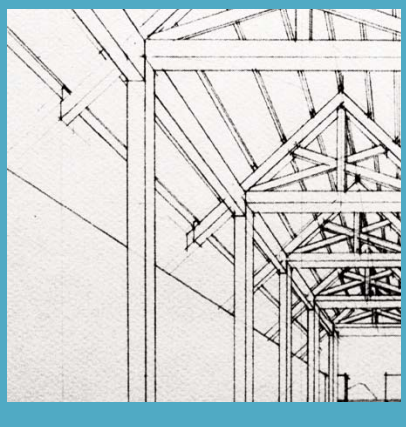
NC STATE UNIVERSITY

13th Annual
Graduate Student Research Symposium

ABSTRACTS

Wednesday
March 21, 2018
1:00 to 5:30 pm
McKimmon Center



Thirteenth Annual
Graduate Student Research Symposium
North Carolina State University

SYMPOSIUM ORGANIZERS

Graduate School

Dr. David Shafer, Assistant Dean
Bridget Foy, Administrative Assistant
Todd Marcks, Fellowships and Grants Administrator
Darren White, Webmaster

Graduate Student Association (2017-2018)

Urmila Adhikari – Plant Pathlology (Co-Chair)
Desiree Unselt – Genetics (Co-Chair)
Brent Boland – Physics
Bryan Maxwell – Biological and Agricultural Engineering
Tamika McEleveen – Teacher Education and Learning Sciences
Stephanie McKnight – Toxicology
Erica O'Brien – Psychology
Lauren Pellegrino – Adult, Workforce, and Continuing Professional Education
Patrick Perkins – Genomic Sciences
Erin Peterson – Genetics
Allison Plitman – Public Administration
Sugandah Singh – Civil, Construction, and Environmental Engineering
Matt Zimmer – Nuclear Engineering

AGENDA

12:00 pm - 1:00 pm	Poster Set Up (All set up their posters).....	Area 1
1:15 pm - 1:30 pm	Welcoming Remarks and Symposium Overview	Room 6
	Mr. Tyler Allen, GSA President	
	Dr. David Shafer, Assistant Dean of the Graduate School	
1:30 pm - 4:00 pm	Poster Session and Competition.....	Area 1
4:15 pm - 5:30 pm	Announcements of Awards and Reception	Room 2
	Dr. Peter Harries, Interim Dean of the Graduate School	
	Dr. Duane Larick, Senior Vice Provost	
	Dr. David Shafer, Assistant Dean of the Graduate School	

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ABSTRACTS

College of Agriculture and Life Sciences

Pragya Adhikari[1], Frank J. Louws[2], Hamid Ashrafi[1], Consuelo Arellano[3], Christopher C. Gunter[1] and Dilip R. Panthee[1]
Graduate Programs: Horticulture Science[1]; Plant Pathology[2]; Statistics[3]
Advisors: Dilip R. Panthee and Frank J. Louws
Poster Number: 2

Mapping QTL Derived from S. pimpenellifolium LA3707 for Bacterial Spot Resistance against Race T4

Bacterial spot of tomato is a serious disease caused by at least four species and four races of Xanthomonas- X. euvesicatoria (race T1), X. vesicatoria (race T2), X. perforans (race T3 and T4), and X. gardneri, with X. perforans race T4 being predominant in North Carolina. The disease affects all-above ground, and potentially causes up to 66% yield loss. However, practical management of this disease is challenging because of lack of effective chemical compounds and commercial resistant cultivar. Genetic resistance to race T4 has been identified in the S. pimpinellifolium LA3707 derived line NC22L-1(2008) through greenhouse and field screening in previous studies. Therefore, to detect quantitative trait loci (QTLs) controlling bacterial spot resistance, we carried out QTL analysis in a F2:6-derived population developed from crossings NC-22L (008) x NC 30P consisting of 110 recombinant inbred lines (RIL). A linkage map with 886 single nucleotide polymorphism (SNP) molecular markers was constructed covering 739.5 cM on 12 chromosomes of tomato, with an average of 0.83 cM between markers. Two major QTLs were detected on chromosome 6 at positions 14.33 cM and 28.49 cM with a LOD score of 4.6 and 4.9, respectively, explaining 26% of total phenotypic variance. These QTLs were responsible for major variation in bacterial spot disease resistance observed in the fourth and fifth week. Another major QTL was observed on chromosome 1 at position 46.58 that explained 20% of total phenotypic variation observed in the first week. A minor QTL was detected on chromosome 4 explaining 13% of phenotypic variation observed in the second week, but this QTL was limited to single location and single year. The markers linked to these QTLs would be valuable in a marker-assisted tomato breeding program against bacterial spot disease.

Sayan Chakraborty, Haiyun Pan, and Guozhou Xu
Graduate Program: Molecular and Structural Biochemistry
Advisor: Guozhou Xu
Poster Number: 27

Structural characterization of the extracellular domain of Pollen Receptor Kinase 3

During reproduction in flowering plants, the male gametophyte moves to the female gametophyte in pistil by formation of pollen tubes and delivers immotile male gamete. In Arabidopsis thaliana, two synergid cells situated on either side of the egg cell produce cysteine rich chemoattractant peptide LURE that guides the pollen tube to the female gametophyte for sexual reproduction. Recently, in Arabidopsis thaliana, Pollen Receptor Kinase 3 (PRK), along with PRK6, PRK8 and PRK1 have been identified as the predicted receptors that senses LURE. These receptors belong to Leucine Rich Repeat Receptor Like Kinases (LRR-RLKs)- the largest family of receptor kinases found in Arabidopsis thaliana. These proteins have three domains- extracellular domain interacting with the external cues, a membrane spanning region and a kinase domain containing serine and threonine responsible for the phosphorylation and subsequently inducing cellular responses to the received signals. How pollen specific receptor kinases regulate the growth and development of pollen tube remains elusive. To resolve the structure, function and signaling mechanism mediated by the receptor kinases in the growth of pollen tube, we have determined the crystal structure of the extracellular domain (ecd) of PRK3 at 2.5 Å, which resembles the SERK family of plant co-receptors. The structure of ecdPRK3 contains a conserved surface on the Capping domain and the concaved surface of the LRR domain, which coincides with the conserved receptor-binding surface of the SERK family co-receptors. Our structural analysis suggests that PRK3 may function as an LRR-RLK co-receptor as SERK family co-receptors in regulation of pollen tube development. This research will broaden our overall understanding about the reproduction system of flowering plants.

Jennifer Fideler[1, 2], Suzanne D. Johanningsmeier[2, 1]
Graduate Programs: Food, Bioprocessing and Nutrition Sciences[1]; Food Science Research Unit, USDA Agricultural Research Service, Raleigh, NC[2]
Advisor: Suzanne D. Johanningsmeier
Poster Number: 43

Formation of gamma-aminobutyric acid (GABA) in fermented cucumbers

Foods fermented with lactic acid bacteria (LAB) such as yogurt, cheese, and pickled vegetables are considered healthful due to live microorganisms, yet microbial viability is often compromised during processing. Still, health-promoting potential may be enhanced through bioactive compound formation. Certain LAB metabolize glutamate into gamma-aminobutyric acid (GABA) to regulate intracellular pH during fermentation. In humans, GABA supplementation has promoted antihypertensive and antianxiety effects and improved cognitive function. In this study, compositional changes in amino acids during cucumber fermentation were characterized to provide insight into formation of GABA and other health-promoting compounds. Natural fermentations were conducted in triplicate by brining cucumbers in sodium chloride solutions (648 mM NaCl, equilibrated) and incubating for 6 weeks at 28°C. Acidified cucumbers were prepared as controls by brining in NaCl with an additional 110 mM lactic acid to mimic fermented cucumber acid content and 8 mM sodium benzoate to prevent fermentation. Quantification of amino acids was performed without derivatization using liquid chromatography triple quadrupole mass spectrometry (LC-QQQ-MS) with multiple reaction monitoring (MRM). Fermented cucumbers were enriched in free amino acids compared to acidified cucumbers. Two to three-fold increases in content were observed for phenylalanine (2-fold), histidine, asparagine, leucine and lysine (2.5-fold), proline (2.7-fold), isoleucine (3-fold), and ethanolamine (3.3-fold). Ornithine, a product of arginine metabolism, increased more than 20 fold. Notably, GABA levels increased two-fold, demonstrating that GABA is produced during natural fermentation of cucumber. The GABA precursors glutamate and glutamine also increased slightly, indicating that these amino acids were not only converted to GABA but also liberated from proteins or generated by LAB. GABA, a non-proteinogenic amino acid with antihypertensive and antianxiety effects, was enhanced in cucumbers during natural fermentation. Production of beneficial health compounds adds value to cucumber pickles which are often processed to eliminate live microorganisms for shelf stability.

Glenn H. Galle, Kathleen H. Nunez, and James P. Kerns
Graduate Programs: Entomology and Plant Pathology
Advisor: James P. Kerns
Poster Number: 48

In Vitro Analysis of Nematicides and Fungicides on Belonolaimus longicaudatus

The control of nematodes, specifically plant-parasitic nematodes has proved difficult in recent years. Many chemicals previously used as nematicides are detrimental to non-target organisms and have been removed from the market. This has left growers and golf course superintendents with little recourse to manage populations of plant-parasitic nematodes that are causing economic damage. As such, the search for alternatives to these chemicals is imperative. This study was focused on the management of sting nematode (Belonolaimus longicaudatus), a major pest of turfgrasses. Sting nematode populations from three different golf courses and an agronomic field in North Carolina were studied. Four different pesticides were analyzed using a bioassay that monitored motility of the nematodes. Two known nematicides, abamectin and fluopyram, and two SDHI fungicides, fluxapyroxad and penthiopyrad, were tested. Abamectin was the fastest acting product, with nematode populations affected in the first 24 hours. The two registered SDHI fungicides were also effective nematicides, although at higher concentrations than the two nematicides. The results of the study also indicated that sting nematode management by these chemicals tested varied greatly by location. This emphasizes the need to assess each population of sting nematode on a case-by-case basis to ensure proper chemical control, as certain chemicals may be more effective given golf course soil parameters. This complicates the search for another comprehensive nematicide.

