth of microbes and decreased water quality at some locations in a network. In response to reduced water quality, consumers may reduce demands for drinking, cooking, and hygiene purposes. Lack of access to clean water can create high costs for some households due to the cost of using bottled water for drinking, cooking, and hygiene purposes. This research expands a COVID-19 agent-based modeling (ABM) framework to assess equity in a community that uses a WDS. Reduced demands and inequitable access to clean water are explored in this research in the context of the COVID-19 pandemic through a coupled framework. First, an agent-based modeling (ABM) framework is applied to simulate COVID-19 transmission, social distancing decision-making, and reductions in water demands. Large-scale reductions in industrial and commercial demands leads to hot-spots of increased water age. A demographic layer is added to the ABM that models household income. Based on water quality perceptions, households choose to reduce demand from the system and buy bottled water for cooking, cleaning, and hygiene purposes. Equity is evaluated using an adjusted income metric that includes the cost of water bills and supplemental bottled water. The coupled framework is applied for a virtual water distribution system. This research develops an equity metric that assesses the water quality of delivered water and can be used to facilitate WDS management that provides equitable access to clean water.

Vinson Oliver Williams, Saurabh Agrawal, Leslie Walker, Kenneth Granlund, Andre P. Mazzoleni, and Matthew Bryant
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Poster Number: 171

Underwater Tethered Coaxial Turbines: Modelling, Analysis, and Testing

Marine hydrokinetic energy is a relatively untapped energy source in the form of rivers, tides, or ocean currents. Tethered coaxial turbines (TCTs) may be a potential solution to accessing these resources, as the system is passively stable and mechanically simple. A TCT consists of two turbine rotors affixed to the halves of a generator, which counter-rotate in response to incoming flow. The performance of the TCT is influenced by the orientation skew relative to flow, and electromechanical coupling of the generator. Dual rotor devices have shown increased power extraction coefficients when compared to single rotor devices - more so when skewed. A novel blade-element momentum theory (BEMT) model which incorporates radial and azimuthal discretization, RAD-BEMT, has been developed to explicitly incorporate the effects of azimuthal flow variations and nonuniform inflow conditions into the analysis of turbines, and has been validated against experimental data. RAD-BEMT has formed a low-order analytical foundation for TCTs or single rotor devices, to analyze the loading, efficiency, and local performance, amongst other metrics, in complex inflows. The low-order foundation can be used in dynamics, control, and early prototyping, where the use of relatively computationally costly techniques such as CFD are undesirable. This foundation will allow us to analyze the performance of a TCT to determine its performance in a flow resource, depending on its inflow velocity, geometry, orientation, and generator characteristics. By incorporating a center of gravity shifting mechanism and electrical load control, the orientation, dynamic coupling, and power extraction may be controlled. We have successfully tested a power-takeoff TCT within the Croatan Sound in Wanchese, NC. Efforts to model and experimentally demonstrate operation, maximum power-point tracking (MPPT) control, and positional control are currently underway. Experimental testing of our MPPT controlled TCT is planned to be performed at Navy Surface Warfare Center Carderock, in Bethesda, MD.

Ruijie (Sherry) Xi
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Advisor: Munindar P. Singh
Poster Number: 174

Decoding Morality in Social Media

Morality presents a complex challenge within society, encompassing a broad spectrum of ethical dilemmas and conflicting perspectives. Our research focuses on three crucial aspects — blame assignment, moral reasoning, and social commonsense — to explore real-life morality through insights gained from moral scenarios unfolding within Reddit. The scenarios involve interpersonal moral situations shared by authors and judgments of whose behaviors were inappropriate provided by other community users. We explore how individuals perceive and respond to these situations by adopting computational technologies such as Natural Language Processing (NLP) and psychological research such as Moral Foundation Theory (MFT). Our study uncovers biases in social morality, wherein blame assignment is influenced by social identities of individuals involved in the stories and linguistic features used to describe the stories. Moreover, we delve into the most prominent ethical touchpoints within a post that attract attention and generate discussion among commenters. To do so, we adopt social commonsense and find that the moral reasoning used to judge the appropriateness of social behaviors is influenced by social factors such as authors' age and gender. Our experiments also underscore specific factors such as emotions expressed in the stories attract more attention, demonstrating recurring themes across diverse moral scenarios.

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Graduate Programs: Chemical and Biomolecular Engineering[1], Computer Science[2], Mechanical and Aerspace Engineering[3]
Advisor: Milad Abolhasani
Poster Number: 175

Data-Driven Synthesis Science Studies of Metal Halide Perovskite Nanocrystals with Autonomous Robotic Experimentation

Recently, all-inorganic Metal halide perovskite (MHP) quantum dots (QDs) have emerged as a highly promising class of semiconducting nanomaterials for various solution-processed photonic devices. These quantum-confined nanocrystals exhibit unique optical properties that can be precisely engineered by altering their composition, shape, size, and geometry. The surface ligation of MHP QDs relies on an acid-base equilibrium reaction, which is commonly utilized not only to provide colloidal stability in organic solvents but also to tune their optical properties. The use of various organic acids as surface capping ligands results in distinct growth pathways and thereby different QD morphologies. Consequently, the optical characteristics of MHP QDs are strongly influenced by both the ligand structure (discrete parameter) and the reaction conditions (continuous parameters). The multidimensional nature of this parameter space makes it extremely challenging to comprehensively explore. Traditional synthesis methods for MHP QDs, similar to other colloidal QDs, are time-consuming, material-intensive, and laborious, relying on manual flask-based techniques. The manual nature of these methods, along with the interdependent reaction and processing parameters in colloidal QD synthesis, hinders the discovery of optimal formulations and fundamental understanding of MHP QDs.

In this work, we have developed and deployed a multi-robot self-driving lab (SDL) for accelerated QD synthesis and development research. The developed SDL enables systematic investigation of the effects of ligand structure and precursor concentrations on the photon-conversion efficiency, nanocrystal size uniformity, and bandgaps of MHP QDs. Next, we utilized the developed multi-robot SDL to conduct multiple autonomous experimentation campaigns to rapidly discover the pareto-front of MHP QDs optical properties for various capping ligands.

We overcame challenges of conventional QD research by investigating the science and engineering of a modular autonomous robotic experimentation platform. We established a closed-loop QD synthesis and development strategy by integrating a modular robotic experimentation platform with data-driven modeling and experiment-selection algorithms. The developed SDL accelerated mapping the optical properties of MHP QDs to the ligand structures and synthesis conditions and understanding the underlying role of ligand structure on the shape, morphology, and optical properties of MHP QDs. The SDL-generated knowledge will enable on-demand synthesis of MHP QDs with optimal optical properties for the next generation energy and display technologies.

Liudmyla Yutskevych[1] and Kaelan Moore[2]
Graduate Program: Environmental Engineering[1]
Undergraduate Program: Biomedical Engineering[2]
Advisors: Jacqueline MacDonald Gibson and Andrew Grieshop
Poster Number: 179

Sick Building Syndrome, Indoor Air Quality, and Related Health Effects: A Systematic Literature Review

Sick Building Syndrome (SBS) refers to a range of non-specific symptoms experienced by individuals in a specific building. These symptoms typically alleviate upon leaving the building. As more than 90% of the individual's time is spent indoors, the problem of Indoor Air Quality (IAQ) is a big concern. In Abu-Dhabi, UAE, indoor and outdoor air pollution was identified as a cause of hundreds of premature deaths and hospital visits. That is why we conducted a systematic literature review based on PRISMA guidelines to establish the evidence-based connection between SBS, IAQ, and its associated health effects. SBS may be influenced by a variety of factors, including IAQ, humidity, temperature, and psychosocial stress at work. The focus was on IAQ/SBS research in high-income countries, which helped us discover a gap in this area in America and the Middle East regions. The total number of found articles was 1200, and 222 articles were added to the full-text review stage, where 165 studies were excluded. The review results based on 57 articles confirmed an association between SBS and IAQ factors and contaminants. SBS symptoms are associated with numerous contaminants (e.g. CO2, VOC, Formaldehyde) and IAQ factors (e.g. temperature, humidity, air movement), and consistent trends were identified across various IAQ analysis approaches (Measured Air Pollution, Perceived AP, and Observed Potential Sources of Indoor AP). Our examination of different building types highlights a strong, type-independent connection between SBS and IAQ. A major challenge in progressing with this research is the necessity for standardized questionnaires and consistent AQ measurement procedures to ensure the comparability of results across countries and researchers, enabling broader quantitative analysis.

College of Humanities and Social Sciences

Sydney Alston
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Advisor: Nishani Frazier
Poster Number: 8

Black Tobacco in the Bull City: The Contribution of Black Laborers to Durham's Tobacco Industry

The revitalization, or the gentrification of Durham, has culturally catapulted the city onto numerous top 10 lists and New York Times profiles. The award-winning food, artistic offerings, proximity to Research Triangle Park, and the pleasant atmosphere in a previously vacant downtown has made Durham the place to be in recent years. Though the impact of this revitalization has only come to fruition in recent years, its roots extend back to the 1980s with the slow departure of the American Tobacco Company. One of the central themes of downtown Durham's revitalization is repurposing the American Tobacco Campus and acknowledging the history of this old tobacco town. Not only are the city and developers utilizing the extensive factory network left behind by ATC, but the city's branding has been overrun by acknowledging what was and cashing in on what used to be the city's primary industry. With vintage-style murals and refurbished smoke stacks paying homage to brands like Liggett & Myers and Lucky Strike, it's not only the physical space drawing connections to the past. Culturally, Durham has cemented itself as a place that acknowledges and utilizes its not-so-distant history. But something is missing. While there are many reminders of ATC and brightleaf tobacco, there is little interpretation of the workers who populated and pushed that industry forward. In a city where the culture and presence of African American citizens is deeply entrenched, Durham's recollection of its tobacco heritage is missing the contribution of Black tobacco workers in the company and the city's nearly 134-year-old history. Durham's revitalized American Tobacco Campus fails to interpret the contributions of Black tobacco workers by erasing their contribution to the industry's success and sanitizing the conditions of the industry in which they worked.

Ari Berntsen
Graduate Program: Technical Communication
Advisor: Michelle McMullin
Poster Number: 15

Game On: Leveling up Soft Skills in Project Management using Avery Alder's Map Making Game The Quiet Year

This study examines the gap between hard and soft skills in project management and proposes a novel training approach to address this issue using a tabletop map making game by Avery Alder called The Quiet Year. The traditional model for training Project Management Professionals (PMPs) has focused primarily on technical proficiency and methodologies. Training often stresses the importance of effective communication and collaboration but does not reinforce these soft skills. This training oversight has led to a gap in communication skills that impacts project development teams in various ways. To help bridge this gap, this research explores a decentralized training approach to project management that encourages active engagement from all team members using gameplay. The study introduces a training workshop built around The Quiet Year that is designed to expand participant skills beyond conventional boundaries and foster an environment where all team members actively contribute to the project's success. The Quiet Year, known for its unique approach to collaborative storytelling and decision-making, is an ideal choice for this workshop due to the projects that participants must conceive, plan, and execute. Challenges are presented to the players that impact project development which can only be mitigated through communication and teamwork. Through the action of the game, participants enhance their soft skills within the context of project management and problem-solving. The game's creative play fosters a fun atmosphere while timelines and the threat of danger maintains a sense of urgency, making it a valuable tool for teaching communication and collaboration skills. This research aims to close the gap between technical expertise and soft skills by exploring the potential of The Quiet Year as a training tool. The paper delves into the design and implementation of the workshop, drawing insights from the game to demonstrate the effectiveness of this gamified training program.

Gabby Brown
Graduate Program: Technical Communication
Advisor: Douglas Walls
Poster Number: 22

Experience Architecture Website Redesign for North Carolina Urban Forest Council

The NC Urban Forest Council (NCUFC) is a non-profit that advocates for the sustainable use of North Carolina's urban and community forests. They are currently planning a redesign of their website to better suit the needs of their users. This redesign presented the opportunity to analyze the information needs of NCUFC users and design a more efficient website navigation system. A heuristic evaluation of the NCUFC website revealed that it was overcrowded with information and had a confusing and redundant menu structure. The goal of this project was to use theories and methods of Experience Architecture (XA) to simplify navigation and search processes in a way that prioritized the informational needs of the users, encouraging civic engagement through increased usefulness of information structures on the website. The research included a heuristic evaluation, a user survey to determine information habits and needs, navigation redesign, and parallel user testing. This is a practical project that aligns with Jones, Moore, and Walton's (2016) assertion that user advocacy is a central concern to the field of Technical Communication. The implications of this project include a case study that points to the continued relevance of Information Architecture in Technical Communication projects.

Jiana Brown
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Advisor: Johanna Montlouis-Gabriel
Poster Number: 23

From Reel to Real: French Universalism in the Contemporary Age

This project analyzes how the comedic genre in French films often tends to espouse color-blind and universalist rhetoric to reaffirm the republican ideal of sameness. In a very compelling and blockbuster film, Il a déjà tes yeux (2016), superstar actress Aïssa Maïga and renowned actor Lucien Jean-Baptiste play the roles of Black parents adopting a white child, thus subverting the transracial narratives of adoption. While the narrative accentuates color-blindness, implicit discourses of race in the film inherited from colonization undergird it using the "non-dit" ("the unsaid'') as well as comedic tones. These tones identify the omnipresent demand to adhere to the "French identity," one that is based in whiteness and standards created during colonial periods of so-called scientific justifications of the racial hierarchy. Through forced assimilation to racist norms hidden within the French Republican ideal of universalism, non-white citizens are surveilled and held to norms they ultimately cannot obtain according to the pigmentation of their skin. Operating within such a society creates internalized rules to these socially constructed ideals. A discussion on the implications highlighted within the film allows audiences to reflect on contemporary French culture and compare the ways in which French is distinct from Francophone, rather White French is distinct, and superior, to Black French (denoted as Francophone). This leads to a discussion towards ways of redefining the French identity to reflect the true ideal: integration and acceptance over assimilation to an unattainable norm. Looking ahead, the corpus in this project invites us to reflect on ways to apply this knowledge to classrooms in order to foster student's critical reflection on social representations in popular media, and to provide tools to instructors to use film in the classroom.