Benjamin P. Graham[1], Michael R. Stiff[2], Ethan T. Pierce[1], Robin E. Grant, and Candace H. Haigler[1, 2]
Graduate Programs: Plant and Microbial Biology[1]; Crop and Soil Sciences[2]
Advisor: Candace H. Haigler
Poster Number: 51

Influence of Cortical Microtubules on Cotton Fiber Elongation and Tip Diameter

Cotton fibers are single cells that elongate from the seed epidermis of Gossypium species. The details of cellular morphogenesis determine fiber quality traits such as length, strength, and diameter that affect the value and uses of the fiber. Lower and more consistent diameter would increase the competitiveness of cotton fiber with synthetic fiber, but we do not know how this trait is controlled. We showed that the fiber tip is a region of both control and variability in diameter, which differs between three tip types in the two commercially grown cotton species. In G. hirsutum cv DeltaPine 90, we observed that the diameter of curvature (DOC) at the apex defined two distinct classes of tips with different diameters, whereas fiber tips in G. barbadense cv Phytogen 800 had only one narrow tip type. In additional experiments, we used cotton ovule culture, fiber length and morphology measurements, and immunofluorescence of microtubules to observe the effects of the microtubule antagonists (oryzalin, colchicine, and paclitaxel) on fiber length and tip diameter. Oryzalin treatment (1.5 μM) led to shorter disorganized microtubules, but only led to diametric expansion and length reduction in G. hirsutum. Colchicine treatment (50 μM) abolished the microtubule array and increased diameter in both species, while minimally reducing fiber length only in G. hirsutum. Paclitaxel (2.5 μM) stabilized microtubules in abnormal orientations, and fiber bulged along their flanks while elongation was unchanged. We will discuss how dynamic and spatially controlled microtubule arrays impact elongation and diameter in early cotton fiber morphogenesis, along with similarities and differences between fibers with different tips types.

Sammuel H. Ingram[1], Miguel S. Castillo[2], Alan J. Franzluebbers[2], Daniel H. Poole[1], and Matt H. Poore[1]
Graduate Programs: Animal Science[1]; Crop and Soil Science[2]
Advisor: Matt H. Poore
Poster Number: 65

Developing Renovation Strategies for Toxic Tall Fescue that Best Manages for Profitability, Animal Performance and Soil Health of the Production System

Kentucky 31 tall fescue (TF) is the most widely cultivated forage in the U.S. totaling over 35 million planted acres. After rapid adoption, farmers noticed poor growth performance, reproductive issues and overall poor body condition of animals grazing this forage. The reason for these symptoms were ergot alkaloids produced by a fungal endophyte within the fescue plant. The best option for improving plant and animal performance is achieved by planting a novel endophyte TF variety (NE). A renovation strategy that best manages for profitability, animal performance and forage value without compromising soil health is needed to effectively transition away from toxic TF in the southeast U.S. A no-till strategy is important especially for southern Appalachian ridges and valleys and the southern piedmont. Langdale and Moldenhauer (1995) suggested this region poses the greatest risk of soil erosion in the U.S. because of the topography, soil characteristics and rainfall intensities. Three renovation strategies will be evaluated for impact on soil health, forage value, profitability, and animal performance. Strategies include: 1) control, 2) renovation to NE after a single season of a single specie grass cover crop, 3) renovation to NE after three seasons of a single specie grass cover crop, 4) renovation to NE after three seasons of a six-forage specie cover crop. Renovation and maintenance costs will be quantified to provide economic analysis of each strategy. Soil from each strategy will be analyzed for macronutrients, bulk density, soil organic carbon and nitrogen prior to renovation and following NE establishment to determine impact on soil health from each strategy. This study examines several aspects from the whole beef cattle production system and each piece will be crucial when providing educational assistance to producers.

Jonathan Kressin[1,2], **Marc Planas**[3], Dilip R. Panthee[1], Frank J. Louws[2], Nuria Sanchez-Coll[3], and Marc Valls[3]
Graduate Programs: Horticultural Science, North Carolina State University[1]; Entomology and Plant Pathology, North Carolina State University[2]; Centre for Research in Agricultural Genomics, Barcelona, Spain[3]
Advisors: Dilip R. Panthee and Frank J. Louws
Poster Number: 81

Spatiotemporal dynamics of colonization by Ralstonia solanacearum in grafted tomatoes

Tomato (Solanum lycopersicum L.) is afflicted by the soil-borne bacterial pathogen Ralstonia solanacearum Smith (Rs), which causes bacterial wilt (BW) in many growing regions around the world, including the Southeastern USA, where it can jeopardize tomato production efficacy. This fatal disease is effectively managed by grafting highly resistant rootstocks with local scion cultivars, a production system seeing increased adoption in the Southeastern USA. The quantitative resistance in tomato does not prevent the bacteria from invading roots and hypocotyl tissue; rather it restricts the ability of the pathogen to colonize adjacent xylem cells. We explored several enigmatic aspects of the bacterial invasion patterns over time and space in grafted tomato combinations (susceptible to highly resistant) with luciferase (LUX)- and green fluorescent protein (GFP)-labeled GMI1000 strains to better understand why vegetable grafting endures as a viable management strategy. Through destructive sampling and novel imaging techniques, we observed a rapid invasion and proliferation of root and hypocotyl tissues, leading to the invasion of the primary vascular bundles, which was reduced in severity or prevented in resistant rootstocks. Bundle colonization, however, was not homogenous even in the susceptible cultivar, and additional bundles were colonized over time leading to permanent wilt. Wilt development was dependent upon reaching a critical density threshold in any part of the stem, regardless of the host resistance level, and seemed linked to bundle colonization. Furthermore, the ability of the pathogen to move vertically in the host was reduced by resistance, as well as the propensity to invade the apoplastic spaces of the pith and cortex from the xylem tissues. We did not observe significant indications of rootstock-scion interactions modulating resistance. Collectively, resistant rootstocks appear to work by preventing large numbers of bacteria from crossing into susceptible tissues, limiting the bacteria below a critical, wilt-inducing level of xylem blockage.

Lisa LaFountain[1], Suzanne D. Johanningsmeier[2], Robert C. Price[2], and Fred Breidt, Jr.[2]
Graduate Programs: Food, Bioprocessing and Nutrition Sciences, North Carolina State University[1]; USDA-ARS Food Science Research Unit, Raleigh, NC[2]
Advisor: Suzanne D. Johanningsmeier
Poster Number: 82

Effects of a Brief Blanching Process on Quality of Refrigerated Cucumber Pickles

Refrigerated pickles are characterized by a crisp, white flesh that meets the needs of consumers desiring fresh-like products. Since these products have no thermal process, their safety relies on preventive controls during production, composition of cover brine, and hold time prior to consumption. We hypothesized that a brief blanching process applied to whole cucumbers prior to processing could reduce background microbiota, without negatively impacting quality of the finished product. Brief blanches (15, 90, and 180 seconds) in 80°C water were conducted on whole cucumbers prior to acidifying and storing under refrigeration (3.9 ± 1.5 °C). Microbial counts of total aerobes, lactic acid bacteria, yeasts and molds, and Enterobacteriacea were conducted following blanching. Texture and color analyses were conducted for fresh and blanched cucumbers and for pickle products during storage. Peak mesocarp puncture force (N) was recorded for 15 cucumber spears per sample. Exocarp color was measured and overall appearance was visually monitored. Microbial enumeration indicated that 90 seconds was the minimum blanch duration able to consistently achieve a 2-log reduction in all microorganisms tested. A small decrease in tissue firmness occurred with increasing blanch duration ($P = 0.0038$), resulting in an average initial cucumber firmness of 8.9, 8.6, and 8.6 N for 15, 90, and 180 second blanches compared to 9.1 N for unblanched controls. Blanch treatments had no additional impact on tissue firmness during refrigerated storage up to 60 days ($P = 0.8855$). Differences in hue and chroma values observed immediately following blanching ($P < 0.05$) were no longer apparent after brining and 30 days refrigerated storage. No cured appearance development was noted for the 15 and 90 second blanch treatments. Our findings demonstrated that a 90 second blanch at 80°C could significantly reduce background microbiota without causing degradation of quality attributes associated with refrigerated cucumber pickles.

Zachary Lentz
Graduate Program: Biological and Agricultural Engineering
Advisors: John Classen and Praveen Kolar
Poster Number: 86

Waste Not, Want Not: Developing Value-added Products from Swine Manure

As the number two pork producer in the nation, North Carolina has been working to balance the significant contribution of the industry on the state's economy against the potential environmental risks associated with confined animal feeding operations (CAFOs). Concentrated animal production means concentrated manure production, and traditional manure management methods may no longer be sustainable for large operations. Developing processes to convert manure into value-added products offers the opportunity to enhance the economics of pork production and further boost NC's economy, while simultaneously curtailing water contamination and odorous emissions from hog farms. Hydrothermal carbonization (HTC) of swine manure is one such process. HTC, or thermochemical conversion of an aqueous solution at low temperature and pressure (up to 260°C, > 0.1 MPa), produces coal-like hydrochars from carbonaceous materials which may be utilized for energy through combustion or converted into liquid or gaseous fuels, as a soil amendment, or for adsorption of target compounds. Due to the complex reaction mechanisms of HTC, variations in reaction temperature results in chars with different physical and chemical properties, and each set of conditions and products must be evaluated to determine the economic viability of such a process. After all, such a process will only be adopted if it's economically advantageous. Swine manure derived hydrochars have been generated at five temperatures (180°C, 200°C, 220°C, 240°C, and 260°C), and have been analyzed to elucidate the effect of operating temperature on char physical and chemical characteristics. Additionally, the chars have been tested for usefulness as a solid fuel and adsorbent for urea capture, and potential benefits of adoption of swine manure HTC for NC's economy and environmental health have been estimated.

Hope K. Lima[1], Montana Wagner-Gillespie[1], Ken Vogel[1], Lisa L. Dean[1], Maryanne T. Perrin[1,2], and April D. Fogleman[1]
Graduate Programs: Food, Bioprocessing, and Nutrition Sciences, North Carolina State University[1]; Nutrition, University of North Carolina Greensboro[2]
Advisor: April D. Fogleman
Poster Number: 89

Comparison of Nutritional, Bacterial, and Bioactive Components in Holder Pasteurized and Shelf-Stable Donor Human Milk Products: Implications for Premature Infant Feeding

Historically, donor human milk available in a hospital setting has been pasteurized using Holder pasteurization. Recently, a shelf-stable human milk product, created using retort processing, has become available; however, little is published about the effect of retort processing on human milk. We aim to assess the ability of retort processing to eliminate bacteria and quantify the difference in nutritional and bioactive components between Holder pasteurized and shelf-stable human milk, using raw human milk as the control. Milk samples from 60 mothers were pooled. From this pool, 36 samples were taken; 12 samples were kept raw, 12 samples were Holder pasteurized (HP), and 12 samples were retort processed to create a shelf stable product (SS). Percent fat, percent solids, and lactose were similar between raw, HP, and SS samples. Total protein was statistically increased in RP samples when compared to raw ($p = 0.005$) and HP ($p < 0.001$) samples, but protein differences are not clinically relevant (raw = 15.1, HP = 14.8 and RP = 15.8 mg/mL). Total lysine was highest in raw samples (0.85 mg/mL) and decreased as temperature of heat processing increased (HP = 0.77 mg/mL and RP = 0.68 mg/mL). One raw sample and 3 HP samples contained B. cereus, and there were no detectable bacteria in SS samples at time of culture. HP samples retained significantly more lysozyme and sIgA activity (54% and 87%, respectively) than SS samples (0% and 11% respectively). Human milk processed using Holder pasteurization should continue to be screened for presence of B. cereus. Clinicians should be aware of the differences in the retention of lysine, lysozyme and sIgA activity in HP and SS products when making feeding decisions for medically fragile or immunocompromised infants to ensure optimal growth and immune protection.

Lawrence C. Long and Steven D. Frank
Graduate Program: Entomology and Plant Pathology
Advisor: Steven D. Frank
Poster Number: 93

Urban Forest Fragments Buffer Heat Driven Insect Pests

Urban forests play a critical role in maintaining environmental health and human well-being. However, urban trees are subject to abiotic stressors such as high temperature and low water availability, which results in reduced growth and greater pest abundance. The objective of this study is to determine if urban forest fragments buffer the effects of abiotic stress associated with urbanization and thereby reduce pest pressure. Our study system is that of the oak lecanium scale (Parthenolecanium quercifex), a common pest of willow oak trees (Quercus phellos) in urban areas. We measured temperature, water potential, lecanium scale density, and natural enemy abundance in urban trees growing within and adjacent to urban forest fragments in Raleigh, NC. Study sites consisted of a tree growing in an urban forest fragment and a planted landscape tree within 50 meters of the forest fragment. Lecanium scale density was correlated with tree temperature such that forest trees were cooler and had fewer lecanium scales than adjacent landscape trees. There was no difference in water potential among forest fragment and landscape trees. Natural enemies were more abundant in landscape trees than forest fragment trees but because lecanium scales were also more abundant in landscape trees it suggests that natural enemy activity has little bearing on leacanium scale density outside of forest fragments. We demonstrate that temperature drives the abundance of a common urban pest and that urban forest fragments can mitigate tree stress and thereby reduce pest density. Our results also illustrate the complexity of factors which contribute to overall tree health and pest abundance in urban environments. Because of their role in maintaining tree health, which ultimately contributes to human well-being, the creation or conservation of urban forest fragments should be at the forefront of landscape design and urban planning.

Catherine Loy
Graduate Program: Youth, Family, and Community Sciences
Advisor: Annie Hardison-Moody
Poster Number: 94

“Autism Does Not Mean Anything”: Are Parents Re-Conceptualizing Autism in Their Own Families with the Neurodiversity Paradigm?

Recent literature has illustrated a shift in how some view neurological differences in individuals with special needs, most notably autism spectrum disorder. The neurodiversity paradigm posits that neurological differences can be biologically advantageous and should be promoted within our society. This paradigm may influence how some parents are viewing their child’s unique brain and differences, and how they are adjusting their parenting accordingly. However, little is known about where this paradigm fits within parenting, family life, and the public sphere (Ozturk et al, 2014). In this exploratory study, I delve into the experiences of parents of children with autism through their parenting choices, advocacy, and their impressions of current societal perceptions. Data from this study is drawn from participant interviews and additional measures including a family functioning scale, parenting style scale, and demographic information. Findings suggest that parents are using ideas similar to the neurodiversity paradigm in meaningful ways in their families while advocating for the integration of neurodiversity in the public sphere. This study contributes to the understanding of how parents are viewing their child’s unique needs and in turn how those perspectives influence parenting choices including promoting strengths and adjusting environments. Furthermore, this research contributes to the understanding of parental expectations for professionals and educators when working with their children, especially concerning tolerance of differences. This work adds to an important element of the existing literature surrounding parenting children with autism by exploring connections between the neurodiversity paradigm and parenting choices.

J. M. Luis[1], Ignazio Carbone[1], G.A. Payne[1], D. Bhatnagar[2], J. Cary[2], M. Lebar[2], G.G. Moore[2], and Peter S. Ojiambo[1]
Graduate Program: Center for Integrated Fungal Research, Entomology and Plant Pathology[1]; USDA-ARS/SRRC, New Orleans[2]
Advisors: Peter S. Ojiambo and Ignazio Carbone
Poster Number: 96

Characterization of the Morphological, Metabolic and Transcriptional Changes during the Fertilization of Aspergillus flavus Sclerotia

Toxigenic strains of the fungus Aspergillus flavus contaminate several agronomic crops with carcinogenic aflatoxins where consumption of contaminated produce can lead to health problems in humans and animals. For most of its life cycle, A. flavus survives in its asexual state as conidia, hyphae or mycelia. When conditions became unfavorable, the fungus produces thick-walled sclerotia that can bear ascospore-bearing ascocarps when fertilized by a conidia of the opposite mating type. This shift from asexual to sexual states can have broad implications on the survival, morphology and genetic diversity of the fungus, but the processes are not well understood. Moreover, there is limited information on the biochemical and transcriptional changes that occur when sclerotia are fertilized. This study used differences in female fertility of A. flavus crosses to examine changes in the morphology, secondary metabolite expression, and transcriptional profiles of the sclerotia over time. Two reciprocal crosses (sclerotia x conidia) with high and low fertility levels were plated in mixed cereal agar and incubated at 30°C in continuous dark. Batches of sclerotia were harvested from the time of crossing and every two weeks for a total of eight weeks. Scanning electron micrographs showed progressive development of ascocarps and ascospores in the stroma of sclerotia over time. Ultra-performance liquid chromatography and mass spectrometry produced distinct secondary metabolite expression between fertililty crosses. Transcriptional profiles revealed clustering of genes according to fertility level based on backbone enzymes of the Aspergillus secondary metabolism gene clusters and genes involved in Aspergillus development. Results of the study can help facilitate our understanding of the transitional phase of asexual to sexual reproduction in A. flavus. Results can also be useful in developing highly fertile strains of atoxigenic A. flavus that can be used as biological control agents against toxigenic strains.

Emily Meyers[1], Rebecca Whetten[2], and Christina Cowger[1,2]
Graduate Programs: Plant Pathology, North Carolina State University[1]; USDA-ARS, Plant Science Research Unit, Southeast Area, Raleigh, NC[2]
Advisor: Christina Cowger
Poster Number: 109

Uncovering the Genetic Components of Reduced Sensitivity to Demethylation Inhibitor Fungicides in Wheat Powdery Mildew

Wheat powdery mildew, caused by the fungus Blumeria graminis f.sp. tritici (Bgt), infects wheat worldwide, and a severe epidemic can decrease yield by 30%. In the US, this disease appears annually in eastern seaboard states, with damaging epidemics also occurring recently as far west as Montana and south as Alabama. Host resistance genes and foliar fungicides are used to manage wheat powdery mildew globally. As Bgt can quickly adapt to overcome those genes, effective fungicides are essential to managing the disease. Populations of Bgt in Europe and Australia have developed insensitivity to an important fungicide class, demethylation inhibitors (DMI), which are widely used against both crop and human diseases. This study is the first evaluation of sensitivity in the US Bgt population to DMI fungicides, which have been preferred for Bgt control for years. Detached-leaf assays were utilized to measure sensitivity to two DMIs, tebuconazole and prothioconazole, among 380 Bgt isolates collected from 15 states. DMI sensitivity varied geographically, with reduced sensitivity observed in isolates from eastern states as compared to isolates from the central Great Plains states. Isolates were genotyped for a mutation commonly associated with DMI insensitivity, Y136F in CYP51, a gene necessary for fungal cell membrane structure. Presence of Y136F was correlated with reduced sensitivity to tebuconazole ($P < 0.001$, $R2 = 0.11$) and prothioconazole ($P = 0.003$, $R2 = 0.03$). However, genotypes of 84 isolates did not align with their tebuconazole phenotypes and 90 isolates with prothioconazole phenotypes, indicating that additional genetic components may impact DMI sensitivity. Experiments are underway to determine if these isolates have other CYP51 mutations and to assess whether the gene is overexpressed in DMI-insensitive isolates. Revealing the specific mutations underlying DMI insensitivity in the US Bgt population can facilitate modification of fungicides to extend efficacy for both crop and human health.