Marlo Chapman
Graduate Program: Rhetoric and Composition
Advisor: Stacey Pigg
Poster Number: 36

Wooly Narratives: The Rhetorical Role of the Frankenstein Myth in Media Coverage of Dolly the Sheep

Science communications to the general public have often relied on metaphoric language to explain complex or abstract novel technologies. A common metaphorical narrative is the Frankenstein story — a framework used to describe science perceived as having gone too far or posing a danger to humanity. It has been called "The governing myth of modern biology" and is still applied to science 200 years after Mary Shelley released her novel (Turney, 1998). This study conducts a rhetorical analysis of media coverage concerning Dolly the sheep's unveiling in 1997 to understand use of the Frankenstein myth in explaining real-world science. As the first cloned mammal from an adult somatic cell, Dolly generated a moral and ethical debate around bioethics and a proliferation of news articles about the imminence of human clones. Popular media linked Dolly and the lead scientist behind her creation, Dr. Ian Wilmut, to Frankenstein and his "monster" in their coverage through direct references, metaphors of production, and a depiction of Dolly as a child of science. This study uses conceptual metaphor theory, narrative paradigm, and a technofeminist lens to understand how the Frankenstein myth was implemented, how it endured, and the consequences of its application Dolly through analysis of images, diagrams, and text from magazines during the late '90s. Outcomes of this research will be able to inform us of how metaphoric framing can affect the reception of novel technologies — in particular, this myth's recent resurgence alongside media coverage of artificial intelligence and machine learning. Furthermore, it will contribute to ongoing conversations of narrative and metaphor, providing insight into how these both inform and actively shape human knowledge.

Alexa Cortes
Graduate Program: Technical Communication
Advisor: Huiling Ding
Poster Number: 41

The Academic Home of Agricultural Communication: Job Ad Analysis Findings

Much like the technical communications industry, agricultural communication job titles do not follow a uniform format. Similarly, agricultural communicators encompass a myriad of different backgrounds, both academically and professionally. Agricultural technologies are advancing at a faster rate than ever before and public-facing communications roles are vital to the proper dissemination of new technologies. Understanding the job market for agricultural communicators, as well as identifying the academic home of ag comm, is the key to providing current agricultural communications students with the proper tools for preparing for the industry.

The research included gathering 20 agricultural communication job ads, 5 extension agent job ads, and 10 research articles that identify the skills typically required of agricultural communicators (both academically and professionally). Job ads were then statistically analyzed using LancsBox and AntConc to identify keywords and collocations of common phrases and requirements. Education requirements, professional experience requirements, expected skills, and desired skills, salary ranges, and job format (in-person, remote, or hybrid), were manually coded and compiled into tables and graphs to help visualize trends in the agricultural communications job market. Using supporting literature, the job ad analysis was then compared to current expected agricultural communication skills.

Sarah Dixon
Graduate Program: Anthropology
Advisor: Jennifer Carroll
Poster Number: 49

The Extension of the Physical Body: Embodiment in Virtual Reality

This project investigates embodied experiences in virtual reality (VR) environments by studying the users' relationship with their avatar (i.e. their VR character), uncovering how users feel physically connected to the virtual world. Drawing from information gathered from 15 interlocutors and theories of the cultural phenomenology of embodiment, this research argues that through experiences of embodiment in VR, especially that of phantom sense (in which users experience physical sensation in response to virtual stimuli), real and virtual worlds exist in parallel with one another. Findings reveal how the mind and body are able to connect users' virtual and real bodies through action, presence, and perception. Not only are these classic characteristics of embodiment, but these components are crucial in the curation of phantom sense. Experiences of phantom sense further erode distinctions between real and virtual, rearranging our perceptions of reality and the physical body. The immersive experience of VR demonstrates the impact of manufactured experiences in VR, and how it can shift our understanding of the body. Presentation of findings will also include novel insights and strategies for conducting ethnographic fieldwork in VR — a uniquely challenging venue for ethnographic work that remains largely under-addressed in literature. This poster will exhibit a practical means to assist other researchers who aim to study virtual social worlds as we embark further toward transcending physical boundaries.

Anne Elkins
Graduate Program: World Languages and Cultures
Advisor: Jordi Marí
Poster Number: 51

Back to the (Paleolithic) Future: Nature, Tourism, and the Reappropriation of the Past in Paleolítico Vivo and La Reserva Bison Bonasus

How humans treat other animals and 'nature' more broadly is central to debates about who we are: are we thoughtful or prudent, selfish or altruistic? Some proponents of the Rewilding movement have anchored 'humanity' in a distant, sometimes pre-Neolithic past characterized by humans' harmonious and occasionally spiritual relationship with nature to make a case for the recovery and conservation of 'ancient' animals and ecosystems. My work explores how this rhetoric is appropriated and localized in northern Spain by two tourist-oriented conservation parks offering visitors an encounter with 'prehistoric' animals commonly used in European Rewilding projects. Paleolítico Vivo promises to connect visitors to a period in human history that is "full of clues for our own sustainability" through encounters with European bison, tarpans (equids), aurochsen (bovids), and Przewalski's horses. La Reserva Bison Bonasus describes its European bison as "mythical animal[s] charged with symbolism" for "our ancestors." I examine the parks' promotional materials, including websites and social media posts, scholarly research on Spanish history and culture, and research in fields such as (zoo)archaeology and ecology. I argue that these parks' messages of conservation serve to reassure the Spanish public of a positive national character in a time of political division and economic uncertainty. Further, they contribute to a wider conversation in which humans' treatment of the non-human is perceived as reflecting our species' own character.

Allyson Gee
Graduate Program: Foreign Languages and Literatures
Advisor: Jim Michnowicz
Poster Number: 59

To Fill or Not to Fill? Filled and Silent Pauses in N.C. Spanish

Silent pauses (SPs) and filled pauses (FPs) are abundant, natural features of speech that may be misconstrued as missteps in conversation, but that perform several discourse functions; they give time for speakers to reformulate and for interlocutors to process and respect conversational turn-taking. Due to their prevalence in speech, FPs, both phonological and lexical, are among some of the first elements borrowed in a language contact environment (Erker & Bruso, 2017). Hence, Erker & Bruso (2017) found that Spanish-English bilinguals with higher English-contact demonstrate signs of linguistic integration as they produce more English-like phonological FPs including the central vowels, [ə] and [a], compared with the monolingual Spanish [e]. Although research remains scant regarding bilingual FP behavior, even less research exists on SPs in environments of Spanish-English contact. Excessive and abnormally long SPs in speech have been suggested to correlate with oral disfluency and are associated with the speech of heritage Spanish-Afrikaans bilinguals (García-Amaya, 2022). The current study of North Carolina Spanish speakers further investigates the distribution of FPs and duration of SPs as possible indicators of contact induced linguistic convergence and (dis)fluency. Preliminary results suggest differences in FPs and SPs exist due to sex and generation which may indicate ongoing linguistic convergence toward the English-dominant norms of the community of interest. Compared to first-generation immigrant (G1) participants, second-generation heritage (G2) speakers more closely approximate English pauses with more centralized vowels and more diverse lexical FP choices, including English so and como (a calque from English FP, like). Moreover, G2 speakers and women produced shorter SPs compared to G1 speakers and men. As such, it is probable that SP duration reflects the influence of shorter SPs in monolingual English as compared to longer SPs in monolingual Spanish.

Haley M. Kinsler
Graduate Program: English
Advisor: Jason Swarts
Poster Number: 93

“There’s a lot of baggage”: Trans North Carolinians’ Orientations to Southern Identity in Discourse

This study uses a discourse analytic approach to evaluate sociolinguistic interviews collected as part of the North Carolina Trans and Nonbinary Language Project. From these interviews, I explore how transgender, nonbinary, and gender-diverse people in North Carolina take variable stances (Du Bois, 2007) in relation to Southern identity. Through inductive and iterative coding of interview transcripts, I identify a variety of stances that participants take on Southern identity. In some cases, participants rejected stigmatized characteristics that are associated with particular enregistered (Agha, 2005) Southern identities, such as conservatism or anti-LGBTQIA+ sentiment. In other cases, participants indicated that their Southern identity allows them to combat these dominant social narratives, rendering the diverse experiences of trans people in the South more visible. Overall, this study explores the complex contextual circumstances and ideologies that speakers draw on while negotiating their identities as gender-diverse people in relationship with Southern identity.

This work is rooted in trans linguistics, a growing discipline that centers the lived experiences of transgender, nonbinary, and gender-diverse people and allows them the space and agency to document their experiences with language (Zimman, 2020). Previous research has tended to center the experiences of cisgender people in the LGBTQIA+ community, despite effects of oppression and marginalization that trans and nonbinary people experience at disproportionate rates (Stryker, 2008). Trans linguistics as a field seeks to bridge this gap, illustrating how trans people adopt unique linguistic strategies as a form of survival and resilience in a cisheteronormative society. The purpose of this analysis, then, is to begin to document the lived experiences of trans people in North Carolina and investigate the ways in which they negotiate their proximity to Southern identity given this complex environment that is, at times, hostile to the transgender, nonbinary, and gender diverse people who live there.

A. M. McLucas
Graduate Program: Literature
Advisor: James Mulholland
Poster Number: 112

Open Secrets: Conflict Commodities in and as Culture

The things we use generate cultural importance. In wealthy countries like the United States, those things include our cars, illicit drugs, and our phones. But much like the vaunted diamond, there is a significant gap between the perception of these cultural materials from one end of the supply chain to the other. The open secret behind many of the rich world's most used commodities is that they are the products of conflict and exploitation. In this literary and cultural analysis research grounded in Thing Theory, I examine the ways things like cars, drugs, and phones manifest themselves in the culture of wealthy countries, and juxtapose that impact by demonstrating the violence required to procure the oil, opium, and batteries required for those products to exist. Using Helon Habila's Oil on Water, I look at the differences between American car culture and oil extraction practices in the Global South, and compare ExxonMobil to the East India Company. With Kim Barker's The Taliban Shuffle, I observe how Afghanistan's opium farming and the rich world's war on drugs generate feedback loops of violence without meaningful decreases in harmful drug abuse. Through Joseph Conrad's Heart of Darkness and John Le Carré's The Constant Gardner, I show the history of centuries of African resource exploitation, and how cobalt mining to make lithium-ion batteries does not fit with the messages from tech chief executives who say their battery-powered products can positively change the world. The things we use matter, as does the way those things come to exist. It is high time, therefore, to understand the open secrets at the heart of our culture of consumption.

Travis R. Merchant-Knudsen
Graduate Program: Communication, Rhetoric, and Digital Media
Advisor: Andrew R. Johnston
Poster Number: 115

Frames of Mediated Memory from 1960s to 2000s: Visual Rhetoric & Media Studies Examination of MyRetroTV

For the decades of the 1960s to 2000s, MyRetroTV—a project by Joey Cato, an independent media creator and former software engineer for Electronic Arts in California—operates as a time capsule and memory bank of access to a television set from decades. The soft tinge of CRT televisions gives an eerie feeling of time travel. On MyRetroTV, the cartoons, music, sports, and news of years past are delivered through technical apparatuses of their time—or at least a mimetic one through a digital screen. It is missing the tactility offered by pressing buttons, waving fingers over static, and seeing beyond the front of these CRT televisions that are, without a doubt, heavy and large. Yet, it affords the user of the website to reengage with the past in operative ways that ask them to reconsider the importance of those years and their media. Why? In what way do these TV simulations function and what do they tell rhetorical and media scholars? MyRetroTV acts as a case study for visual rhetoric and media studies because of the way it remediates past moving images through the modern digital age through its visual design and programming. This study utilizes two primary frameworks: 1) the schema for visual studies from visual rhetoric scholars and 2) media archaeology from media studies. This study is also about media & rhetoric—with an emphasis on the ampersand that joins these two fields together. I draw upon the emphasis on the ampersand to reveal the tight relationship that rhetoric and media studies afford when thinking through visual artifacts like MyRetroTV. Though we are missing physical television sets, users can recognize what they resemble through their digital materiality and what the television sets afford: access to a digital world of images approximating different contextual periods that asks us to consider how memories are remediated and reflected upon.

April L. Najjaj
Graduate Program: World Languages and Cultures
Advisor: Shelley Garrigan
Poster Number: 120

Linguistic Imperialism in Sub-Saharan Africa: The Case of Nigeria

Linguistic imperialism is a theory first espoused by Robert Phillipson in 1992, and since that time, it has become an important analytical tool in considering the continuing role of English in postcolonial settings throughout the former British empire. A significant part of that former empire in sub-Saharan Africa included Nigeria, an ethnically diverse country with three main languages—Yoruba, Hausa, and Igbo—and dozens of others that are typically given a significantly lesser public role today than the language of the former colonizer—English. In this project, Linguistic Imperialism in Sub-Saharan Africa, The Case of Nigeria, I propose to consider how the continued use of English as the language of instruction in education, as well as its predominance in business, law, and government, has perpetuated the former colonial assumptions and privileges of more urban areas and those from higher socioeconomic levels than that of peoples from the largely rural and less economically developed areas of the country. While a common assertion in postcolonial writings claims that English can serve as a unifying factor in a multilingual and multi-ethnic society such as Nigeria, that potential can only be realized if everyone has equal access to learning the language and that it exists on an equal footing with the many other languages in the country, thus encouraging a multilingual context more appropriate to a multi-ethnic state like Nigeria. Reconciling with the vestiges of imperialism is a challenge for any former colony; however, with the ethnic tensions, religious differences, and widespread corruption in today's Nigeria, any aspect of the society that has the potential to unify the country and increase civic participation and economic development, including language, should be explored and made available to everyone.

Mandy Paige-Lovingood
Graduate Program: Public History
Advisors: Akram Khater and Tammy Gordon
Poster Number: 124

Lost in Translation: The Social Lives of Eighteenth-Century French Women's Turquerie Portraits, 1742-2024

This dissertation investigates eighteenth-century French turquerie, a set of French artistic productions appropriating the Ottoman Empire's Turkish culture and forms, and a cross-cultural "style" permeating literature, architecture, and the visual and decorative arts. More specifically, my project analyzes the exhibition and interpretation of eighteenth-century French women's turquerie portraits in three prominent phases of their lifecycle, spanning their early modern genesis, their modern exhibition/s, and their present-day display. Here, I argue such eighteenth-century exotic objects relied upon the intersections of exhibition, French and Ottoman aesthetics, and gender, class, and race identity to both affect and carry out meaning-making and interpretation. In doing so, I highlight the dual function of turqueries during their eighteenth-century production and exhibition phase wherein, on the one hand, women intentionally catered to, responded to, or subverted prescribed French gender "norms" through the embodiment and depiction of Ottoman women and harem imagery. And, on the other, the exhibition of turquerie portraits and the spectatorship involved communicated and reinforced French patriarchal stereotypes and Orientalist ideologies of Ottoman culture, eliciting the further objectification of French and Ottoman women.

By spotlighting both the internalized and shifted oppression involved in turqueries, we become cognizant of turquerie paintings as pre-colonial contact zones in the eighteenth-century and, thereby, understand the patriarchal parameters in which French women operated, how they intentionally and unintentionally contributed to pre-colonial discourse, and why museums historically exhibit women's turqueries (largely) through a Western lens framed by the male Orientalist gaze and prejudiced notions of "women," "feminine" and/or desirable object. Such an undertaking also sets forth a museological interpretive program in response to Western museum practices, challenging Eurocentric and patriarchal exhibition practices built upon eighteenth-century attitudes through the implementation of an interpretive strategy emphasizing the complexities of the French and Ottoman social, political, and cultural politics depicted in women's turqueries.