J. Christina Mitchell[1], Steven D. Frank[1], and Vincent D'Amico[2]
Graduate Programs: Entomology and Plant Pathology, North Carolina State University[1]; USDA Forest Service NRS-08, University of Delaware[2]
Advisor: Steven D. Frank
Poster Number: 112

Conservation in the City: Effects of Nonnative Vegetation on Ground Beetle Communities

Eastern deciduous forests are threatened by habitat loss and fragmentation due to urban expansion from increasing city populations. Forests are important because they contribute to the preservation of native species and habitat, carbon sequestration, and atmospheric cooling. Increased urbanization and presence of nonnative species change the composition of ecological communities and alter forest function. The family Carabidae, ground beetles, are used around the world as 'indicator taxa' for monitoring forest health. Carabids are ecologically and taxonomically varied, abundant, and sensitive to human-caused disturbances. We studied communities of carabid beetles in rural, suburban, and urban forest fragments in Raleigh, North Carolina and Newark, Delaware. We tested the hypothesis that nonnative vegetation in urbanized forests will have an effect on carabid community composition. We quantified vegetation and carabid beetle communities in 12 forest fragments in each city. Forest fragments spanned a rural to urban gradient and a size gradient of 1 to 25 hectares. We collected carabid beetles every six weeks from May to December using pitfall traps. From a total of 239 pitfall traps, we collected 947 adult carabids. Carabid beetles were identified to species and categorized by life history traits, and pooled by forest fragment. Older forest fragments with established canopies were less colonized by nonnative plant species. We collected more carabids in forest fragments with less nonnative plant species, and these sites had more predatory carabid species. Smaller and younger forest fragments had more nonnative plant species, and more generalist carabid species. These findings support the idea that improving remnant native habitats in urban areas, by removing nonnative species, may help to conserve forest-specialist carabid and other native biotic communities.

Lise Montefiore
Graduate Program: Biological and Agricultural Engineering
Advisor: Natalie G. Nelson
Poster Number: 116

Coupling climate, land use, and sea level rise projections to identify threatened estuaries in North Carolina

The combined effects of changing population densities, land use change, sea level rise, and water availability will likely degrade the quality and volume of riverine discharges to the coasts. These pressures are expected to impact estuarine ecology, thereby affecting local economies that depend on estuaries to thrive (e.g., tourism, commercial and recreational fishing). Prior studies reported that the Southeast U.S. was particularly threatened by these pressures due to sea level rise and population growth. However, no prior studies have integrated sea, freshwater, and land use dimensions to determine how spatial variability in these factors might expose estuaries to varying degrees of stress in the future. The present work seeks to quantify the projected risks of anthropogenic and climatic pressures on estuaries in North Carolina by evaluating a suite of projections that capture different modes of global and local change. Spatial variability in outputs from downscaled climate projections, NOAA projections for rates of relative sea level rise, EPA projections for population density, and projected land use scenarios were considered and combined into a scaled index that allowed for one-to-one comparisons across sites. Neuse, Cape Fear, Tar-Pamlico, White Oak, Chowan, and Pasquotank river basins were considered in this geospatial analysis. Findings from this study inform risk assessments and regional planning for North Carolina by identifying regions were coupled stressors put estuaries at relatively higher risk of degradation. Future work will expand this analysis to the Southeast U.S. to quantify how fishery production and estuarine-dependent economies may be impacted by the combined effects of the considered stressors.

Fernando Montero de Espinosa[1], Jonathan R. Schultheis[1], and Michael D. Boyette[2]
Graduate Programs: Horticultural Science[1]; Biological and Agricultural Engineering[2]
Advisor: Jonathan R. Schultheis
Poster Number: 117

Internal Necrosis Evaluation Comparing Apparent Problem and Clean Production Fields Linked to Commercial Storage Facilities

North Carolina leads in sweetpotato production in the United States, with 95,000 acres planted in 2016 and comprises over 50% of the national production. Covington, released by NC State University in 2005, accounts the 80% of the commercial acreage across the state. In 2006, a grower reported that 1600 tons of sweetpotato in storage were affected by small brown to black areas in the flesh very near where the root was removed from the stem, later named Internal Necrosis (IN). Since initial reports in 2006, IN continues to be a concern across the North Carolina sweetpotato industry putting at risk the reputation of North Carolina´s main crop brand. Previous research seeking answers to this problem have proven that it is not caused by any biotic organisms, herbicides or insecticides. Also, research proved that IN can be induced when an application of Ethrel before harvest and high temperatures during postharvest treatments increased the incidence of IN. The objective of this study was to evaluate Internal Necrosis at the commercial scale by collecting roots from apparent “problem” and “clean” production fields and link it with commercial storage facilities that have either routinely had or not had IN incidence. A total of six growers provided six 20-bushel bins with roots harvested at their fields the same day and each of them was given one bin from each grower and one of their own bins to cure and store them until the study is concluded. Also, Temperature and RH were measured inside three of the six bins at each facility with Hobo units. After 59, 91,124 & 180 days after harvest (DAH), 30 root samples from each bin at each facility were cut and IN incidence and severity was recorded. Data from Hobo units was collected after 59 DAH and plotted. With this study, results could indicate if IN is prone to be induced during preharvest practice or if postharvest treatments play the main role in inducing IN.

Colin Murphree[1], Melodi Charles[1], Soundarya Srirangan[2], and Heike Sederoff[1]
Graduate Programs: Plant and Microbial Biology, North Carolina State University[1]; Bayer Crop Science[2]
Advisor: Heike Sederoff
Poster Number: 120

New methods to produce industrial and pharmaceutical proteins in plants

The global value of genetically engineered seed is expected to reach $92 billion by 2020. This market is almost entirely due to insect and herbicide resistance traits that were introduced into crop plants by genetic engineering. The potential of plant genetic engineering is far higher. Plants could be used as factories to produce pharmaceuticals, vaccines, or industrial enzymes like those used in laundry soap or cheese production. Crops could also be imbued with more powerful and more environmentally friendly forms of pest resistance. However, none of this is possible yet because the only scalable method of plant genetic engineering crops is limited to the nuclear genome. Plants have three genomes: nuclear, mitochondrial, and plastid (chloroplast). Traditionally, only the nuclear genome is modified. This is because it is the only genome for which there are easy methods that allow manipulation. Unfortunately, the nucleus has the fundamental limitation that any changes made can later be spread to non-engineered organisms via pollen. Genes introduced into the nucleus suffer from low levels of expression, and are subject to being silenced (inactivated) in the long term. As an alternative, we have developed tools to modify the plastid genome. These tools mean that previously unusable genetic traits can be deliberately introduced into major crops. Our plastid genome engineering tools rely on the existing methods of nuclear genome modification, but entail new ideas to extend those methods into a different part of the cell. Our hypothesis is that implementation of these tools in a living plant will result in an altered plastid genome. To establish proof-of-principle, we have introduced individual components and demonstrated their proper functioning. These experiments gave us valuable insight into the flaws of our system, and have allowed us to implement improvements that might unlock the next generation genetically engineered crops. This work is funded by the NCSU Chancellors Innovation Fund.

Pete Nelson
Graduate Program: Entomology
Advisors: Hannah Burrack and Clyde Sorenson
Poster Number: 124

Assessing a non-chemical strategy to reduce pest damage in sticky plants

Plant-provided foods, including nectar and pollen, increase top-down control of herbivores by enlisting natural enemies for protection. Arthropod carrion entrapped by “sticky” plants covered in glandular trichomes has recently been recognized as another form of plant-provided food for predatory arthropods. Research with wildflowers elucidated a mutualism between such “sticky-plants” and predators: trichomes trap arthropods, providing food that increases predator abundance, reducing herbivory, and thus increasing plant fitness. Our goal in this research was to assess the potential of this mutualism to enhance biological control of pests of in economically important plants. Using Nicotina tabacum as a model system, we augmented plants in the field with frozen Drosophila spp. carrion and surveyed plants for predator and pest abundance, yield, and damage to seed capsules. Surveys of plants for arthropod carrion abundance were also performed to assess the impact of systemic insecticide use on carrion entrapment. Our results indicate that augmenting plants with carrion increases predator abundance and decreases plant damage. Systemic insecticides did not affect carrion entrapment, indicating that this protective mutualism may be compatible with other pest management tactics. Insect entrapment by plants is a widespread and potentially common form of defense. A literature review revealed that at least 25 economically important plant species, including tomato, hemp, and petunia, trap insects on their surfaces. Crops may benefit directly from this mutualism, or it could be exploited to develop alternative food resources that increase natural enemy abundance. Using this plant-insect interaction to enhance biological control could reduce reliance on insecticides for pest management.

Meichen Pan, Claudio Hidalgo-Cantabrana, and Rodolphe Barrangou
Graduate Programs: Food Science
Advisor: Rodolphe Barrangou
Poster Number: 135

Differential Adaptation of Lactobacillus crispatus to the Intestinal and Vaginal Environmental Conditions

A healthy human vaginal microbiome is associated with a Lactobacillus dominated microbial community, which lowers the pH of the vaginal cavity to pH 3.5-4.5 due to lactic acid production. Lactobacillus crispatus is commonly found in both healthy human vaginal and intestinal microbiomes. These two environments are different in nutrients, pH, and microbiota composition. We hypothesize that, in order to survive and thrive in both environments, various strains of Lactobacillus crispatus have evolved to develope distinct genotypic and phenotypic features, leading to specific adaptations to each environment. This study investigated the acid resistance of vaginal and intestinal lactobacilli isolates in the presence of lactic acid and hydrochloric acid at log and stationary phase. We also formulated a simulated vaginal fluid (SVF) that models the vaginal environment to test the growth potential of various L. crispatus strains. We observed that vaginal isolates tend to be more resistant to acids than intestinal strains. Overall, stationary cells were more acid resistant, and lactic acid was more lethal than hydrocholric acid. Interestingly, vaginal isolates outperformed intestinal strains in SVF. Overall, our results indicated that vaginal and intestinal strains differ in their abilities to survive in vaginal environmental conditions.