Luke Priest[1] and Justin Travis[2]
Graduate Programs: Psychology[1]; Psychology, University of South Carolina Upstate[2]
Advisor: Adam W. Meade
Poster Number: 133

A Unified Theory of Leadership Perceptions

There exist several influential and generative theories of person perception across the psychological literature. In social psychology, the stereotype content model is used to study judgments of individuals and groups, and their interrelations. In management and I/O psychology, the implicit leadership theories approach often guides research into perceptions of leaders and leader behaviors/traits. We contend that both of these approaches are underpinned by categorization theory and should be considered in conjunction when studying how individuals form judgments of leaders. Considering the routine finding of two leadership behavioral categories (initiating structure and consideration), we construct and propose a conceptual model that unifies these three approaches, and then test it in two studies using for-profit and nonprofit leaders as our stimuli. First, a within-subjects descriptive study (N = 210) finds ideal nonprofit leaders are rated higher in sensitivity and dedication, and for-profit leaders rated higher in intelligence, tyranny, and masculinity. Next, a between-subjects experiment (N = 513) demonstrates that individuals are more likely to recommend someone higher in warmth for a nonprofit and higher in competence for a for-profit business. Collectively, our results support the hypothesized Unified Leadership Perceptions Model, concluding with theoretical implications for leadership researchers and practical considerations for recruitment, selection, and leadership development for nonprofit organizations.

Abigail Robinson
Graduate Program: English, Rhetoric and Composition
Advisor: Kirsti Cole
Poster Number: 140

The Multimodal Move: A Heuristic for Instructor Development in Multimodal First-Year Composition Curriculum

Multimodality supports meaning-making across a wide range of communicative modes. As the composing process continues to be influenced by digital technologies, material practices, and new genres, multimodal pedagogy allows for instructors to connect with their students and account for a variety of backgrounds, lived experiences, and unique skill sets. As a growing number of instructors in higher education engage with multimodal pedagogical practices, institutional writing programs are adapting their curricula to explicitly invite multimodal composing. In order to do so, however, writing program administrators (WPAs) must ensure first-year composition (FYC) instructors are prepared to create, implement, and assess multimodal projects. This preparation is often achieved through faculty development. Little scholarship accounts for the multimodal professional training procedures aside from institutional case studies. Drawing from recent scholarship and interviews with writing program administrators, my research identifies common points of consideration regarding the creation and implementation of multimodal faculty development opportunities for FYC instructors. To begin my research, I compiled a list of writing programs within high-research doctoral institutions with an explicit focus on multimodality. I then surveyed and interviewed WPAs within these programs in order to gather more information about multimodal development opportunities. My findings result in a working heuristic that acts as an entry point for WPAs considering multimodal faculty development. More so, the results can extend beyond writing studies to additional professional organizations advocating for multimodal pedagogies, as well as individual instructors across disciplines looking to enhance their teaching based upon ongoing trends in research.

Mar Scardua
Graduate Program: Communication, Rhetoric, and Digital Media
Advisor: Adriana de Souza e Silva
Poster Number: 144

Metronome: The Rhythm of Anxiety

"Metronome" is a ludic exercise on existing in public spaces when you live with social impairments. Constructed in Twine and presented as a text game/interactive fiction, "Metronome" seeks to complicate the perception of normal/awkward and ability/disability as binaries through the simulation of a simple, casual conversation where the player has a limited time to choose one of the rapidly flickering answers that are presented. Social impairments can be of many kinds: caused by personality traits, mental illness, physical differences, insecurity in the language or culture, racism, and many other aspects with variables that may escape one's control. Still, socially impaired people still need and deserve to exist in a world where being socially apt in every situation is considered a basic, logical, even innate, skill. This game is but a snapshot of this process: a flowing commentary on how to learn to exist in spaces you want to be in, when others are present. Spaces that have always been unwelcoming, or so you thought, or so you assumed they would be. And yet attempting to be present in that challenging situation through an inherently apprehensive process. What we call "self-care" or "mental well-being" for a socially impaired person can have many working parts, like attending a family-friendly concert at a park on a nice weekend and talking to a nice stranger who tries to be part of your life for a few minutes. And every failure, every moment you can't do it anymore, is but another step of this difficult dance. That way, "Metronome" immerses the player into a quick-paced reflection on the difficulties of human relationships in a short, anxiety-inducing experience.

Rachel Suffern
Graduate Program: History
Advisor: K. Steven Vincent
Poster Number: 156

Fitzgerald's Folly: Comedy, Reality, and The Immigration Debate in The Great Gatsby

F. Scott Fitzgerald's The Great Gatsby is considered by many to be "The Great American Novel." It is generally presumed to be a serious and tragic love story illustrating the general excesses of the Roaring Twenties and representing the elusiveness of the American Dream. However, these interpretations largely developed after Fitzgerald's death and twenty years after the novel's publication. Fitzgerald left no explanation as to its inspiration but did express dismay that none of the early reviewers knew what it was about. Fitzgerald's editor maintained that the book was a comedic satire, not a serious romance, but his view has been largely ignored by Fitzgerald scholars. This thesis investigates that claim, highlighting the context of Fitzgerald's career at the time. Gatsby was begun while Fitzgerald was living on Long Island, preparing for the opening of his comedic play, The Vegetable. The zany play mocks working-class individuals who believe themselves capable of becoming anything they wish simply because they live in a democracy. This thesis argues that, while assisting with the preparation for this play, Fitzgerald set to work on a new comedic project ridiculing the other end of the social spectrum by mocking the corrupt lives of the New York elite who were supposed to be setting examples for the rest of society. During this time, Fitzgerald kept company with one of the most powerful women in New York, Mary Harriman Rumsey, a prominent eugenicist whose circle was busy advocating for race-based immigration reform. These efforts would result in the 1924 Johnson-Reed Immigration Act. This thesis argues that Mary Harriman Rumsey, not Zelda Fitzgerald, is the main inspiration for the character of Daisy Buchanan, and that the themes of eugenics and immigration run throughout the book.

Daniela Trujillo Hassan
Graduate Program: Anthropology
Advisor: Julie Wesp
Poster Number: 161

Diet, Inequality, and Ecological Change at the Nueva Esperanza Archaeological Site during the Late Muisca Period (11th to 17th century)

This study examines the impact of environmental stressors on the dietary practices of the Muisca society at the Nueva Esperanza archaeological site, situated in the Sabana de Bogotá, Colombia, during the Late Muisca Period (11th century to 17th century). This time frame coincides with significant climate changes associated with the onset of the "Little Ice Age," which profoundly affected human interactions with agriculture and access to natural resources in both the northern hemisphere and equatorial regions.

Conducted at North Carolina State University and financially supported by Sigma Xi, this research collaborates with Minuto de Dios University in Colombia. With the aim of understanding the ecological interactions inherent in food intake and their implications for societal adaptations within this pre-Columbian group, this exploration, employed a multiproxy analysis encompassing stable isotopes of δ15N and δ13C, the identification of phytoliths in dental calculi, and the study of skeletal pathologies associated with nutrition. These methodologies were applied to 35 individuals from two occupations during the Late Muisca Period: occupation 4 (n=13) representing the onset of climatic changes (11th to 12th century) and occupation 13 (n=22) reflecting the coldest weather effect (15th to 17th century).

The central hypothesis guiding this research suggests that, prior to the arrival of the Spanish colonies, this hierarchical group experienced a transformation in their dietary habits over time. Preliminary results indicate that as the climate became colder, this chiefdom adopted more egalitarian dietary practices and a more equitable distribution of resources within various segments of society. These findings underscore the societal adaptability to climatic adversities in this group, suggesting greater dietary flexibility and adaptation to more hostile conditions.

Kelsey Ward
Graduate Program: Liberal Studies
Advisor: Jorge Mari
Poster Number: 166

Weaving the Commons: A Multimedia Exploration of Grassroots Socio-Environmental Sustainability Projects in the Raleigh-Durham Community

"Weaving the Commons" is a multimedia research project aimed at documenting diverse, self-managed communities of practice committed to nurturing socially, culturally, and environmentally sustainable communities in the Raleigh-Durham area and its surroundings. While self-managed communities and grassroots socio-environmental projects are not new phenomena, there has been a noticeable increase in grassroots involvement or interest in recent years, perhaps indicative of a "recommoning" and likely driven by political, economic, and social pressures and discontent. In response to these pressures, urban regions are witnessing a surge in the formation of grassroots community and environmental care groups. These communities employ various methods and tools that challenge exploitation in social, economic, and environmental spheres, often aligning closely with activist movements. Examples of such projects include resource-sharing networks, mutual aid hubs, co-housing developments, community gardens, and so on. Through a mixed-media ethnographic approach, drawing from interviews, observations, and active engagement with these community projects, "Weaving the Commons" captures the visions, methodologies, and narratives of these groups, weaving them into a digital archive accessible to the communities themselves, educators, policymakers, and the public, with the objective of fostering a deeper comprehension of these innovative communities and addressing a gap in research and knowledge about them up to this point.

Davion Washington
Graduate Program: Sociology
Poster Number: 168

Black Perspectives on White Racial Allyship

This study takes a critical look at the current state of white allyship in movements toward racial justice and equity, particularly within interpersonal relationships between Black and white Americans. A recent shift in public opinion and perception of racial justice has now fostered increased dialogue on the necessary work of white Americans to bring forth and ensure racial justice and equity. Overall, this study seeks to address the limitations of previous research by highlighting Black voices to examine Black experiences and perceptions regarding white racial allyship, its intricacies, contradictions, possible downfalls, and areas of improvement. Through in-depth interviews with Black and African American student leaders, this qualitative study explains how these student leaders view and define white racial allyship as racial justice movements persist and evolve, how identified white racial allies can and often do continue to perpetuate racial harm, the solutions and improvements that can be identified by the research participants, and lastly, how effectual white racial allyship ultimately is to Black Americans and racial justice movements. These findings are vital in equipping the existing literature on race and allyship with the tools for establishing a growing cognizance of the possible harms of white racial allyship, while also uplifting the necessity and significance of this allyship. This research seeks to position what works well within acts of white racial allyship for these acts to persist, while subsequently positioning what is harmful and does not work within acts of white racial allyship for these acts to cease.

Bella Wick
Graduate Program: Technical Communication
Advisor: Michelle McMullin
Poster Number: 170

Redesigning Training Documentation for an Efficient, Learner-Centric Training Process

More than ever, technology assists in creating a context for user learning. It considers elements such as design, modularity, multimedia learning, and is often offered through the context of a learning management system (LMS). However, technology training is little discussed in the context of brick-and-mortar environments.

This project used frameworks of pedagogy, technology, and technical communication to redesign training documentation—and, in turn, the training process—for a locally-owned toy store, Learning Express. Analysis of the original training demonstrates issues including poorly-written text as well as small, difficult-to-read font on a printed packet. These issues resulted in misplaced training causing progress loss and setbacks, difficulty in understanding the meaning of training content, too much time required from trainers, and ineffective evaluation.

The redesign considers social learning theory, design principles and LMS tools, and coordinative and transformative design. I conducted preliminary data through anonymous surveys from the learners to gather preferences in training and suggestions. The redesign occurred in Google Classroom to create an efficient, modular, learner-centered learning environment for the learners. Social learning theory was applied to allow for observation via training videos and modeling via in-person practice, allowing feedback from the trainers. The LMS utilized modular design to allow for macro and micro learning, and a variety of tools were used including textual explanations, video demonstrations and explanations, and assessments, as well as implementing the space for in-person practice and observation. Finally, this redesign was created through the use of transformative design—understanding client expectations and translating them for user understanding—and coordinative design—involving the users in the design process.

This redesign creates a framework of future training implementation in brick-and-mortar contexts while considering theories of technology implementation. Training implementation requires evaluation, resulting in a loop of updating, developing, and re-implementing the design.

Yinman Zhong
Graduate Program: Public Administration
Advisor: Amanda J. Stewart
Poster Number: 181

What Makes a Difference: Factors Influencing Community Benefit Provisions in Nonprofit Hospitals

Social determinants of health (SDOH) are the conditions in which people are born, grow, live, work, and age. SDOH can be shaped by political, social, and economic forces, thus, organizations that address SDOH would benefit by focusing on the broader community rather than individual-based treatments. Governments, healthcare organizations, and community-based organizations collectively contribute to addressing SDOH. Among the healthcare organizations, nonprofit hospitals have assumed significant responsibilities and increased accountability in serving their communities in exchange for their tax-exempt status. However, previous research showed mixed results on whether nonprofit hospitals provided enough community benefits compared with the values of their exempted taxes. Moreover, community benefit expenditures that aimed to address SDOH widely varied among nonprofit hospitals. Thus, this paper explores what factors influence nonprofit hospitals to allocate expenditures towards community benefit activities, and why these hospitals exhibit diverse efforts in addressing SDOH.

College of Natural Resources

Kazi Md Yasin Arafat, Hasan Jameel, Lucian Lucia, and Lokendra Pal
Graduate Program: Forest Biomaterials
Advisor: Lokendra Pal
Poster Number: 10

Tuning Microfibrillated Cellulose for High-Barrier Sustainable Packaging Films

Microfibrillated cellulose (MFC) is of great interest for its potential application in the development of sustainable biomaterials. The biodegradability and high strength-to-weight ratio, along with the abundance of hydroxyl groups on their surface, render them amenable to a wide range of chemical modifications. In this research, MFC of varying dimensions was mechanically produced using southern bleached hardwood kraft pulp (SBHK). MFC was then modified employing a cationic surfactant, viz., cetyltrimethylammonium bromide (CTAB), and a non-ionic surfactant (NS), alcohol ethoxylate, in order to improve its mechanical and barrier properties for prospective application in packaging films. The MFC and surfactant-modified MFC were characterized by using high-resolution fiber quality analyzers (HiRes FQA, OpTestEquipment Inc.), scanning electron microscopy (SEM), fourier transform infrared spectroscopy (FTIR), and time-of-flight secondary ion mass spectrometry (ToF-SIMS). It was found that the surfactant-modified MFC-based films enhanced the mechanical and barrier properties such as tensile, stretch, air resistance, oil and grease resistance, and moisture vapor transmission rates. Moreover, the adsorption of surfactant reduced bound water (BW), and hard-to-remove water (HRW) in MFC. Therefore, the current approach is expected to improve industrial applications of microfibrillated cellulose by reducing the total energy demand of dewatering and cutting the usage of single-use plastic for food packaging.

Munmun Basak, Lucian A. Lucia, and Lokendra Pal
Graduate Program: Forest Biomaterials
Advisor: Lokendra Pal
Poster Number: 13

Trash to Treasure: Repurposing Waste Disposal Paper Cups into Sustainable Fibers and Nanocellulose for Circular Economy

Every year billions of waste disposable paper cups are used and most of them are thrown away after use due to the lack of recycling system. Disposable paper cups are made of 95 wt% cellulosic paper board and 5 wt% polyethylene (PE) layer, which makes them hard to recycle by conventional recycling plants. Since throwaway paper cups are difficult for traditional recycling facilities to recycle due to the presence of the thin PE lining, just one out of every 400 gets recycled. To address this issue, a mechanical recycling technique followed by acid hydrolysis has been implemented to recover fibers as well as cellulose nanocrystals. The obtained cellulose nanocrystal's structural, morphological, thermal and suspension properties were investigated by X-ray diffractometer, transmission electron microscopy, thermo-gravimetric analysis and zetasizer, respectively. The isolated cellulose nanocrystals showed rice-like morphology and can be used in barrier coating for packaging materials to enable circular economy.

Christopher C. Boyer
Graduate Program: Parks, Recreation and Tourism Management
Advisor: Jason Bocarro
Poster Number: 18

NCAA's Mental Health Best Practices Still Need Coaching: Perceptions of Division I Student-Athletes on Strategies and Support Offered by Their Universities

The NCAA recognized the growing issue of student-athlete mental health over the last decade through publishing of best practices, passing of legislation, and surveying of student-athletes and coaches related to mental health. Depression rates in the U.S. are highest among 18 to 25-year-olds, with suicide now the second leading cause of death for collegiate student-athletes. Yet, many student-athletes do not use available services. A 2021 NCAA survey showed 31% of women and 37% of men do not know where to go on campus with mental health concerns. Our study consisted of virtual focus groups with student-athletes utilizing a semi-structured interview format. The interview guide was informed by emergent Mental Health Literacy theory (MHLt), NCAA 2016 recommended mental health best practices and 2019 mental health legislation. Twenty-two student-athletes representing 10 sports at 14 Division I institutions participated in seven focus groups before saturation was reached related to our questions. Overarching themes that emerged included (a) importance of coaches; (b) institutional/administrative culture; (c) barriers to seeking support (time, stigma, resources); and (d) triggers/root causes. The importance of coaches as both a standalone theme and influencing factor on the other primary themes is the focus in our results and contextualized through related discourse in the NCAA mental health best practices and Coaches Well-Being Study. Additionally, our data indicates support of the MHLt hypothesis that knowledge, attitudes, and beliefs around causes and sources of knowledge regarding mental health can help predict ability to seek help. It extends MHLt into the sport ecosystem by indicating coaches play a leading role in the MHL of athletes, as they consider coaches to be a primary source of knowledge and support around mental health. Our results show current failures by institutions to effectively and consistently implement related best practices and opportunities for improvement among coaches and administrators.

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Graduate Programs: Center for Geospatial Analytics[1]; Department of Agricultural and Resource Economics[2]; Biological and Agricultural Engineering[3]
Advisor: Natalie M. Nelson
Poster Number: 29

Assessing the Value of USDA Crop Data: A Comparative Analysis of NASS and RMA Resources

The United States Department of Agriculture (USDA) plays a pivotal role in crop monitoring, primarily relying on the National Agricultural Statistics Service (NASS) for data collection. NASS, with its long history dating back to the mid-1800s, has traditionally been the cornerstone of crop data acquisition, predominantly through landowner reporting. Despite NASS's prominence, the Risk Management Agency (RMA) provides an alternative data stream based on insurance reporting since 1996, covering a substantial portion of cropland. While NASS remains the primary data source for crop research, discrepancies between NASS and RMA data have been noted, prompting questions regarding data reliability. This study delves into the comparative value of NASS and RMA data, focusing on soybean and corn crops from 2011 to 2021. By analyzing data availability and variability, we aim to provide insights into the most effective resource for crop research, considering potential financial and research implications for landowners and stakeholders.

Hannah M. Desrochers[1], Nils Peterson[1], Lincoln Larson[2], Christopher Moorman[1], and Nathan J. Hostetter[3]
Graduate Programs: Fisheries, Wildlife and Conservation Biology[1]; Parks, Recreation, and Tourism Management[2]; U.S. Geological Survey, North Carolina Cooperative Fish and Wildlife Research Unit/Department of Applied Ecology[3]
Advisor: M. Nils Peterson
Poster Number: 45

Accounting for the Role of Emotions in Predicting Perceptions of Risk Posed by Wildlife Disease

Understanding risk perceptions related to wildlife disease is crucial to ensure that the communication of disease risks and wildlife disease management objectives align with stakeholder values. Perceived risk is influenced by beliefs about the actual likelihood and severity of something happening, as well as social and cultural factors such as demographics and political ideology. Prior research suggests that emotions may also impact perceptions of risk due to the evolutionary significance of emotions in protecting human beings from exposure to infectious diseases. We investigated the role of emotions as drivers of wildlife disease risk perception by surveying residents of Durham County, asking participants to rank the extent to which a list of emotions would reflect how they would feel if they saw a deer on their property. To measure risk perceptions, participants indicated how much risk they associated with a list of scenarios related to three wildlife diseases (tick-borne, Chronic Wasting Disease (CWD), and COVID-19). We identified predictors of the perceived risk of wildlife diseases using three regression models, one for each disease; the models included the following independent variables: emotional response to deer, demographics, and urban/rural identity. Positive and negative emotions were significant predictors of perceived risk in all three models and had larger effect sizes than demographic variables in all models. Negative emotions predicted greater perceptions of risk in all three models: tick-borne illness (Std. $\beta = 0.2195$), CWD (Std. $\beta = 0.2092$), and COVID-19 (Std. $\beta = 0.2265$). Positive emotions predicted lower perceptions of risk for the tick-borne illness (Std. $\beta = -0.1674$), CWD (Std. $\beta = -0.1385$), and COVID-19 (Std. $\beta = -0.0931$) models. These results indicate wildlife managers can reduce public risk perceptions, and potentially increase support for wildlife disease management, by working to reduce negative emotions associated with wildlife species such as deer.

Kayla Gilligan
Graduate Program: Parks, Recreation and Tourism Management
Poster Number: 60

Enhancing Collaboration and Inclusion in Disaster Recovery Networks: A Case Study of the North Carolina Inclusive Disaster Recovery Network (NCIDR)

Disaster recovery, resilience, and climate adaptation pose significant challenges for marginalized communities. These are particularly apparent in coastal Black, Indigenous, people of color (BIPOC), and low-income communities. Despite the urgency, many decision-makers need more collaboration practices and adequate inclusion strategies. This research delves into the complexities of disaster recovery networks, focusing on the North Carolina Inclusive Disaster Recovery Network (NCIDR) as a case study. NCIDR, a collaborative initiative comprising public, private, non-profit, and faith-based organizations, aims to foster equitable access to resources and amplify community voices in disaster recovery efforts. This study seeks to understand how collaboration, engagement, and participation within NCIDR influence organizational capacity and mission attainment. By analyzing meeting minutes spanning 2018-2022, the research team employs qualitative thematic analysis and NVivo software to map and measure the network's collaboration dynamics. The meeting notes or minutes describe the topics discussed, meeting attendance, and the next steps following the meeting. Meeting minutes are crucial for internal and external learning, evaluation, team accountability, and greater inclusion of team members who are not present, ensuring that groups continue to move towards their stated goals. The study uncovers insights into the network's evolution, gaps, and potential pathways for improvement. Key findings, such as participant interaction data from the notes, suggest that effective collaboration and engagement enhance organizational carrying capacity. The study identifies challenges in measuring the impact and value of collaboration, underscoring the necessity for metrics and sources of accountability. Metrics provide a standard for evaluating the effectiveness of collaboration, guiding decision-making, and resource allocation within the network. We also offer insights into the functioning of disaster recovery networks and present actionable recommendations for enhancing collaboration and inclusion. Such as which localities they explicitly mention in meetings and which show gaps in the areas that are not mentioned at all or often. NCIDR and similar networks can better serve their communities and advance equitable disaster recovery efforts by mapping the growth and scope of their network, allowing them to work to build more resilient communities and mitigate the impact of future disasters. The data collected is a way to expand network social capital by decentering the facilitator to improve equity through transparency, allowing for direct lines of communication amongst its members and a way for members to find and fill gaps they see in previous meetings. Quick, full integration into the network facilitates the efficient implementation of essential planning and policy initiatives.

Taylor A. Kanipe[1], Luz Meza[1], Sunkyu Park[1], Hou-Min Chang[1], Matt Farrell[2], and Richard A. Venditti[1]
Graduate Program: Forest Biomaterials[1]; Cotton Incorporated[2]
Advisors: Richard A. Venditti and Sunkyu Park
Poster Number: 88

Developing a Chemical Platform Based on Cottonseed Oil to Develop Functional Finishes for Cellulosic Materials

Cottonseed oil (CSO) is a byproduct of cotton production, and its unsaturation makes it a candidate for many chemical reactions to produce bio-based products. The objective of this research was to explore chemical methods to convert CSO into a functional finish for textiles and paper. Previously in our labs, CSO was functionalized via the Prilezhaev reaction to produce epoxidized cottonseed oil (ECSO). The ECSO was further modified with fatty primary amines to introduce a secondary amine group to the triglyceride. The molar ratio of the amines to ECSO was varied with and without a ZnCl2 catalyst. FT-IR and 1H NMR were used to determine the structure of the alkanol amine. Thermogravimetric analysis (TGA) and differential scanning calorimetry (DSC) were used to determine the thermal properties of the product. Oxirane oxygen content using AOCS Official method Cd 9-57 was determined. Successful aminolysis of ECSO was confirmed. Ongoing research involves the production and evaluation of water-based emulsions for fabric and paper applications. Further analysis and development is necessary to evaluate the suitability of ECSO and modified ECSO as a finish. This research is an example of the upgrading of renewable biobased resources to serve societal needs as replacements for petroleum-based chemicals.

Ashley Lynn[1], Nathan Hostetter[2], Christopher Moorman[1], Nils Peterson[1], John Kilgo[5], Heather Evans4, Mikiah Carver-McGinn[1], Jonathan Shaw[4], and Elizabeth Kierepka[1,3]
Graduate Programs: Fisheries, Wildlife, and Conservation Biology[1]; USGS, North Carolina Cooperative Fish and Wildlife Research Unit, Department of Applied Ecology, NC State University[2]; North Carolina Museum of Natural Sciences[3]; North Carolina Wildlife Resources Commission[4]; Southern Research Station, USDA Forest Service [5]
Advisor: Elizabeth Kierepka
Poster Number: 105

Estimating Post-Hunt White-Tailed Deer Densities along an Urban-Rural Gradient in Durham County, North Carolina

White-tailed deer (Odocoileus virginianus) populations are increasing in areas of high human density, particularly within suburban areas. These increased densities have led to numerous negative interactions between both species. We used a spatially explicit capture-recapture framework (SCR) with fecal DNA and telemetry data to model densities along the gradient. Seven sampling sites represented the gradient based on percent impervious surface ranging from 3% (most rural) to 60% (most urban). Private land makes up 95% of parcels in our study area and through community outreach, we worked with over 100 landowners to sample their land. To maintain a consistent sampling design throughout the gradient, we employed a cluster sampling design that was flexible enough to account for sporadic land access. Density estimates were affected by sex and impervious surface percentage. We sampled 353 31-m plots and collected 642 fecal samples resulting in 491 genotypes of 411 unique deer. Based on SCR estimates, the highest deer density was 60 deer/km2 (95% CI = 56-98) in rural sites. Densities decreased along the urban-rural gradient estimating almost <10 deer/km2 in the urban areas. Our findings provide a baseline density estimate in Durham County, North Carolina in areas where harvest regulations are lessened. This will inform state agencies on how to proceed with future regulations and opens possibilities of further non-invasive genetic SCR studies in abundant game species.

Jonathan Morizet-Davis, Yaojing Qui, Richard A. Venditti, and Joe Sagues
Graduate Program: Forest Biomaterials
Advisor: Richard A. Venditti
Poster Number: 118

Sustainable Life Cycle Assessment on Textile Cotton Waste Valorization Technologies

In this study three textile-cotton waste valorization technologies are assessed by modeling their environmental impact: combustion, pyrolysis, and composting. The potential for atmospheric carbon removal via the inclusion of CO2 capture and sequestration for combustion and composting and biochar sequestration for pyrolysis are also assessed. Due to copyright the CO2 capture technology for composting is excluded from the poster presentation.

Emissions are calculated in OpenLCA, a program used by industry professionals to assess the environmental impact of products and manufacturing systems. OpenLCA is used with the Ecoinvent database, a comprehensive database with over 20,000 life cycle assessment (LCA) data sets spanning across sectors. Aspen Plus is used to model mass and energy balances and used for the life cycle inventory in OpenLCA.

The TRACI, "tool for the reduction and assessment of chemicals and other environmental impacts" assessment method is used to quantify impacts. Its impact categories include global warming, ozone depletion, smog formation, acidification, eutrophication, ecotoxicity, fossil fuel depletion, and human health impacts including respiratory, carcinogenic (cancer-causing), and non-carcinogenic (other harmful effects).

The LCA concluded that pyrolysis had the highest impact on global warming potential (GWP) and smog, due to upstream operations producing high-voltage electricity in the SERC region. The carbon capture systems had higher impacts in all categories except for GWP, as the energy demand was higher for carbon capture systems. Compared to landfilling, all processes had lower impacts in ecotoxicity and soil eutrophication, due to the runoff in open landfilling systems. Overall, combustion had the lowest carbon footprint before credits. After applying all carbon credits, all processes had carbon-negative emissions, with combustion using carbon capture being the most carbon-negative activity.

Aakash Upadhyay, Lucian Lucia, and Lokendra Pal
Graduate Program: Forest Biomaterials
Advisor: Lokendra Pal
Poster Number: 162

Harnessing Barrier Properties of Cellulosic Fibers by Mechanical Modification for Sustainable Packaging

The quest for sustainable alternatives to single-use plastics has galvanized research into paper and packaging materials based on cellulosic fibers. This investigation explored chemical-free techniques to enhance the barrier properties of paper while retaining its inherent flexibility. Fibers were modified to different fibrillation levels in various compositions. This multi-scale refining elucidates the relationship between fiber morphology and paper's surface chemistry. Enhanced refining improved the barrier properties of paper sheets, evident from improved air resistance, WVTR, and OGR. The refining and calendaring process altered the fiber structure and reduced the surface energy of the produced sheets, leading to a more homogenized and compacted lattice. XRD and SEM analysis underscored subtle shifts in cellulose crystallinity and topographical aspects. Our work demonstrates that mechanical alterations of fibers can effectively optimize paper barrier properties without compromising its inherent flexibility.