Kamaira Hartley Philips[1,2], Joshua Hemric[1], Keturah (Kim) Faurot[2], and Susan A. Gaylord[2]
Graduate Programs: Prestage Department of Poultry Science, North Carolina State University[1]; Department of Physical Medicine, University of North Carolina[2]
Advisor: Paul E. Mozdziak
Poster Number: 59

Systematic Review of the Effect of Omega-3 Fatty Acid Intake in Preconception Period on Maternal and Child Health Outcomes with Comparison to Animal Studies

Despite evidence that greater attention to early maternal nutrition improves maternal and child health (MCH) outcomes, fatty acid intake during preconception (before conception and early gestation) has received little attention. Omega-3 polyunsaturated fatty acid (n-3 PUFA) is critical for several important developmental pathways. However, Western diets often fall short of this essential nutrient, suggesting that many women are entering pregnancy with inadequate stores. A systematic literature review was conducted to explore available evidence on the impact of preconception n-3 intake on MCH outcomes. Studies were included based on the following: 1) humans or mice (female); 2) supplementation or dietary intake of n-3 or metabolites; 3) initiated during preconception; 4) measured at least one MCH outcome. Nine human (1 RCT, 8 observational) and five animal studies were selected and examined. Generally, higher n-3 consumption was associated with increased birth weight, gestation time and lower blood pressure, but the highest n-3 consumption was negatively correlated with birth size. Elevated n-3 intake was associated with improved fertility and embryo morphology in couples undergoing in vitro fertilization. One study found increased birth size only in overweight women while mice studies showed decreased birth size. In mice, n-3 mitigated obesity comorbidities and vitamin B deficiency, however, high fat diets epigenetically inhibited long chain PUFA availability, potentially impairing growth and development. There is limited research on this topic. Early n-3 intake modulates maternal and fetal metabolism, but the overall impact and exact mechanisms are unclear. There is no consensus on dosage, safety or efficacy for n-3 intake in the preconception period. Mice may be poor models for PUFA metabolism as evinced by conflicting data on birth size. High quality RCTs are urgently needed to evaluate preconception n-3 intake on MCH outcomes.

Casey Reagan[1], Anna M. Locke[2], and Thomas E. Carter, Jr.[2]
Graduate Programs: Crop and Soil Science, North Carolina State University[1]; USDA-ARS Soybean and Nitrogen Fixation Unit, Raleigh, NC[2]
Advisor: Thomas E. Carter, Jr.
Poster Number: 143

Screening Southern soybean germplasm for genetic flood tolerance in North Carolina

Soybean (Glycine max (L.) Merrill) growers in eastern North Carolina often face flooding as a result of massive rainfall, such as Hurricane Matthew in 2016. The effects of prolonged waterlogging can include weak root development, spindly plants and ultimately, a decrease in yield. However, yield response of regionally-adapted soybean genotypes to flooding has not been quantified well in NC. We conducted a 7 acre field trial at Tidewater Research Station in Plymouth, NC in 2016. A flooding treatment was imposed on the experimental plots at the R2 growth stage for approximately 7 days. 17 breeding lines and varieties from both the Mid-South and North Carolina were evaluated for yield response (bu/ac), visual appearance (0-9 ratings where 0 indicates no damage) and maturity date. Visual ratings were influenced by maturity (later maturity types had better ratings), but S11-25615 and Walters exhibited flood ratings that were better than expected for their maturity. Walters was one of the first soybean genotypes identified as flood tolerant in the Delta region of the South. S11-25615 is a flood tolerant breeding line from the Univ. of Missouri. August flooding reduced seed yield more than 50% as compared to control and later maturity types tended to be higher yielding in the flooded plots. Surprisingly, the correlation of genotypic means for yield under control conditions and flooded conditions was close to zero. S11-25615, Ellis, and N02-7779 yielded best under flooded conditions, but only S11-25615 exhibited a desirable visual rating for flood response. Results from this 2016 experiment and follow-up experiments currently underway are the essential first steps in identifying parental stock for a breeding program to improve flood tolerance for the eastern USA. Further steps for this project will include identifying the mechanism(s) and genes that underlie this crucial stress tolerance and incorporating them into successful, high-yielding cultivars.

Wayne Roper, Deanna Osmond, Joshua Heitman, and Wayne Robarge
Graduate Program: Soil Science
Advisors: Deanna Osmond and Joshua Heitman
Poster Number: 162

Comparing Methods to Measure Soil Organic Carbon in North Carolina

The beneficial ecosystem services provided by soil organic carbon (SOC) make it a major factor in soil health management. Different techniques have been developed to measure SOC, but it remains uncertain how results from different procedures can be compared when making soil management decisions.To compare different procedures for measuring SOC, we used soils from long-term (16-31 yr.) agronomic trials in the coastal plain, piedmont, and mountain regions of North Carolina. The coastal plain and mountain trials included combinations of tillage and management (conventional vs. organic), whereas piedmont trials were configured to evaluate tillage intensity. In total, 84 soils were used in the analysis. Soil was collected from the top 15 cm and homogenized to fit a 2-mm sieve before analysis. Methods used to measure SOC were Walkley-Black (WB), mass loss on ignition (LOI), and automated gas chromatography (AGC). Correlations between SOC measured using different procedures were weak, and less than 30% of the variation could be explained for either correlation ($r2 < 30$). Separate analyses for individual trials did not significantly improve relationships between different procedures. Conversions of SOC measured by one procedure to SOC measured by another procedure could be off by as much as 1.6-2.8 g C kg-1, which is a significant amount for soils with less than 20 g C kg-1 (2% SOC). Also, LOI and AGC were more sensitive to differences in agronomic management than WB. It is difficult to compare values of SOC because results from one technique are not predictive of results from another. Our data show that measured effects of tillage and management vary based on procedure. To avoid confusion about how agronomic management affects SOC, continued assessments of SOC should only compare results from a common SOC measurement procedure.

Casey L. Ruark[1], Michael Gardner[2], Melissa G. Mitchum[2], Eric L. Davis[1], and Tim L. Sit[1]
Graduate Programs: Plant Pathology, North Carolina State University[1]; Division of Plant Sciences, University of Missouri[2]
Advisors: Eric L. Davis and Tim L. Sit
Poster Number: 147

Novel RNA Viruses within Plant Parasitic Cyst Nematodes

The study of invertebrate – and particularly nematode – viruses is emerging with the advancement of transcriptome sequencing. Five single-stranded RNA viruses have now been confirmed within the economically important soybean cyst nematode (SCN; Heterodera glycines). From previous research, we know these viruses to be widespread in greenhouse and field populations of SCN. Several of the SCN viruses were also confirmed within clover (H. trifolii) and beet (H. schachtii) cyst nematodes. In the presented study, we sequenced the transcriptomes of several inbred SCN populations and identified two previously undiscovered viral-like genomes. Both of these proposed viruses are negative-sense RNA viruses and have been named SCN nyami-like virus (NLV) and SCN bunya-like virus (BLV). Finally, we analyzed publically available transcriptome data of two potato cyst nematode (PCN) species, Globodera pallida and G. rostochiensis. From these data, a third potential virus was discovered and called PCN picorna-like virus (PLV). PCN PLV is a positive-sense RNA virus, and to the best of our knowledge, is the first virus described within PCN. The presence of these novel viruses was confirmed via qRT-PCR, endpoint PCR, and Sanger sequencing with the exception of PCN PLV due to quarantine restrictions of the nematode host. While much work needs to be done to understand the biological and evolutionary significance of these viruses, they offer insight into nematode ecology and the possibility of novel nematode management strategies.

Rachel Taylor
Graduate Program: Biological and Agricultural Engineering
Advisor: Chadi Sayde
Poster Number: 172

Optimizing Regenerative Stormwater Conveyance for Nutrient Removal with Heated Fiber Optics

Nonpoint source pollution (NPS) causes roughly 60% of water quality impairments. A major source of NPS pollution is stormwater runoff particularly from agricultural watersheds. Over application of fertilizers, particularly animal manure leads to excess nutrients entering surface water bodies. Regenerative Stormwater Conveyance (RSC) is an innovative approach to remove pollutant loading from excess storm water runoff. To date, RSC research is limited to urban watersheds with few results indicating water quality improvement. The potential of RSC to remove nutrients has not yet been fully investigated in a full sized, functioning system. In this presentation, I will discuss a conceptual framework of a research study that investigate the ability of RSC to remove nutrients in an agricultural setting with high nutrient loadings. Several media compositions of RSC's will be evaluated to see if improved nutrient removal can be accomplished. High resolution sensing systems for monitoring fluxes within the RSC media will be employed to improve our understanding of the dynamic hydrologic and (bio) geochemical processes that control nutrient removal within RSC systems. I will also present, preliminary results from a series of column experiments that explore the use novel media composition for nutrient removal, and of Heated Fiber Optics technology for distributed flux monitoring within the media.