College of Sciences

Ryan D. Bartone[1], Logan J. Tisch[1], Judith Dominguez[2], Samantha K. Holmes[2], Victoria McQuade[3], Loretta Que[3], Christine K. Payne[2], and James C. Bonner[1]
Graduate Programs: Toxicology, Department of Biological Sciences[1], Thomas Lord Department of Mechanical Engineering and Materials Science, Duke University[2], Department of Medicine, Duke University School of Medicine[3]
Advisor: James C. Bonner
Poster Number: 12

House Dust Mite Extract Proteins Adsorb to Multi-Walled Carbon Nanotubes to Form an Allergen Corona that Intensifies Allergic Lung Disease in Mice

Inhaled particulate air pollution is a major factor that exacerbates allergic asthma in humans. With the increase in nanotechnology research, exposure to engineered nanoparticles (NPs) are more prevalent and therefore could adversely affect human health when inhaled. We previously reported that the co-exposure of mice to house dust mite (HDM) allergens and multi-walled carbon nanotubes (MWCNTs) intensified lung inflammation in mice in vivo and amplified cytokine production by alveolar macrophages in vitro. NPs, including MWCNTs, avidly bind biomolecules to form protein coronas that can modify NP immunotoxicity. Therefore, we hypothesized that exacerbation of innate and adaptive responses from co-exposures of MWCNTs and HDM in mice in vivo is due to the formation of an allergen corona. Coronas were prepared in a cell-free system by co-incubating MWCNTs (NC7000, Nanocyl Inc.) with HDM extract (Greer Laboratories, Inc.), followed by sequential rinsing and centrifugation of the MWCNTs to remove free HDM proteins. Male and female C57BL/6J mice were exposed to a vehicle solution (PBS), pristine MWCNTs, or MWCNT-HDM coronas 6 times over a period of 21 days via oropharyngeal aspiration. Approximately 5-7% of proteins in HDM extract adsorbed to the MWCNTs to form a stable allergen corona and these HDM proteins included allergens associated with asthma pathogenesis, particularly Der p 2. Corona-MWCNTs exacerbated transcription of pro-inflammatory and pro-fibrotic mediator genes including IL-6, CCL11, Arg1, and Col1A1 to a significantly greater extent compared to pristine MWCNTs. Bronchoalveolar lavage fluid demonstrated increased eosinophils in mice exposed to the MWCNT-HDM coronas as compared to pristine MWCNTs. Exacerbation of HDM extract-induced allergic lung inflammation in mice by MWCNTs is due, at least in part, to the formation of a HDM-allergen corona. Overall, this study provides new insight to the mechanisms through which inhaled NPs exacerbate allergic asthma.

Jenna M. Berger[1], Jovica Todorov[1], Kalynn M. Turner[1], Hannah P. Sumner[1], Gregory S. McCarty[1], Elena V. Romanova[3,4], Jonathan V. Sweedler[3,4], Leslie A. Sombers[1,2]
Graduate Programs: Department of Chemistry; Comparative Medicine Institute; Department of Chemistry and Beckman Institute, University of Illinois Urbana-Champaign; Neuroproteomics & Neurometabolomics Center on Cell-Cell Signaling, University of Illinois Urbana-Champaign
Advisor: Leslie Sombers
Poster Number: 14

Unveiling Dopamine and Met-Enkephalin Dynamics: Simultaneous Co-Detection in Rat Striatum

Many studies have investigated striatal dopamine (DA) transmission with respect to reward-related learning and goal-directed behavior. Atypical opioid peptide activity in the striatum has also been heavily linked to drug abuse and addiction; however, these neuropeptides have proven difficult to detect in situ because they exist at low concentrations and are readily broken down by endogenous protease activity. As such, many fundamental questions regarding opioid peptide transmission remain unanswered, including how kinetics directly compare with those of more classical small-molecule neurotransmitters, like DA. In this work, fast-scan cyclic voltammetry (FSCV) is coupled with carbon-fiber microelectrodes for co-detection of DA and met-enkephalin (M-ENK), at single recording sites in rat striatal brain slices. An inhibitory Designer Receptor Exclusively Activated by Designer Drugs (DREADD) was used to minimize mesolimbic DA release enabling the co-detection of both analytes using a unique voltammetric waveform that was specifically designed to incorporate three distinct scan rates in each sweep. This minimizes sensitivity to DA, maximizes sensitivity to M-ENK, and mitigates electrode fouling. Locally evoked DA and M-ENK kinetics were dependent on both stimulation frequency and duration. Interestingly, M-ENK dynamics displayed a unique biphasic release profile with a significant latency to peak extracellular concentrations that occurs ~30 seconds after stimulation, a diffusion distance roughly 3x larger than that of DA. Finally, a series of independent experiments combined solid phase extraction with liquid-chromatography tandem mass-spectrometry (LC-MS/MS) to validate the M-ENK electrochemical signal using the m/z ratio and ion mobility. These findings provide direct evidence to support widely held assumptions regarding neuropeptide release, and they demonstrate how simultaneous release can affect distinct cell populations in striatum to ultimately shape circuit output.

Duy T.M. Chung, Khiem Chau Nguyen, and Jonathan S. Lindsey
Graduate Programs: Chemistry
Advisor: Jonathan S. Lindsey
Poster Number: 38

Total Synthesis of Native Bacteriochlorophyll A

Bacteriochlorophyll a (BChl a) is one of the chief pigments in anoxygenic photosynthesis. Along with chlorophylls, bacteriochlorophylls play a crucial role in absorbing light to power the biosphere but have largely been neglected as targets of chemical synthesis. The advent of synthetic routes to the native photosynthetic pigments is expected to open a portal for addressing diverse questions in the plant sciences. An approach to BChl a relies on joining AD and BC halves via (i) Knoevenagel condensation followed by (ii) double-ring closure (Nazarov cyclization, SEAr, and MeOH elimination), which together form ring E and the aromatic macrocycle. The AD and BC halves were constructed via 3 key-steps: (i) Sonogashira coupling to join pre-A and pre-D or pre-B and pre-C constituents; (ii) anti-Markovnikov hydration of the internal alkynylpyrroles; and (iii) Paal-Knorr type cyclization to form the dihydrodipyrrin AD and BC fragments. The trans-dialkyl substituents of each pyrroline ring (B, D) are introduced via chiral hexynones, which are prepared in a stereoselective manner. To date, we have prepared the individual pre-A–D constituents from small commercially available molecules (≥10 mmol each) as well as the target bacteriopheophorbide a. The results validate the ability to carry stereochemically defined substituents over the entire course of the synthesis. The conversion of bacteriopheophorbide a to Bchl a and extension of the route to valuable analogues are under investigation.

Ashley Connors, Emma M. W. Hepworth, and Jeffrey A. Yoder
Graduate Program: Toxicology
Advisor: Jeffrey A. Yoder
Poster Number: 40

Investigating the Impact of Per- And Polyfluoroalkyl Substances (PFAS) on Macrophage Phagocytosis

Immune function can be impaired by environmental contaminants. One class of chemicals recently shown to interfere with the immune system is per- and polyfluoroalkyl substances (PFAS). Earlier work focused on impacts on the adaptive immune system, though disruptions to the innate immune system have also been identified. These studies indicate that PFAS exposure can influence the numbers of innate immune cells, cellular signaling, and functional endpoints. To complement our previous studies in neutrophils, we are evaluating how macrophages are affected by a 2-day (in vitro) and 4-day (in vivo) exposure to ten PFASs: perfluorobutanesulfonic acid (PFBS), perfluorohexanesulfonic acid (PFHxS), perfluorooctanesulfonic acid (PFOS), perfluorohexanoic acid (PFHxA), Perfluorooctanoic acid (PFOA), perfluorononanoic acid (PFNA), perfluorodecanoic acid (PFDA), Nafion Byproduct 2, perfluoro-2-methoxyacetic acid (PFMOAA), and hexafluoropropylene oxide dimer acid (HFPO-DA or GenX). In single-PFAS cytotoxicity studies with macrophage-like THP-1 cells, exposure to 320 µM PFDA, PFNA, PFOS, and Nafion Byproduct 2 significantly reduced viability. We observed no changes in cell viability at or below exposures to 80 µM PFAS. We are currently investigating how phagocytosis is affected during PFAS exposures using both zebrafish larvae and THP-1 cells: macrophage populations derived from zebrafish and THP-1 cells will be challenged with fluorescent heat-killed E. coli. Phagocytic index and number will be measured with flow cytometry. Thus far, we have observed that PFOS, but not PFOA, increases the average extent of phagocytosis. Based on these functional assays, 2-3 PFASs will be selected for further studies to elucidate currently unknown molecular mechanisms of PFAS immunotoxicity. Understanding how PFAS affect innate immunity will help us better understand how these chemicals can alter an organism's ability to recognize and destroy pathogens in its environment as well as infected or transformed cells.

Erin Crites
Graduate Program: Physics
Advisors: Laura Clarke and Jason Bochinski
Poster Number: 42

Formation of Water Vapor from Hydrogels via Photothermal Heating of Embedded Nanoparticles

Hydrogels are a highly water-absorbent class of polymers. They can be used to create clean water from contaminated water: the unclean water is absorbed by the hydrogel and then energy is added to produce water vapor, leaving behind the contaminants. Compared to boiling the unclean water and condensing the vapor, hydrogels lower the energy needed to form water vapor (as compared to bulk water), thus the process is more energy efficient. This results from the interactions between the water and the hydrogel that encourage water evaporation (e.g., the interaction energy between a water molecule and the hydrogel surface is less than that between two water molecules). Because the hydrogel collapses and has decreased permeability when the water is removed, bulk heating (for instance, placing the hydrogel in an oven where the surface heats first) leads to hardening of the outer layer of the hydrogel, reducing the water vapor output. In contrast, photothermally active nanoparticles (that convert light to heat) can be used to internally heat the gel from the inside out. We present results on the vapor formation efficiency from photothermal and bulk heating using a hybrid hydrogel from sodium acrylate and N-isopropylamide that has either gold nanoparticles (GNP) or melanin nanoparticles (MNP) embedded. GNPs are a common photothermal material, but they can be impractical for applications, while MNPs are a relatively new photothermal material that can be mass-produced inexpensively and are innately biocompatible.

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Melody Hancock [1], Dana Hodorovich [2], Rachael Bieler [1], Chris Cole [1], and Kurt Marsden [1]
Graduate Programs: North Carolina State University[1], National Institute of Environmental Health Sciences[2]
Advisor: Kurt C. Marsden
Poster Number: 69

Identifying Molecular Targets of CHD7 that Mediate CHARGE Syndrome Phenotypes in a Zebrafish Model

CHARGE syndrome is a developmental disorder that affects 1 in every 10,000 births, and patients exhibit ear, eye, and craniofacial abnormalities. As well as behavioral characteristics that include autistic-like behaviors, intellectual disabilities, and sensory disorders. A de novo mutation in CHD7 (chromodomain helicase DNA binding protein 7) causes 70% of CHARGE syndrome cases. The Chd7 protein is a chromatin remodeler, can enhance or repress transcription, and has thousands of predicted binding sites in the genome. Our lab created a zebrafish model of CHARGE syndrome with a CRISPR/Cas9-induced 7 bp frameshift mutation in chd7. This model recapitulates CHARGE-like phenotypes including craniofacial defects, ear defects, cardiac defects, and defects in both acoustically- and visually-driven behaviors. However, the neural and molecular pathways that underlie these behavior defects are unknown. To determine the specific parts of the brain that require Chd7, we used brain-wide imaging to identify regions with altered activity patterns as well as altered numbers of inhibitory and excitatory neurons. To identify Chd7 target genes that mediate CHARGE-like behavioral phenotypes, we analyzed transcriptomic and proteomic data from chd7 wild type, heterozygous, and homozygous mutant zebrafish brain tissue at two developmental time points. We used differential expression analysis, ingenuity pathway analysis (IPA), and machine learning approaches to define a set of strong candidate genes and pathways that link Chd7 with disease-related phenotypes. To determine if the identified pathways impact CHARGE-like phenotypes in our zebrafish model, we will design CRISPR gRNAs to knockdown or enhance expression of candidate genes and measure morphological and behavioral phenotypes, and assess whether they phenocopy or rescue CHARGE-like phenotypes. Together these analyses will bridge a key gap and allow us to define molecular and cellular pathways that may be targets for potential therapeutic intervention to alleviate specific aspects of CHARGE syndrome.

Seiya Ishizawa, Anuja Koirala, Yume Iwakura, and Jun Ohata
Graduate Program: Chemistry
Advisor: Jun Ohata
Poster Number: 78

Serine-Selective Protein Modification by Fischer Esterification

Serine is the second most abundant amino acid residue of the human proteome and plays key roles in enzyme activities (e.g. serine proteases). Moreover, many post-translational modifications on serine residues are known to occur, and the relationship between diseases and post-translational modifications is reported (e.g. enhanced migration of cancer cells and phosphorylation of serine residues of keratins).

Amino acid residue-specific protein modifications could be strong tools for such biological studies by unveiling the role of target residue. However, compared to other residues, serine-specific modification methods are limited, presumably because of the presence of more nucleophilic residues (e.g. lysine or cysteine) and water in the typical bioconjugation solvent (i.e. aqueous buffers). Because of these limitations, most of the reported serine-specific modification methods in aqueous solutions are sequence-specific or proximity-driven, lacking the generality of the target proteins.

I hypothesized that the use of potentially biomolecule-compatible acidic media such as acetic acid enables selective modification of serine through Fischer esterification while suppressing the reactivity of other side chains. Serine would be insensitive toward acidic pH while some other nucleophiles on canonical amino acids (i.e., amine on lysine/N-terminus, guanidine on arginine, imidazole on histidine) are deactivated by protonation. During the modification process, the conservation of the structure and activity of peptides/proteins could be expected by tuning the reaction conditions as a high concentration of acetic acid is often used as a buffer component to stabilize proteins. Serine-selectivity and reaction efficiency of the method were optimized through the screening of different carboxylic acids and catalysts. After the modification, the retention of the enzymatic activity of lysozyme was confirmed. Installation of bioorthogonal handles to different proteins and further functionalization with fluorophores by click chemistry was successfully achieved.