Redife Aslihan Ucar
Graduate Program: Food, Bioprocessing and Nutrition Sciences
Advisor: Ilenys M. Perez-Diaz
Poster Number: 177

Utilization of Secondary Energy Sources by Selected Lactic Acid Bacteria, Candidates for Starter or Adjunct Cultures for Commercial Cucumber Fermentations

Carbohydrate utilization in lactic acid bacteria (LAB), defines the extent of cucumber fermentations and the quality and long-term stability of the preserved fruit. Aside from glucose and fructose, secondary energy sources such as citrulline, trehalose, cellobiose, xylose, lyxose, gentiobiose, and furfural seem to be present in cucumber fermentation prior to spoilage. This study evaluated the ability of candidates for starter or adjunct cultures for cucumber fermentations, including Lactobacillus plantarum, L. pentosus, L. brevis, L. buchneri and Pediococcus pentosaceous, to use secondary energy sources and aid in preventing spoilage. The natural content of the secondary energy sources in fresh cucumbers and commercial fermentations was corroborated using HPLC. The presence of putative substrates utilization and energy deriving pathways for the 7 compounds listed above were investigated using the publically available genome sequences: the KEGG Orthology and Integrated Microbial Genomes (IMG) tools. Conversion of metabolic substrates was monitored by HPLC. While the presence of gentiobiose, cellobiose, and lyxose was unconfirmed in fresh cucumber juice and cover brines collected on day-3 of commercial fermentations, citrulline, trehalose, and xylose were sporadically detected to 1.6 ± 0.6, 15.5 ± 1.6 and 36 mM in the fresh fruits, respectively. Furfural content determination on fresh cucumbers was prevented by technical difficulties. Trehalose was utilized by the primary fermenters, L. plantarum and L. pentosus, presumably via the putative starch & sucrose pathway. Xylose was utilized by most of the LAB studied, except L. plantarum and L. pentosus. L. buchneri was unique in its ability to utilize citrulline presumably via the arginine biosynthesis pathway. We conclude that no additional interventions are needed to remove trehalose and that utilization of P. pentosaceous as an adjunct culture represents an alternative for the removal of xylose in cucumber fermentation. Further studies are needed to identify a suitable strategy for the removal of citrulline.

Sophia H. Webster-Tostenson and Maxwell J. Scott
Graduate Program: Entomology and Plant Pathology
Advisor: Maxwell J. Scott
Poster Number: 186

Genetically Engineering a Killer-Rescue Gene Drive System for Insect Population Replacement

Mosquitoes transmit numerous diseases with great morbidity and mortality that affect hundreds of millions of people each year. The mosquito Aedes aegypti is a vector for zika, dengue, chikungunya, and yellow fever. The symptoms of these viruses can range from minor flu-like to severe hemorrhaging, circulatory shock and sometimes death. The zika epidemic has led to thousands of babies born with microcephaly and other severe birth defects. Genetically engineering mosquitoes to carry anti-pathogen or lethal genes is an innovative form of vector control that can work in combination with current tools such as insecticides and larval habitat removal. Genetic technologies designed for population replacement are a promising approach to mosquito vector control. The end goal of population replacement is to drive anti-pathogen genes though a population so that the original disease transmitting population is replaced with a population that has decreased vector competency and is incapable of spreading the virus. Since mosquito population densities are so high, researchers are favoring population replacement approaches over population suppression or eradication. We are creating a gene drive system, that when coupled with an anti-viral gene, can be used to reduce disease incidence through mosquito population replacement. This gene drive system, Killer-Rescue, includes two engineered constructs that are present on independently segregating loci. Mosquitoes that inherit the killer gene die unless they also inherit the rescue gene, which in the future, will be coupled to an anti-viral gene. Thus, the only mosquitoes that survive each generation are those that inherit the rescue and linked anti-viral genes. We have established an initial killer-rescue gene drive system in Aedes aegypti as well as Drosophila melanogaster and are beginning laboratory cage experiments to test the efficacy of the system to drive the desired genes through a population.

Abigail Whitaker
Graduate Program: Agricultural and Extension Education
Advisor: Jackie Bruce
Poster Number: 187

The Lived Experience of Female Cattle Producers

This qualitative phenomenological study describes the lived experiences of female cattle producers. Women in agriculture control over 14% of the farmland in our country, creating a footprint for 30% of US agriculture (USDA, 2012). While they may be present in the industry, women are not equally represented in the literature. Society has expectations of groups instead of allowing individuals to define themselves and what categories they do or do not fit into. This study was framed by psychoanalytic, cognitive-developmental, biological, and social cognitive theories of gender identity and development. Using a phenomenological approach, the following themes emerged most prevalently- doubt, sacrifice, expectations, mentoring, and acceptance. No two female cattle producers look the same. Their stories, day to day lives, experiences, and outlooks differ from one woman to the next. They face a set of challenges that center on others expectations of their lives, careers, and roles in their families rather than what the woman would define herself as. This study concludes that when dealing with people in any situation, they need to be treated as individuals rather than representatives of groups. Organizations, work places, and even social settings must see the person and not the category.

Nathan Wilson[1], Christophe La Hovary[1], Caroline Smith-Moore[2], Amy Grunden[1], and Heike Sederoff[1]
Graduate Programs: Plant and Microbial Biology[1]; Functional Genomics[2]
Advisor: Heike Sederoff
Poster Number: 192

Utilizing a Synthetic Carbon Fixation Cycle to Enhance Plant Productivity

Photosynthetic CO^2 fixation via the Calvin cycle accounts for >90% of global inorganic carbon fixation. The remaining 10% is fixed by autotrophic bacteria via alternative CO^2 fixation pathways. Ribulose-1,5-bisphosphate carboxylase/oxygenase (RuBisCO) is the notoriously inefficient enzyme of the Calvin cycle that is responsible for fixing atmospheric CO^2 in plants. RuBisCO also reacts with oxygen which leads to as much as a 30% loss of fixed carbon and energy. This is a rate-limiting process that is most inefficient in C^3 crops, such as soybean, wheat, canola, and rice. It has been estimated that a 5% decrease of this O^2 reaction would translate into ~$540 million per year. For a future green economy amidst climate uncertainties it is necessary to develop sustainable strategies to boost agricultural productivity. Synthetic metabolic engineering allows for designer CO^2 fixation cycles that utilize the natural diversity of carbon fixing enzymes to bypass RuBisCO. We constructed a synthetic CO^2 fixation cycle (SynCycle) inspired by bacterial metabolism to achieve a CO^2 fixation cycle with 20% less energetic requirements than the Calvin cycle. SynCycle consists of 5 bacterial enzymes that work in cooperation to utilize succinate and CO^2 to generate glyoxylate and regenerate the carboxylation substrate. SynCycle has been shown to function in vitro and we have engineered Camelina sativa to express SynCycle enzymes. Preliminary data from SynCycle C. sativa plants show increased biomass and photosynthetic CO^2 assimilation rates suggesting that the cycle can contribute to overall CO^2 fixation in vivo. Future work will discern the physiologic and metabolic role that this synthetic pathway has in vivo and to integrate it with other traits to further increase inorganic carbon fixation in plants. This research was funded by the Department of Energy (ARPAe #AR0000207)

Yu Wu[1], Katrina Mullan[2], Trent Biggs[3], Jill Caviglia-Harris[4], Daniel W. Harris[5], and Erin Sills[1]
Graduate Programs: Economics, North Carolina State University[1]; Economics, University of Montana[2]; Geography, San Diego State University[3]; Economics and Environmental Studies, Salisbury University[4]; Geography and Geosciences, Salisbury University[5]
Advisor: Erin Sills
Poster Number: 193

Forest Watershed Services on an Old Frontier in the Brazilian Amazon

Tropical deforestation affects ecosystem services at multiple scales, from global to local. At the local scale, deforestation is known to affect watershed processes including erosion rates, water chemistry, base flow, and groundwater recharge. These processes in turn affect ecosystem services including the quality and availability of water for livestock and crops immediately downstream. However, in humid tropical regions such as the Amazon, where the terrain is relatively flat and water is relatively abundant, it is unclear whether and which forest watershed services are valuable to local farmers. We test whether the extent of forest in upstream drainages affects downstream farm production in agricultural colonization settlements, which have some of the highest rates of deforestation and a large fraction of the farming population in the Brazilian Amazon. In our study site, dairy is the primary agricultural activity. We begin by estimating milk production as a function of hydrological and other inputs, using an inverse hyperbolic sine latent class panel Tobit model with controls for temporal and spatial fixed effects. We find that the amount of forest in the watershed does not influence productivity or net farm revenues when water is abundant. However, when water is scarce, i.e. in small watersheds, dry seasons, and drought years, milk production per cow as well as the stocking rate of cows per hectare of pasture are higher on farms with more mature forest in the drainage that supplies their water. This suggests a forested drainage provides a form of insurance against drought to farmers in agricultural colonization settlements in the Amazon. This insurance function is likely to become more important in the future as rainfall in the region becomes more variable with global climate change. These findings should encourage consideration of the benefits of standing forest in land use policy.

Yawen Zhai
Graduate Program: Food Science
Advisor: Ilenys M. Perez-Diaz
Poster Number: 64

Defining Fermented Cucumber Damage Induced by Freezing

Brined, fermented cucumbers bulk stored in outdoor tanks are at risk for quality damage due to exposure to sub-zero temperatures in winter climates. Increasing NaCl content to 8 -14% in cover brines to prevent freezing could damage the fermented cucumber tissue due to increased osmotic pressure. The objective of this study was to characterize and quantify fermented cucumber damage induced by freezing. Freshly fermented, pickling cucumbers (3A, 3.8-4.4 cm diameter) were obtained from geographically distant commercial processors. Cucumbers (n = 30) were individually packed in quart freezer bags with or without cover brine, incubated at -20 °C for 48 hours and thawed at 20 °C for 24 hours. Cucumbers packed without cover brine were vacuum sealed to minimize growth of aerobic microbes. Changes in fruit appearance, mesocarp tissue firmness and mesocarp and exocarp color were monitored by visual inspection of the degree of pittedness and skin separation, instrumental texture analysis and a colorimeter, respectively. Efflux of lactic acid was monitored in cucumber exudate using HPLC analysis. Substantial development of tissue pittedness and occasional skin separation were observed in fermented cucumbers subjected to freezing. Tissue firmness significantly decreased from 10.5 ± 2.5 N to 8.1 ± 2.8 N after freezing ($P < 0.0001$), regardless of the presence of cover brine. Exocarp color darkened as compared to the control, as indicated by a change in L* value from 32.6 ± 3.9 to 30.7 ± 3.0 ($P < 0.05$), with a delta E of 1.2. Leakage of lactic acid increased by 6.4 ± 2.1 mM due to freezing. Freezing damage of fermented cucumbers was defined as loss of tissue firmness, changes in skin color, development of tissue pittedness and increased lactic acid efflux. These criteria will aid in determining the level of salting required to minimize freeze-induced damage in winter-stored fermented cucumbers.