Emmett B. Kendall[1,2], Curtis B. Storlie[2], Misty A. Radosevich[2], Erica D. Wittwer[2], and Matthew A. Warner[2]
Graduate Programs: Statistics[1]; Department of Quantitative Health Sciences, Mayo Clinic[2]
Advisor: Jonathan P. Williams
Poster Number: 90

Hidden Markov Methodology for Identifying Physiological States of Shock in Intensive Care Units

Detecting hemorrhaging (i.e. internal bleeding) in patients in intensive care units (ICUs) can pose significant challenges for critical care workers. Because the trauma occurs subcutaneously, clinicians rely on monitoring vital signs for specific trends indicative of a hemorrhage event. Moreover, the inherent difficulties of diagnosing such an event ultimately can lead to late intervention by clinicians which has catastrophic consequences. Therefore, a methodology for early detection of internal bleeding has wide utility in reducing the number of deaths witnessed in ICUs. We develop a Bayesian regime switching model (RSM) that analyzes trends in patients' vitals to provide a probabilistic assessment of the underlying physiological state that a patient is in at any given time. Training on EHR data from real ICU patient encounters at Mayo Clinic, we model heart rate, blood pressure, hemoglobin, and lactate measurements as a vector autoregressive (VAR) process. This provides a manner by which we can account for both the correlation between vitals as well as the temporal correlation within vitals to inform the RSM of the probability of hemorrhaging in a semi-supervised fashion.

Hyoshin Kim[1], Sujit K. Ghosh[1], Adriana Di Martino[2], and Emily C. Hector [1]
Graduate Programs: Statistics[1]; Autism Center, Child Mind Institute[2]
Poster Number: 92

Bayesian Estimation of Clustered Dependence Structures in Functional Neuroconnectivity

Motivated by the need to model the dependence between regions of interest in functional neuroconnectivity for efficient inference, we propose a new sampling-based Bayesian clustering approach for covariance structures of high-dimensional Gaussian outcomes. The key technique is based on a Dirichlet process that clusters covariance sub-matrices into independent groups of outcomes, thereby naturally inducing sparsity in the whole brain connectivity matrix. A new split-merge algorithm is employed to achieve convergence of the Markov chain that is shown empirically to recover both uniform and Dirichlet partitions with high accuracy. We investigate the empirical performance of the proposed method through extensive simulations. Finally, the proposed approach is used to group regions of interest into functionally independent groups in the Autism Brain Imaging Data Exchange participants with autism spectrum disorder and co-occurring attention-deficit/hyperactivity disorder.

Sarah Kromer, Michael Rosko, Alexandra Barth, Nicolas Durand, and Felix N. Castellano
Graduate Program: Chemistry
Advisor: Felix N. Castellano
Poster Number: 94

Ligand Modification in Platinum(II) Dimers Alters Observed Photophysics Through Enhanced Orbital Overlap

Synthetic approaches to tune the metal-metal distance and orbital overlap in homonuclear Pt(II) dimers are well established. As previously demonstrated in complexes of bidentate cyclometalating ligands connected through a modified pyridine or pyrazole bridge, the extent of interaction between the platinum 5dz2 orbitals plays a substantial role in observed photophysics. Significant Pt-Pt orbital overlap produces metal-metal-to-ligand charge transfer (MMLCT) transitions originating from an antibonding dz2 interaction, while reduced d-orbital overlap at increased Pt-Pt distances produces transitions dominated by metal-to-ligand charge transfer (MLCT) transitions akin to mononuclear systems. In newly conceived systems, further modification of the ligand manifold is designed to again alter the Pt-Pt distances and thereby the observed photophysics. Modified terpyridine cyclometalating ligands lead to more direct platinum dz2 overlap enforced by increased π-stacking interactions. This enhanced orbital overlap allows for MMLCT transitions at longer Pt distances, as is observed from a new series of dimers utilizing both previously studied and novel bridging ligands. In this work, the synthesis and spectroscopic characterization of these new systems are used to evaluate the role of ligand identity on the photophysical properties of Pt(II) dimers.

Isabella G. Livingston[1],[2], Samantha L. Badgett[2], Melissa K.R. Scheible[2], Nicholas P. Gould[3], Erin P. Meredith4, Jennifer Strules[3], Christopher S. DePerno[3], Colleen Olfenbuttel5, Michael K. Stoskopf[2], Chad Arnold[6], Kelly Meiklejohn[2], and Matthew Breen[2]
Graduate Programs: Genetics and Genomics1; College of Veterinary Medicine[2]; College of Natural Resources[3]; California Department of Fish and Wildlife, Wildlife Forensic Laboratory[4]; N.C. Wildlife Resources Commission, Wildlife Management Division5; N.C. Wildlife Resources Commission, Law Enforcement Division[6]
Advisor: Matthew Breen
Poster Number: 102

Population Genetics and Dynamics of the North Carolina Black Bear (Ursus Americanus)

High-throughput sequencing positions genetics to provide an understanding of genetic diversity, evolutionary history, and population dynamics for any species. Genetic factors are essential for combating threats to populations as levels of genetic diversity can impact fitness and survivability. The American black bear (Ursus americanus) is ubiquitous across North America and is an important ecological resource. North Carolina is home to a significant population of bears where they are contributors to biodiversity and ecosystem health. In this study, we aim to determine how rapidly changing environments and anthropogenic effects are influencing the structure and genetic health of North Carolina black bears. We use advanced genetic and genomic tools to assess the population dynamics of bears spread across the discrete management units, including the effective population sizes, genetic differentiation, and individual inbreeding coefficients. These data will inform decisions regarding the definition of conservation units, and following this foundational study, we will develop the first single nucleotide polymorphism (SNP) panel that can be used by managers for population/individual assignment. The data will provide a key resource of actionable information that can be used by the state to effectively conserve bear populations and maintain their IUCN status as a species of least concern.

Samhita Pal
Graduate Program: Statistics
Poster Number: 125

Coverage of Credible Sets for Variable Selection Using Sparse Projection-Posterior

We consider asymptotic frequentist coverage of credible sets based on a novel Bayesian approach for a linear regression model under sparsity. In this study, we initially ignore the underlying sparsity and put a conjugate normal prior on the coefficient vector. We then induce the posterior distribution through a map, thereby immersing the dense posterior samples of the parameter vector to the desired low-dimensional space by minimizing the sum of squares of deviations plus a suitably scaled l1-penalty on the vector. We demonstrate that a properly recentred credible ball has the exact asymptotic frequentist coverage. Through extensive simulation, we provide a guideline for choosing the penalty parameter as a function of the credibility level appropriate for the corresponding coverage. We also show finite-sample numerical results that agree with the asymptotic theory.

Arlee Shelby[1], Patrick Barry[2], and Chueng-Ryong Ji[1]
Graduate Programs: Physics[1]; Argonne National Laboratory[2]
Advisor: Chueng-Ryong Ji
Poster Number: 148

Including Complementary Data for the Global QCD Analysis of the Pion Parton Distribution Functions

The pion plays an important role in understanding the nature of strong interactions between the nucleons and more fundamentally the quantum chromodynamics (QCD) of quarks and gluons, generically called partons. As the lightest QCD bound state, the partonic nature of the pion can be used to probe the fundamental properties of QCD interactions, typically known as the confinement mechanism of quarks and gluons inside the nucleon and the chiral symmetry of the effective nucleon-nucleon interactions mediated by the pion. The global QCD analysis [1,2] has been performed to understand what the available experimental data tell us about the internal structure of the pion, namely its parton distribution functions (PDFs) which describe the probability of finding a parton inside the pion at a specific momentum fraction, x. Both the high energy pion-nucleus Drell-Yan (DY) lepton pair production data and the leading neutron (LN) production data have been analyzed with the Monte Carlo methodology for Bayesian inference to probe the pion PDFs not only at the high x values (close to 1) but also at the low x values (close to 0). In this work, we further analyze the inclusive neutron production data from the proton-proton collisions involving the pion exchange which probes the probability of the pion splitting from the nucleon. This probability information known as the pion splitting function appears in both the proton-proton data as well as the LN electroproduction. As another data set to constrain the splitting, it indirectly adds indispensable information in the global QCD analysis of the pion PDFs scrutinizing validity of the previously obtained pion PDFs and their universality.

[1] P. Barry, N. Sato, W. Melnitchouk and C.-R. Ji PRL121, 152001(2018)

[2] P.Barry, C.-R. Ji, N. Sato and W. Melnitchouk, PRL127, 232001(2021)

Matthew Singer[1],[2], Srijan Sengupta[1], Karl Pazdernik[1],[2], and Liz Richerson[3]
Graduate Programs: Statistics[1]; Pacific Northwest National Laboratory[2]; Laboratory for Analytic Sciences[3]
Advisor: Srijan Sengupta
Poster Number: 151

Conformal Prediction for Named Entity Recognition and Other Sequence Labeling Problems

Sequence labeling is a foundational problem in multiple natural language processing tasks such as named entity recognition (NER), text chunking, part-of-speech (POS) tagging, and semantic role labeling. The outputs of these tasks are often utilized in downstream applications such as entity linking, question answering, and document summarization. Therefore, any errors within the output of the aforementioned sequence labeling tasks will be compounded within their downstream applications. For this reason, we have developed an uncertainty-aware formulation for sequence labeling, which will output a well-calibrated prediction set that is guaranteed to contain the correct answer at a user-specified confidence level. We outline three new conformal prediction-based methodologies designed explicitly for sequence labeling problems and demonstrate how prediction sets may be generated for any given, continuous sub-sequence of labels. All methods rely on the conditional random field (CRF) decision head and may be applied to any task that utilizes such a structure. All three methods are implemented for the NER task. We show how existing multilingual or monolingual NER models may be quickly retrained with a CRF decision head to enable sentence-level and entity-level conformal prediction. The experimental results on four benchmark data sets and four base models show how our methodologies can be used to produce more interpretable, uncertainty-aware outputs.

Logan Tisch[1], Ho Young Lee[1], Ryan Bartone[1], Silvio Antoniak[2], and James Bonner[1]
Graduate Programs: Toxicology[1]; University of North Carolina[2]
Advisor: James Bonner
Poster Number: 160

Proteinase-Activated Receptor-2 Regulates the Production of the Fibrotic Mediator Arg-1 by Murine Bone Marrow-Derived Macrophages and Ex Vivo Alveolar Macrophages in Response to Multiwalled Carbon Nanotubes in an Asthma-like Microenvironment

Proteinase-activated receptor 2 (PAR2), a 7-transmembrane G protein-coupled receptor, is implicated in immune regulation and the pathogenesis of various inflammatory diseases, including pulmonary fibrosis and asthma. PAR2 is activated by proteolytic cleavage of the N terminus by serine proteases, including those found in allergens such as house dust mite (HDM) extract. We previously reported that co-exposure to HDM extract and multiwalled carbon nanotubes (MWCNTs) synergistically enhanced allergic lung inflammation in mice, with PAR2-deficient (Par2-/-) mice exhibiting reduced airway fibrosis and arginase-1 (Arg-1) expression compared to wildtype (WT) mice. In the current study, we utilized bone marrow-derived macrophages (BMDM) and murine ex-vivo alveolar macrophages (MexAMs) isolated from WT or Par2-/- mice to investigate the dynamic phenotypic and functional alterations induced by MWCNT exposure within an asthma-like microenvironment characterized by TH2 cytokines IL-4 and IL-13. Flow cytometry analysis revealed that MWCNT treatment increased the expression of the M2 polarization marker CD206 in WT and Par2-/- BMDMs compared to media control groups. Furthermore, MWCNTs increased Arg-1 production in both WT and PAR2 -/- BMDMs and MexAMs. Additionally, MWCNTs increased IL-4/13-induced Arg-1 expression in WT BMDMs and MexAMs. Western blot analysis corroborated these findings, showing exacerbated IL-4/13-induced Arg-1 protein expression in WT BMDMs exposed to MWCNTs, while MexAMs exhibited increased phosphorylated STAT6 (pSTAT6) in response to MWCNTs within an IL-4/13 microenvironment. Interestingly, PAR2 -/- BMDMs displayed elevated pSTAT6 protein expression compared to WT cells. Collectively, these results indicate that MWCNT exposure promotes macrophage differentiation towards an M2 or profibrotic phenotype, evidenced by increased CD206 and Arg-1 expression. Moreover, the augmentation of IL-4/13-induced Arg-1 and CD206 expression by MWCNTs offers mechanistic insights into the exacerbation of allergic lung disease observed in vivo. Finally, the differences in cell surface markers and protein expression between PAR2 -/- and WT cells highlight the involvement of PAR2 in macrophage differentiation and Arg-1 production.

E.J. Warner, Q. Guthrie, B. Humphrey, and C. Proulx
Graduate Program: Chemistry
Advisor: Caroline Proulx
Poster Number: 167

New Method for Cyclic Peptide Synthesis Using Hydrazone Linkages with High Side Chain Diversity

Bioorthogonal chemistry has become a powerful tool in the manipulation of biomolecules under mild conditions. We previously demonstrated the use of N-aryl peptides as novel precursors for oxime ligations at neutral pH, taking advantage of their site-selective oxidation into a reactive (protonated) Schiff base intermediate. Among the various advantages of this method, tuning the electronics of the phenyl ring in electron-rich N-aryl peptides have allowed: 1) orthogonal reactivity at varying pHs, and 2) efficient ketoxime peptide ligations, increasing diversity at the site of ligation. Here, we report the use of N-aryl peptide hydrazides, possessing substituents at the alpha-carbon, in head-to-tail peptide macrocyclization reactions. A scope will be presented, showcasing 50 > macrocyclic peptides with sequence diversity and variable ring sizes. Conditions for isomerization, reduction, ring opening, and stability of the resulting kethydrazone-linked cyclic peptides will be presented.

College of Veterinary Medicine

Kayleigh R. Diveley[1,2,5], Tammy S. Tollison[4,2,5], Nicole Adams[3,2,5], Gang Li[6,7], and Xinxia Peng[3,2,5,1]
Graduate Programs: Genetics and Genomics Academy[1], Molecular Biomedical Sciences[2], Bioinformatics[3], Comparative Biomedical Sciences[4], College of Veterinary Medicine[5], Aging Institute, University of Pittsburgh Medical Center[6], Medicine, Division of Cardiology, University of Pittsburgh Medical Center[7]
Advisor: Xinxia Peng
Poster Number: 48

Using High-Throughput Approaches to Identify Functional Fc Gamma Receptor SNPs

Many genetic variations in the Fc Gamma Receptor (FCGR) region have been associated by genome-wide association studies (GWAS) to complex disease and treatment efficacy. However, the genetic complexity exhibited within the human FCGR region presents a challenge for post-GWAS functional analyses. Therefore, the identity and regulatory role of functional Single Nucleotide Polymorphisms (fSNPs) in the FCGR region have been limited to date. Using the high-throughput Regulatory Element (REEL)-Seq screen, we have systematically identified over 400 candidate FCGR fSNPs in THP-1 human monocytes. Several candidate fSNPs with associated immune relevance were selected for further functional characterization and displayed both allele-specific protein interactions and alterations to transcriptional activity of a reporter protein in vitro. These observations lend support to the hypothesis that non-coding variations may influence transcriptional regulation of genes in the FCGR region. To evaluate this hypothesis, we have utilized CRISPR and CRISPRi systems to edit fSNP locations and perturb their interacting proteins to examine the effects upon FCGRs in THP-1. As FCGR abundance may influence monocyte-based antibody-dependent cellular phagocytosis (ADCP) activity, understanding the regulatory impact of these fSNPs may inform the development of antibody-based therapy and prevention.

Glenn Jackson
Graduate Program: Comparative Biomedical Sciences
Advisor: Glenn Cruse
Poster Number: 80

Exploiting the Mechanisms of the KIT Receptor in Mast Cell Proliferative Disorders

Classic studies from 1995 introduced the world to a compelling and powerful tool, exon-skipping oligonucleotides (ESOs), which was shown to be very useful in a multitude of biotherapeutic approaches. Thirty years later, ESOs, which were originally used to treat Duchenne muscular dystrophy, are still an attractive tool used to treat many crippling biological conditions. In this study, we aim to employ ESOs to treat mast cell (MC)-mediated disorders, such as mastocytosis, which are a result of aberrant protein or receptor expression. Mastocytosis is a disorder characterized by abnormal proliferation and accumulation of MCs in tissues. Clinical features of mastocytosis are similar to allergic reactions with symptoms ranging from mild to life-threatening. The majority of mastocytosis patients have the activating D816V mutation of the kit receptor, and this mutation bypasses the need for this receptor to bind its ligand, SCF, which is critical for cell survival. This leads to the consequential accumulation and activation of MCs which markedly increases the chance of anaphylactic shock. As a result, we hypothesized that ESOs can be used to target the kit receptor, inhibiting the MCs' ability to grow and accumulate in tissues. To this end, we designed ESOs to target exon-4 of kit pre-mRNA, resulting in a premature stop codon in the mRNA transcript rendering the receptor as nonfunctional. Preliminary data was very promising with our ESO, KitStop, demonstrating efficacy to decrease receptor expression and cell proliferation of HMC1.2 cells in vitro. We demonstrate translational potential using a humanized xenograft mouse model of mastocytosis in which we inoculate immunodeficient mice with HMC1.2 cells before systemically treating them with our KitStop ESO. In summary, our KitStop work adds to the many potential therapeutic uses of ESOs and will be further developed exploring the roles of kit in other cell types.

Ashlan Jolley[1], William Love[2], Erin Frey[3], and Cristina Lanzas[2]
Graduate Programs: Comparative Biomedical Sciences[1]; Population Health and Pathobiology[2]; Clinical Sciences[3]
Advisor: Cristina Lanzas
Poster Number: 84

Companion Animal Antimicrobial Prescribing by Geographic Region and Urbanicity in North Carolina From 2019-2020

Antimicrobial resistance is a leading global health threat, making judicious antimicrobial use (AMU) critical to informing interventions against future resistance development. Studies have demonstrated significant spatiotemporal variations in AMU based on social determinants affecting patients (i.e., social, economic, and demographic factors). While the majority of AMU research in the United States has traditionally focused on use in people and food animals, the increasing importance of the human-animal bond has highlighted the role of companion animals as potential reservoirs for microbial pathogens. With almost 140 million dogs and cats owned by Americans in 2018, companion animals represent an often overlooked yet substantial source of AMU. In collaboration with IDEXX Laboratories, Inc., North Carolina State University acquired companion animal AMU data from nearly 400 private small animal practices and hospitals in North Carolina (NC). Over 1,000,000 AMU records for topical (24%), and systemic oral (51%) and injectable (12%) antimicrobial agents were extracted, with all other (13%) formulations excluded. Remaining prescriptions for dogs (80%) and cats (20%) were analyzed from 2019-2020. Entries were sorted into one of 6 strata according to the NC region (ie., Mountains, Piedmont, Coastal Plains) and urbanization (i.e., rural, urban) of the county from which they originated. Additionally, variables from the Centers for Disease Control and Prevention's Social Vulnerability Index (SVI) were summarized for each of the aforementioned strata and matched to their respective records. Data were also classified as "pre-pandemic" or "pandemic" by date of administration relative to the onset of COVID-19 pandemic in N.C. Negative binomial regression was then used to identify potential impacts of strata, SVI factors, and the COVID-19 pandemic on prescribing. Fluoroquinolones (15%), aminoglycosides (14%), and β-lactam combination agents (13%) were the most common drug classes prescribed. These preliminary results provide an early summary of companion animal AMU across NC.

Chloe Mariant, S. Klimczak, M. Egensperger, B. Wieland, E. Wood, S. Zacher, D. Salvador, and L. Van Landeghem
Graduate Program: Comparative Biomedical Sciences
Advisor: Laurianne Van Landeghem
Poster Number: 109

GFAP-Expressing Enteric Glial Cells Promote DNA Integrity in Intestinal Epithelial Progenitor Cells to Promote Regeneration After Genotoxic Injury

Preserving the intestinal epithelium integrity is critical to maintain nutrient absorption while preventing toxins and pathogens from penetrating the body. The epithelial barrier is kept intact in homeostatic conditions and regenerated after injury through the fast production of intestinal epithelial cells derived from multipotent Lgr5 expressing intestinal stem cells and progenitors residing in intestinal crypts. Intestinal stem cell and progenitor functions are regulated by extrinsic signals emanating from their microenvironment including those from the gut intrinsic enteric nervous system, and in particular enteric glial cells (EGC). EGC are known as potent regulators of the intestinal barrier function. However, whether and how EGC impact intestinal epithelial regeneration after injury is unknown and uncovering the mechanisms involved in restoration of the intestinal barrier is crucial for many pathologies To investigate this, we used the chemogenetic GFAP-hM3Dq mouse model, in which GFAP-expressing EGC are activated upon Clozapine-N-oxide (CNO) administration. To study the impact of EGC activation on epithelial response to genotoxic injury, mice received CNO 24h prior to and after a single dose of 150mg/kg of the chemotherapeutic drug 5-fluorouracil (5-FU). Small intestines were collected at 12h, 24h, 48h, 72h and 96h post-5-FU injury, and the impact of EGC activation was assessed on epithelial DNA damage (pH2AX), apoptosis (CC3) and proliferation (EdU) via immunofluorescence and H&E staining as well as western blots. The identity of the intestinal epithelial cells targeted by activated EGC was determined using the relative positioning of the cells within the crypt axis and the Lgr5-EGFP reporter mouse model. Our data show that EGC activation significantly decreased the number of cells per crypt undergoing DNA damage response and apoptosis at 12h and 24h post 5FU. In addition, EGC activation significantly increased the number of cells in S-phase per crypt as early as 24h after 5FU injection. More specifically, based on cell positioning along the crypt axis and co-localization with Lgr5-EGFP, our data demonstrate that EGC activate proliferation in intestinal epithelial progenitors (above position 4), but not Lgr5-expressing intestinal stem cells, after 5-FU injury. Altogether, this study indicates that GFAP expressing enteric glial cells might have a major role in promoting intestinal epithelial regeneration after genotoxic injury. Follow-up investigations will identify the mechanisms involved.

Victor N. Rivas, M.S.[1]; Amanda E. Crofton, DVM[2]; Carina E. Jauregui, RVT, RLAT[2]; Jalena R. Wouters[2]; Betty S. Yang, B.S.[2]; Luke A. Wittenburg, DVM, Ph.D.[3]; Joanna L. Kaplan, DVM[2]; Darren T Hwee, Ph.D.[4]; Anne N. Murphy, Ph.D.[4]; Bradley P. Morgan, Ph.D.[4]; Fady I. Malik, MD, Ph.D.[4]; Samantha P. Harris, Ph.D.[5]; and Joshua A. Stern, DVM, Ph.D.[1]
Graduate Programs: Comparative Biomedical Sciences[1]; Department of Medicine and Epidemiology, School of Veterinary Medicine, University of California-Davis[2]; Department of Surgical and Radiological Sciences, School of Veterinary Medicine, University of California-Davis[3]; Research and Non-clinical Development, Cytokinetics, Inc.[4]; Department of Physiology, University of Arizona[5]
Advisor: Joshua A. Stern
Poster Number: 138

Cardiac Myosin Inhibitor, CK-586, Minimally Reduces Systolic Function and Ameliorates Obstruction in Feline Hypertrophic Cardiomyopathy

HCM remains the most common heritable cardiomyopathy in humans and cats with few preclinical pharmacologic interventional studies. Small-molecule inhibitors that modulate the sarcomere are promising novel therapeutics for the management of oHCM patients and have shown efficacy in left ventricular outflow tract obstruction (LVOTO) relief. The objectives of this study were to explore the 6-, 24-, and 48-hour (hr) post-dose, pharmacodynamic effects of the cardiac myosin inhibitor, CK-4021586 (CK-586), in six purpose-bred cats with naturally occurring obstructive hypertrophic cardiomyopathy (oHCM). A blinded, randomized, five-treatment group, crossover preclinical trial was conducted to assess the pharmacodynamic effects of cardiac myosin inhibitor CK-586 in a purpose-bred feline model of oHCM. Serial plasma concentrations were obtained for dose assessments and select echocardiographic variables were assessed five times over a 48-hr period. Treatment with oral CK-586 safely ameliorated LVOTO in oHCM cats. In this study, we report the beneficial dose-dependent effects of CK-586 treatment at eliminating obstruction (reducing LVOTOmaxPG), increasing measures of systolic chamber size (LVIDs Sx), and thus, decreasing select measures of heart function (LV FS%, and LV EF%) in the absence of impact on heart rate. At all tested doses, a single oral dose of CK-586 resulted in improved or resolved LVOTO with well-tolerated, dose-dependent, reductions in LV systolic function. Further studies interrogating the long-term effects of CK-586 in oHCM-affected cats are warranted. The results from this study pave the way for the potential use of CK-586 in both the veterinary and human clinical settings.

Haven Roberts[1],[2], Sydney Joyner[2], and Glenn Cruse[2]
Graduate Programs: Comparative Biomedical Sciences[1]; Molecular Biomedical Sciences[2]
Advisor: Glenn Cruse
Poster Number: 139

Differential Signaling Pathways of Compensatory MS4A Proteins During Human Mast Cell Degranulation

The frequency of allergic diseases has markedly increased over the past few decades. Increased levels of the surface IgE receptor (FcƐRI) on mast cells, one of the main drivers of allergic diseases, further exacerbates inflammatory response to allergens. FcƐRIβ(also known as MS4A2), traffics FcƐRI to the cell surface and potentiates signaling. Recent evidence shows that MS4A6A, a structurally homologous protein to FcƐRIβ, provides compensatory functions to MS4A2 in mediating FcƐRI receptor trafficking and signal transduction. Therefore, the investigation of MS4A6A expression in human mast cells may reveal differential downstream pathways and identify new targets for allergic disease treatment.

We hypothesize that MS4A2 and MS4A6A perform distinct, but overlapping functions, and that elevations in intracellular levels of MS4A6A will heighten mast cell sensitivity.

For our study, our group transduced Laboratory of allergic diseases 2 (LAD2) cells with lentiviral constructs (Scramble-GFP, MS4A2-GFP, MS4A6A-GFP, and MS4A6A-Myc/Flag). Transduction was confirmed by Western Blot analysis. Once confirmed, intracellular levels of tryptase were measured by Western Blot and LAD2 cell degranulation was measured by a colorimetric β-hexosaminidase release assay. The results of our study found that overexpression of MS4A2 significantly reduced intracellular levels of tryptase but did not appear to affect the release of β-hexosaminidase during a degranulation response, although there was a trend for less degranulation. Conversely, the overexpression of MS4A6A appeared to increase the amount of β-hexosaminidase released but had no significant effect on intracellular tryptase levels.

In summary, we demonstrated that overexpression of MS4A2 slightly inhibits degranulation of human mast cells, and significantly decreases tryptase content in the cells. Conversely, MS4A6A overexpression increases degranulation in response to IgE, but has little effect on tryptase content. This data may suggest that degranulation signaling through MS4A2 and MS4A6A is conducted by different downstream protein tyrosine kinases that provide compensatory functions during mast cell activation.

Poole College of Management

Shiyue Yao
Graduate Program: Economics
Advisors: Justin Baker and Zachary Brown
Poster Number: 177

Innovations in the Food-Water-Energy Nexus in California's Central Valley: Dynamic Decision-Making in Agrivoltaic Systems

California's Central Valley farming industry has been facing significant challenges related to water shortage and increasing energy prices, leading to changes in land use patterns and policy mandates such as the Sustainable Groundwater Management Act, which could impose restrictions on agricultural groundwater use. Simultaneously, California's climate ambitions could drive investment in land-intensive renewable energy sources such as solar, potentially displacing agricultural production in productive regions such as the Central Valley. One potential option for managing land use in the region is the adoption of agrivoltaics, which involves the installation of solar panels above agricultural land. Agrivoltaics can provide income benefits to farmers from solar leasing while maintaining a certain level of commodity production and reducing irrigation demands per-unity area.

There is a growing literature about the potential of Agrivolaic systems and their benefits in the Food-Energy-Water nexus, and qualitative studies about land-owner decisions on solar adoption, however, a gap remains in quantitative modeling studies that explore the factors that determine the optimal decision for landowners. In this paper, we develop a regime-switching stochastic dynamic model of land use decisions among purely crop production, solar production, or Agrivolaics. The key assumption for regime-switching is the irreversibility of solar panel installation and crop production removal. Our model incorporates the three aspects of the Food-Energy-Water nexus, the landowner's objective function is to maximize the net benefits derived from food production, irrigation water saving through shading, and energy production (or solar lease income). To address the uncertainties in land-use decisions, we employ a stochastic dynamic programming framework, capturing uncertainty in future economic and environmental conditions derived from empirical trends. Through value iteration, we identify the conditions under which the adoption of intensive solar and/or crop production would be strictly preferred to Agrivolaics.

From the preliminary results we find that 1) under combinations of low solar lease rate and low water prices, producers stay in agricultural production, but as water prices (or the opportunity cost of water) increase, it is optimal for landowners to switch to solar; 2) however, at higher solar lease rates, it is beneficial for landowners to adopt Agrivoltaics. 3) Agrivoltaics is preferable to purely solar production for crops with a lower margin in agriculture production, higher water demand, and higher shade tolerance.