Wenbin Zhou[1], Xiang Ji[2,3], Shihori Obata[1], and Andrew Pais[1]
Graduate Programs: Plant and Microbial Biology[1]; Bioinformatics Research Center[2]; Statistics[3]
Advisor: Qiuyun (Jenny) Xiang[1]
Poster Number: 134

Resolving relationship and phylogeographic history of the Nyssa sylvatica complex using data from RAD-seq and species distribution modeling

Nyssa sylvatica complex consists of three tree species, and four varieties occurring in eastern North America. Due to high morphological similarities and complexity of morphological variation, classification and delineation of taxa in the group have been difficult and the subject of multiple taxonomic debates. Here we employed data from RAD-seq to elucidate the genetic structure and phylogenetic relationships within the group and evaluate previous classification schemes. We also employed Species Distribution Modeling to predict distribution ranges of the taxa to evaluate impacts of climatic changes and to gain insights into the refugia of trees in eastern North America. Results from Molecular Variance Analysis, Structure, phylogenetic analyses using Maximum likelihood, Bayesian Inference and Splittree methods of RAD-seq data strongly supported a two-clade pattern, largely separating samples of N. sylvatica from those of N. biflora-N. ursina. Divergence time analysis with BEAST suggested the two clades diverged in the mid Miocene and the ancestor of the present trees of N. sylvatica in the Pliocene and that of N. biflora-N. ursina in the end of Miocene. Results from SDM predicted a smaller range in the southern part of the species present range of each clade during the Last Glacial Maximum and northward expansion of ranges at interglacial periods, as well as a northward shift of the range in the future under the model of global warming. Our results support recognition of two species in the complex and an N. ursina-like ecotype within N. biflora due to its dwarf habit associated with frequent fire habitat. Our results further support movements of trees in eastern North America in responding to climatic changes and that RAD-seq data and a combination of population genomics and SDM are valuable in resolving relationship and biogeographic history of closely related species that are taxonomically difficult.

College of Design

Kirsten E. Benson
Graduate Program: Design
Advisor: Tania Allen
Poster Number: 14

Hive Mind: Mobile Application to Inspire Action for Local Pollinators

Recent and prolific news reports on the unstable mortality rates of bee populations have emphasized their critical importance to agriculture and the survival of the human community as a whole. Most still do not understand how exactly, bees are impacted by the effects human behavior, and environmental hazards have on their populations. Additionally, North Carolina has the most extensive beekeeping association in the United States, but unlike other states, 90% of the organization is made up of part-time or hobbyist beekeepers, which provides an ample community of honeybee and pollinator enthusiast to inspire to affect significant change in North Carolina. Hive Mind is a mobile, multi-media application, which provided the platform for civilians to participate in science, precisely through the subject of honeybees and pollinators in central North Carolina. Three sections structure this application: education on pollinators and their environmental hazards through illustrated informational graphics; location and identification of pollinators through geo-mapping creating a platform for civilian science; and social learning between beekeepers and apiculture enthusiasts in a social platform. The goal of this project is to capitalize on this interest and awareness in honeybees and native bees and inspire action in the users. These aspects are being developed through design research and experimentation and working in collaboration with expert entomologist Dr. David R. Tarpy. The deliverable of this study will be an interactive wireframe prototype of Hive Mind on a tablet and written thesis of tools and techniques, influences, theoretical framework and cross-disciplinary conversations with the entomology and design.

Clément Bordas
Graduate Program: Graphic Design
Advisors: Helen Armstrong, Denise Gonzales Crisp, and Matthew Peterson
Poster Number: 18

Collaborating with Machines Rather than Commanding Them: Interaction and Interface Design for a Human-AI Collaboration Paradigm

Machine learning is changing the way designers interact with computers. Machines are now able to generate predictions from billions of data points without the need to be programmed. Machine learning allows computers to be trained to act as intelligent agents. This new technology opens up possibilities for reinventing user interface using interaction design principles adapted to machine learning and collaborative techniques. This research investigates the design of interfaces that utilize machine learning to help designers address increasingly complex contemporary design problems. A framework, which integrates several Human-Computer Collaboration (HCC) approaches with machine learning, will underpin the design of these interfaces. This framework will consider computers as intelligent partners in a joint human-computer paradigm. In this paradigm, the human and the computer will collaborate and contribute to achieve shared goals while considering the strengths and weaknesses of both partners. My research methods will be based around this adapted HCC framework, mapping out a range of issues and themes using scenarios, user journey maps, and storyboards, as well as the generation of visual studies and rapid prototypes. Focusing this research specifically on the impact of machine learning upon collaborative activity, via an interface, brings to the forefront of this investigation the impact of big data upon the design process. To propose meaningful, inclusive design solutions, designers must be able to access and analyze expert data and knowledge. Machine learning techniques can enable designers to access this data and knowledge in real time and thus influence their design decisions. Ultimately, this research presents opportunities for designers to define a new collaborative human-computer relationship enabled by machine learning.

Jingyuan Fu
Graduate Program: Design
Advisor: Art Rice
Poster Number: 47

Design Based Study Abroad: The Critical Step in Fostering Creative Designers

The research reported on in this poster demonstrates that design study abroad experiences may be one of the most impactful elements of a design education with regard to enhancing an individual's creative potential. This research builds on a number of recent studies that have indicated that exposure to other cultures can enhance some aspects of creativity. Specific aspects of creative ability were studied and measured in undergraduate design students over a period of three years. Some students, who did not participate in study abroad, pursued their design studies during a semester at a major design college in the United States. Other students in the design college, with similar backgrounds, elected to spend a semester attending a design study abroad experience. Data collected included the results of a series of validated tests used to evaluate aspects of divergent thinking, convergent thinking, and personality related to creativity. A comparison of baseline pre-experience scores of the treatment group and the control group revealed no significant difference prior to the study abroad experience. When the results of a series of validated tests given before and after the study abroad semester were analyzed, those students participating in study abroad showed significant improvement in all of the creativity measures. Those design students electing not to participate in the study abroad semester over the same period of time showed no improvement in three of the creativity measures and a decline in creativity in one. This poster presents details of the study methodology, measurement tests, and statistical analysis of findings. In addition, the results of a parallel study abroad student journaling exercise are discussed that begin to reveal the most impactful elements of a design study abroad experience.

Mac Hill
Graduate Program: Graphic Design
Advisor: Matthew Peterson
Poster Number: 60

Developing an Experiential Visual Language for Uncertainty in Data Journalism

Data journalism has become a pervasive feature of mass media, with infographics and visualizations appearing in print, online, and in television coverage. While visualizations in mass media can render data accessible to the public, they can also give viewers a false sense of truth and certainty. Uncertainty, meaning incomplete or imperfect data, exists in all information and visualizations; it can be introduced during collection, analysis, or even visualization, but it is often left out of final information visualizations. Conveying the uncertainty involved in a data set provides viewers with a fuller picture and more robust understanding of an issue. Currently, there is not a robust, perceptually-sound visual language for conveying that uncertainty. While there are methods for visualizing uncertainty in scientific or statistical figures, those graphics are typically created for audiences familiar with the visual language of scientific data, making them inaccessible to non-expert audiences. This provides an opportunity for graphic design methods and research to expand those techniques to non-expert audiences. Drawing from graphic design methods and frameworks, in addition to statistical and scientific methods for conveying uncertainty, this study explores experiential techniques that data journalists can use to convey uncertainty in statistical and scientific information to a non-expert audience.

Amber Ingram
Graduate Program: Graphic Design
Advisor: Helen Armstrong
Poster Number: 66

The Impact of Anticipation: Responding to Stress through the Design of Enchanted Objects in an IoT Workstation

This research explores the use of a system of anticipatory responsive smart objects as a vehicle for reducing stress within a workstation environment. Contemporary connected workplace technology often demands a user's undivided attention, pushing the user from one task to the next via notifications, alerts, buzzes, beeps, and alarms. This constant demand for attention can increase worker productivity but, simultaneously, increase stress levels. Unobtrusive technology that lives on the periphery of the user's attention—or moves smoothly from periphery to center and back—could create more calming workplace environments, particularly if such technology could anticipate and respond to user stress. Through embedded means of input and output, smart objects could produce more natural and seamless interactions. Mark Weiser and John Seely Brown discuss this concept of calm technology in which objects can engage both the center and the periphery of our attention, allowing them to be more unobtrusive. Other researchers agree and have created their own frameworks for understanding user attention levels. In this investigation, focused, peripheral and implicit interactions will be considered through the lens of David Rose's Designing for Subtlety scale, which defines ways that smart objects can communicate with users. As Rose suggests and Michael Haverkamp, synesthetic research engineer, describes, different bodily senses (modalities) can engage with input to produce peripheral and implicit interactions via connected devices. The intent of this study is to identify opportunities for such ambient, anticipatory design interventions to redefine the workstation user experience, in an attempt to lower stress via a more thoughtful engagement with human attention levels.

Jasmine Kent
Graduate Program: Industrial Design
Advisor: Sharon Joines
Poster Number: 74

Plus-Size Sports Bra Design: A human-centered design approach to influence and empower by design

Sports bras were the necessary coupling to Title IX that enabled women to participate in sports to their fullest potential. Today, more than 3.2 million girls are playing sports in high school and over 193,000 women are playing sports at the NCAA level. Even more girls and women are active outsides of sports with the rise in boutique exercise classes like pole fitness, barre, pilates, and more. However, non-inclusive body image has plagued women based on what the female athletic body should look like. It has caused women that do not think they have a small enough frame, bust size, muscle tone, or height to believe that they cannot participate in sports or any type of activity. Clothing retailers have exacerbated this problem by not providing sports bra options for plus-size women or providing lesser quality options for them. This research investigates the plus-size body, the process of designing garments for it, and the shortcomings of the existing products. A human-centered design research methodology was utilized where primary research was done by interviewing the biomechanical, technical, and design team at Hanes. A survey was conducted with 287 plus-size women, dress size 16+, to attain their opinions on sports bra design for their bodies. A fit model was obtained from the survey participant pool and will be used to create three prototypes to be critiqued through focus groups of plus-size users and expert reviewers. Findings to date have shown that utility, fit/comfort, and appeal are the main categories that are not provided to the plus-size market through sports bras. The new sports bra must provide full coverage of breasts during activity, eliminate distracting elements, and soften bounce during rhythmic activity.