Wilson College of Textiles

Kiran M. Ali
Graduate Program: Fiber and Polymer Science
Advisor: Jessica M. Gluck
Poster Number: 6

Engineering a Cardiac Microenvironment: Utilizing Decellularized Extracellular Matrix-Based Fibrous Scaffold for iPSC-Based Cardiac Differentiation

Cardiovascular disease remains the leading cause of death globally. The primary reason is that the contractile cells in the region, called cardiomyocytes (CMs) do not have the natural ability to regenerate. Therefore, when there is a larger region of infarction, the cells do not regenerate and are replaced by stiff tissue. The high stiffness of the newly formed tissue fails to support the highly contractile nature of CMs and hence, the region of infarction increases, and the functionality of the heart is further reduced. Stem cell transplantation is being investigated to aid the cells in the affected region. Multiple cell lines, including embryonic stem cells and induced pluripotent stem cells (iPSCs), have shown positive results in in vitro studies however, on transplantation the cells are hard to track and therefore, the mechanism remains unclear. With my study, I am investigating the effect of the micro-architecture of cells on the differentiation of iPSCs into CMs. CMs are cells with a brick-like structure and are known for their highly organized contractile morphology in native tissue. I hypothesize that by assisting in organizing the cells, they may differentiate into more CMs, leading to an increase in CM-specific markers. To achieve this, I am using natural ECM proteins from a decellularized porcine heart that has a similar ingredient list as the human heart. However, the decellularization process causes the tissue to lose its integrity. Therefore, a synthetic polymer, polycaprolactone (PCL), is blended with the ECM proteins and spun into fibrous scaffolds with the process of electrospinning. This study provides the material and biological characterization of fibrous scaffolds. The future work of this study is to compare the results achieved with random orientation of fibers with aligned orientation. CM-specific markers will be analyzed for comparison.

Jessica Guadalupe Estrada
Graduate Program: Textile Technology Management
Advisor: Minyoung Suh
Poster Number: 52

Multi-Channel Wearable Connector Using Liquid Metal

Wearable devices are used daily and commonly thought of as accessories such as smartwatches; however, wearable devices can be embedded into textiles and apparel. Some of the most common industries using wearables are medicine, sports, entertainment, and fashion. This study aims to develop a multi-channel wearable connector to embed it into apparel as a button and potentially be used in sectors such as healthcare or entertainment. The connectors were created using a stereolithography (SLA) 3D printer; however, conductive epoxy, conductive ink, liquid metal, and printed circuit boards (PCB) brought this button to the next level. The wearable connector was tested every five cycles consisting of mating 1000 times to see the degradation of its performance. The exact resistance measurements were taken for the four channels of each connector and measured at three different points on the connector. A total of two wearable connectors were prototyped: (1) Button A: 2.8N mating force and (2) Button B: 8.7N mating force. Button A was tested with liquid metal and conductive epoxy. The outcome of these two comparisons indicated that liquid metal performed and withstood the mating test better than conductive epoxy. Button B was only constructed with liquid metal but was not measured due to the connector channels crossing with each other. This study is ongoing for further development and testing.

Andrew Hall[1], Ronald Baynes[2], and R. Bryan Ormond[1]
Graduate Programs: Fiber and Polymer Science1; Toxicology2
Advisor: R. Bryan Ormond
Poster Number: 68

Dermal Permeation of Polyfluoroalkyl Carboxylic Acids Using Flow-Through Diffusion of Porcine Skin

Firefighters are exposed to aqueous film-forming foams, liquid repellents in turnout gear, and moisture barriers, which are all sources of per- and polyfluoroalkyl substances (PFAS). All of these sources have likely contributed to the elevated levels of PFAS found in their blood serum compared to the United States average. Perfluorooctanoic acid (PFOA), a specific PFAS, have been identified as carcinogenic and as an immunosuppressant. Since firefighters are dermally exposed to PFAS compounds, there is a need to determine the skin permeabilities of different PFAS.

Using in-vitro flow-through diffusion, skin permeabilities were determined for 14C PFOA, perfluorohexanoic acid (PFHxA), and perfluorobutanoic acid (PFBA) using porcine skin. Tests were conducted over 8 hours with either acetone or synthetic sweat as the vehicle. PFBA was found to have greater permeability than PFHxA and PFOA, likely due to having a smaller molecular weight. Most of the dosed compound remained on the membrane surface. The dosing vehicle did not appear to impact permeability rates but impacted the disposition through the skin model.

While PFAS compounds have a low permeability rate through skin membranes, PFAS stay in the skin, acting as a reservoir.

Jasmine Jackson
Graduate Program: Textile Technology Management
Advisors: Anne Porterfield and Marguerite Moore
Poster Number: 81

Exploring How Underrepresented Middle School Students Perceive Racial Identity in STEM Activities With Focus in Fashion Technology

Increasing diversity and improving diverse experiences in science, technology, engineering, and mathematics (STEM) education, specifically for racially underrepresented students, has been acknowledged as a common issue within the United States. In addition to the STEM workforce lacking in racial diversity, the social and psychological perspective of racial identity and limited diverse opportunities for minorities has unquestionably led to research studies focused on calling out racial diversity in STEM. In this dissertation, we explore the role of racial diversity in education through a fashion technology STEM-based activity to understand how underrepresented middle school students perceive racial identity when interacting with diverse avatars in the context of 3D fashion technology. The reviewed literature shows that multiple factors impact diverse educational experiences lived by minorities: (a) identifying that racial identity development is critical for adolescents, specifically for people of color, (b) acknowledging that the power of perception affects the social and psychological experiences of minorities and shapes how they make decisions, and (c) representation matters when exploring interests during the critical exploratory stage of adolescence. Racially underrepresented middle school students interacting with diverse educational resources will positively influence their interaction with STEM-based activities and increase their interaction with STEM education. The qualitative phenomenological approach was used to verify minority students' perception of racial identity in STEM education. The findings focused on the first-person perspective of a shared lived experience. Data collection with a sample of 26 middle school students is in progress and includes reflective questionnaires during interactions with diverse avatars and individual interviews. This study will help STEM educators to understand and improve STEM education for minority students through interaction with diverse resources, and benefit underrepresented students' long-term social and academic outcomes.

Xiaohan Lin[1], Chanmi Hwang[2], and Yingjiao Xu[1]
Graduate Programs: Textile Technology Management[1]; Textile and Apparel, Technology and Management[2]
Advisors: Yingjiao Xu and Chanmi Hwang
Poster Number: 99

Consumer Experience with 3D Lookbook: An S-O-R Approach

In the evolving landscape of the fashion industry, online marketing is gaining prominence, especially among young consumers. The traditional print catalog is being replaced by digital alternatives, such as 3D lookbooks, which utilize computer-generated avatars to showcase apparel and accessories in a three-dimensional space. This study aims to investigate the impact of 3D lookbook features on consumer attitudes and intentions, employing the S-O-R model as the theoretical framework. The literature review emphasizes the influence of stimuli (3D lookbook features) on internal affective evaluations, leading to approach or avoidance responses. The study proposes that the interactivity, vividness, and realism of 3D lookbooks influence consumers' perceived usefulness, ease of use, and enjoyment, subsequently shaping their attitudes and intentions. The methodology involves a nationwide online survey with 524 participants, primarily aged 18 to 45, who were instructed to interact with a 3D lookbook. The proposed relationships were tested using a structural equation modeling using AMOS 28. The CFA for the full measurement model had a good fit. According to the findings of this research, the vividness of 3D lookbooks as a fashion communication tool is not substantially correlated with perceived enjoyment. It is comprehensible that the vividness of the virtual picture of the 3D lookbooks does not arouse consumers' enjoyment in the operation process, but it can help to improve the effectiveness and reduce the difficulty of the 3D lookbook when consumers use it. The interactivity and realism characteristics will lead to positive cognition and emotional evaluations of consumers in terms of perceived usefulness, perceived ease of use, and perceived enjoyment, which will positively influence consumers' attitudes and behavior intention toward using 3D lookbooks. Perceived enjoyment was the strongest predictor of a positive attitude. Therefore, companies can focus on enhancing the interactivity and realism of 3D lookbook features to increase consumers' enjoyment.

Meghan Lord
Graduate Program: Fiber and Polymer Science
Advisor: Januka Budhathoki
Poster Number: 103

Modulating Polymer-Dye Interactions for Tunable Applications

Polycarbodiimides are versatile polymers with two tunable pendant groups and a highly nitrogenous backbone. The pendant groups can be altered based on the application of the polymer. The polymer can be dissolved in an organic solvent and its backbone can be protonated and absorb anionic dyes from an aqueous solution under low pH conditions and release the dyes at high pH conditions. Therefore, the dye can be absorbed from one aqueous environment and released into a different aqueous environment. Characterization shows the dye and polymer are not chemically altered, allowing for the reuse of both the dye and the polymer. The simplicity and effectiveness of the polymer-dye interactions and the ability to reuse the organic solvent, polymer, and dye creates a more sustainable option for dye effluent treatment and dye purification. Current dye effluent treatment absorption methods may be efficient but not all are reusable, and some create secondary waste burdens on the environment. Dye purification methods tend to be a long process and require salt and excess solvents. Optimizing the dye absorption and release by polycarbodiimides creates a sustainable solution to both issues.

Nasif Mahmood[1], Mohamed R Eletmany[1], Ummay Mowshome Jahan[1], Ahmed El-Shafei[1], Brian C. Gilger[2], and Jessica M. Gluck[1]
Graduate Programs: Textile Engineering, Chemistry and Science[1]; Clinical Sciences, College of Veterinary Medicine[2]
Advisor: Jessica M. Gluck
Poster Number: 107

Induced Pluripotent Stem Cell-Derived Limbal Stem Cells on Biomimicking Transparent Constructs for Corneal Reconstruction

Limbal Stem Cell Deficiency (LSCD) is a severe eye condition caused by the damage or malfunction of limbal stem cells (LSCs), critical for maintaining the corneal epithelium. LSCD treatments generally involve transplanting healthy limbal tissue from the patient's other eye or a donor, using human amniotic membrane as a support structure. However, the amniotic membrane's limitations, such as its scarcity, the risk of transmitting diseases, and inconsistent results, and limited supply of donor tissue have prompted the search for better solutions. To address these challenges, we introduce a scalable approach using a graft that combines essential properties for compatibility with LSCs. We utilized induced pluripotent stem cells (iPSCs) as a reliable and immune-friendly source of LSCs through developing a xeno-free, chemically defined method to differentiate iPSCs into LSCs. This method successfully induced the expression of key LSC and corneal epithelial markers (PAX6, p63α, CK12). Furthermore, we engineered nanofibrous synthetic membranes through electrospinning, followed by laser perforation and plasma treatment, then biofunctionalized them with Collagen-IV to closely replicate the corneal microenvironment. This process not only provided the necessary mechanical strength for surgery but also enhanced the membrane's light transmittance to 60% and improved cell adhesion by offering more binding sites for cell receptors. By optimizing the perforation sizes and spacing, we were able to finely tune the membrane's mechanical properties and transparency. Our advancement in creating an iPSC-LSC-seeded graft represents a significant step forward in developing effective treatments for LSCD, potentially overcoming the current limitations of donor tissue availability and compatibility.

Akanksha Pragya
Graduate Program: Fiber and Polymer Science
Advisor: Tushar K. Ghosh
Poster Number: 132

Mechanically Gradient and Electrically Conductive Polymer Composites for Flexible Electronics

Flexible electronics are a class of electronic devices that are soft, flexible, and stretchable and span the areas of wearables, soft robotics, electronic textiles, etc. A commercially viable flexible electronic system must allow the integration of soft and extensible components (polymers, textiles, etc.) with traditional hard electronics elements (batteries, LEDs, sensors, etc). A paramount issue caused by this integration is managing the interface between the soft and hard phases. At the soft-hard interface, there is an abrupt change in the mechanical properties of the two phases. This adversely affects the integrity of the hard and soft phases and hampers proper electrical connection between them which deteriorates the electrical performance of the flexible electronics.

The present study introduces an innovative approach for the seamless integration of the mechanically mismatched phases using uniformly (electrically) conducting and mechanically gradient materials (MGM). In particular, MGMs are a special class of materials that exhibit a gradual change in mechanical properties (often stiffness), along one or more dimensions. Contrary to the abrupt change in mechanical properties in traditional soft-hard interfaces, MGM enables a smooth transition between the two mismatched phases. Consequently, the detrimental effects associated with the abrupt (soft-hard) interfaces such as delamination, rupture, cracking, and poor electrical performance can be mitigated.

To accomplish this goal, the tunability of electro-mechanical properties of particle-filled nanocomposites has been leveraged. A fabrication method is developed to create uniformly conductive structures with spatially varying stiffness. The initial prototypes can accommodate up to 8-10 times difference in stiffness over any desired length, demonstrating the versatility of the manufacturing process. This dual-feature design provides great potential to mitigate integration challenges and enhance the electro-mechanical system integrity of flexible electronics.

Shraddha Yadav, Yingjiao Xu, and Helmut Hergeth
Graduate Program: Textile Technology Management
Advisors: Yingjiao Xu and Helmut Hergeth
Poster Number: 176

Walking the Talk: Unraveling the Influence of the Sustainability Features of Leather Alternatives on Consumer Behavior toward Running Shoes

This research undertakes a comprehensive examination of the intricate dynamics inherent in the relationship between sustainability features embedded in running shoes and consumers' willingness to pay a premium price. Employing a rigorous methodology, the study systematically unfolds the mediating effect of perceived sustainability and meticulously scrutinizes the moderating effects of environmental consciousness and animal conservation in the complex interplay between sustainability features and consumers' willingness to pay a price premium. The methodological framework encompasses the dissemination of an online survey on Amazon MTurk. The analytical rigor is augmented by the application of a one-way ANOVA, thereby imparting statistical robustness to the findings, and conclusively establishing the profound impact of sustainability features on shaping consumers' willingness to pay a price premium for running shoes. Noteworthy is the mediation analysis, executed through the utilization of the PROCESS model 4, which brings to light the pivotal role of perceived sustainability as a partial mediator. This elucidation contributes insights into the underlying psychological mechanisms at play within the context of sustainable consumer behavior. Furthermore, the study extends its exploration into the nuanced realm of moderation by applying the PROCESS model 1 in SPSS 28.0. The results unearth the pivotal roles assumed by environmental consciousness and animal conservation as moderators, intricately shaping the relationship between sustainability features and consumers' readiness to pay a premium. This multifaceted analytical approach not only enriches the academic discourse on sustainable consumer behavior but also furnishes practical insights for industry stakeholders endeavoring to align their products with evolving consumer values and concerns.

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Magnet-Driven Origami Actuators

Magnet-driven origami actuators can be wirelessly controlled using an external magnetic field, harnessing the advantages of the origami's folding and deploying features. However, there are very limited studies that have focused on the utilization of soft-magnetic materials to drive origami for actuator applications. Using ferromagnetic particles as fillers mixed with elastomers, soft magnetic films or fibers can be formed, and their magnetic polarity can be programmed during the magnetization process. They are inherently advantageous due to their high compliance and flexibility in shape and dimensions, and light weight. These devices are practically promising for biomedical applications such as in-vivo drug delivery. In this study, we explore the 3D printing of soft magnetoactive film consisting of magnetic particles and UV-curable elastomeric matrix. The printed films are used to be integrated with origami structures to fabricate magnet-driven origami actuators. We demonstrate developed actuators for two applications, including drug delivery and crawling robot.

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