Charity G. Kirk
Graduate Program: Industrial Design
Advisor: Kelly Umstead
Poster Number: 76

Improving the IUD Insertion Experience in Nulliparous Women

IUD (intrauterine device) insertion and use is uncomfortable for many women. Nulliparous women report greater discomfort, likely due to having a smaller uterus and a tighter internal orifices of the cervix. Insertion discomfort, in particular, has been shown to be significantly underestimated by doctors and pain relieving drugs have shown little ability to lessen the experienced pain. The IUD has seen little research and development since the 1980s and almost no research since then has centered on improving the insertion experience (beyond drug studies). As suggested in the literature, reducing insertion pain might increase acceptance and uptake of the device. Additionally, reducing the pain experienced at insertion may improve a woman's overall experience. This investigative study proposes an IUD design aimed at improving the experience of both the doctor and patient during the insertion procedure. Design criteria were compiled and crafted from multiple qualitative and quantitative methods: an extensive secondary source review, patient surveys, interviews, insertion observations, and anatomical studies. Based on these criteria, prototypes for an improved IUD and insertion device have been tested on uterine models and are presented here.

Hongyang Liu
Graduate Program: Design
Advisor: Sharon Joines
Poster Number: 108

Interaction Design of New Technologies for Older Adults: From the Ease of Learning Perspective

Technology as a concept can generally be defined as any electronic or digital product (tablet, mobile phone, laptop, TVs, digital camera, headphones, etc.) or service (e.g., banking apps, browsers, online shopping, etc.). Although these technologies can benefit older adults (i.e., 65 years of age or older) through their everyday activities, older adults have more difficulty than younger individuals in using and learning to use new technology. The learning process among older adults is one of the important factors when considering how to improve the 'learnability' of new technology. Moreover, people with different levels of technology expertise have different user experiences. With higher levels of technology expertise, people are expected to have a better understanding of new technologies and more efficient learning processes. Hence it is essential to investigate older adults with different levels of expertise and to look into the differences in learning processes between these groups. This study aims to explore the interaction design factors of new technologies that can influence the learning process for older adults. As the target of this research, older adults with 4 different levels of technology expertise (novice users, advanced beginners, competent users, and proficient users) were recruited. 8 focus groups (37 participants) were conducted to investigate the barriers of interactions with new technologies, the learning method preferences, and the learning tools between groups of older adults with different levels of expertise. Thematic coding analysis was used to generate findings and insights. The resulting findings and insights will be applied to prototyping and design recommendation development in future studies.

Kate McCracken
Graduate Program: Industrial Design
Advisors: Sharon Joines and Bryan Laffitte
Poster Number: 103

Community Connection Through Social Innovation

Over 2,000 people have been shot and killed by the police in the last two years, and twenty percent of people shot are unarmed. Young black men are eighty percent more likely to be shot by police than any other demographic, and are most likely to be shot during incidents that begin with routine traffic or pedestrian stops. Traffic stops are the third most fatal activity for police officers. The combination of edgy officers and anxious drivers means that traffic stops are often one miscalculation away from tragedy, regardless of the driver's race. The purpose of this study is to expose the extent of the applicable factors perpetuating emotional and mental strife between citizens and police officers and design for gaps in understanding. A human-centered, ethnographic approach was used to study the traffic stop experience. Interviews with thirty-six police across five states were conducted as well as five ride-a-longs. Through collaborative mapping of the police officer's and the citizen's experience combined with overlapping assumptions gaps in understanding were revealed. Within the second part of the study, a car accessory prototype is introduced and reviewed by police for evaluation of protocols and assessing design short-comings due to lack of exposure or cultural understanding. The intent of this product is to serve as non-verbal communicator through shared visual expectations enabling reduction of the police officer's suspicion and fear, building rapport between the police and community, and creating a safer environment for necessary actions. Finally, there was an educational pamphlet inserted at the local DMV including topics like police culture, lawful behavior expectations within a traffic stop, laws, rights, and reasonable consequences for unlawful behavior. Observations and additional information was gathered from a follow up survey with citizens. The results of the study demonstrate the need for education among all communities.

Lesley-Ann Noel
Graduate Program: Design
Advisors: Tsailu Liu and Traci Rider
Poster Number: 127

Fostering empathy through Design Thinking among 4th graders in Trinidad & Tobago

Empathy is a skill that must be developed in children, and lack of empathy has been linked to problems such as bullying at school. Empathy is also a skill that is needed later on in life that can lead to greater success in professions such as healthcare, customer service, sales and marketing and education. Designers use empathy to better understand the lives of the people for whom they design. Therefore design education at primary school could provide a learning experience that facilitates the development of empathy. In this qualitative study, children from a 4th grade class at a primary school in Trinidad and Tobago participated in a three-week summer camp with a curriculum based on design thinking. One of the aims of the study was to examine how children practiced empathy during the design class. Data were collected via focus group discussions, observations and journal reflections by the children and the instructors and analysed . Findings revealed that children practiced empathy at several stages in the design process such as in defining the design problem, in doing research with target stakeholders and in developing appropriate solutions. The findings also demonstrated that the pedagogical style of the design class and collaborative nature of the design studio, where children work very closely with their colleagues also meant that children could practice empathy in group collaborations and during the critique as they listened to the presentations of their colleagues and gave feedback on the projects. These findings improve our knowledge of the potential benefits of design education at primary school demonstrating how design education can be used to enhance the social development of children by providing opportunities for them to practice empathy.

Rachael L. Paine
Graduate Program: Graphic Design
Advisor: Deborah K. Littlejohn
Poster Number: 204

Customizable Interfaces for Varying User Cognitive States

According to a 2014 Pew Research Internet Project study, 72% of internet users searched online for health information within the past year. A person faced with a serious diagnosis has an immediate thirst for knowledge, even though their cognitive ability to find—let alone comprehend—useful information may be hindered due to their traumatized, high-stress mental state. Research on learning and cognition has shown that stress and mental noise can reduce a person's ability to process information by up to 80% [Covello, 2002]. Most online health information platforms are not designed to consider the cognitive state of this type of user, even though new technologies, such as machine learning, have the potential to offer personalized support for this special information-seeking circumstance. Standard search tools and features encountered on the ordinary health information website typically take a one-size-fits-all approach. The purpose of this research is to address this interface design problem. The objective of this study is to determine how intelligent human-computer interfaces can present information in meaningful ways, responding to the health information-seeker's cognitive state—in particular, for someone who is under duress from a recent medical diagnosis. This study employs participatory research methods by collecting qualitative data from 20 patient advocates from the Rare Disease Council through semi-structured interviews, which will inform subsequent prototype testing. Data collection suggests that people under duress prefer to have information delivered in a minimal fashion using different delivery strategies such as chunking, withholding, seeking, gathering, and tiered presentation. This project is a small part of a long-term study. The ultimate goal is to create a semi-working proof of concept / prototype that responds to, or is customizable to, a user's cognitive state.

Jinoh Park
Graduate Program: Design
Advisor: Traci Rose Rider
Poster Number: 136

Conceptualizing a Wellness Program Facilitated through the Built Environment: Facilitating the WELL Building Standard through Wellness Programs in the Workplace

As the public interest in health and well-being has increased and researchers have found a correlation between health and productivity of employees, various governmental, corporate, and organizational services have been developed and released to support increasing employees' health outcomes. The U.S. government established regulations to release wellness programs. However, the wellness program, as part of the governmental and corporate services, does not satisfy the expectation of employee and employer because of (1) the increase of healthcare service costs, (2) the limited eligible participants and options of programs, and (3) the absence of an integrated program approach rather than independent program approaches. To improve wellness programs with existing resources and efforts, this research suggests that the built environment is a medium which can reduce the burden of healthcare cost, expand the range of program participants, and connect independent services. This study explores theoretically structuring a connection between wellness programs and the built environment based on the WELL Building Standard, aiming to identify affordable criteria of WELL which can support wellness programs. First, this study outlines the process of building a wellness program through both the program categories under regulations and actual programs by operators. Second, existing wellness programs are broken down according to the respective categories and programs in the outlined structure. Third, the categorical concepts and criteria of WELL Building Standard are arranged according to the respective elements in the outlined structure. Then, overlaps in subdivided wellness programs and WELL Building Standard are illustrated and applicable criteria of the WELL Building Standard are compared to elements of wellness programs identified in the established structure. Finally, this paper suggests the incorporation of WELL Building Standard as part of wellness programs by changing the paradigm of built environment from an environmental context to an active contributor in a wellness program.

Joshua Wall
Graduate Program: Industrial Design
Advisor: Sharon Joines
Poster Number: 191

Manumit Cymbals | Can "Athleisure" product (and associated brand) lead to discussion across faiths?

The making of art has long prompted discussion on difficult topics between artists, the products of their work, and their art; it all gave the artist a voice and then spoke to those who viewed (or consumed) their art. Using this basis, can "athleisure" product (and associated brand) be created such that it provides a voice to those who create it (the designer) and ultimately foster community and prompt dialogue between the product/brand consumers? The dialogue relevant to the creation of this product brand is rooted in the timeless, contemporary challenge that, 'Ignorance is known to give rise to conflict.' Tensions between people of varied faiths persist an interfaith dialogue is one method of mitigating ignorance. The term faith is emotionally charged in contemporary society; as a result, a more acceptable term of spiritual discussion will be used. Within this context, and to address this unmet need, to promote candid interfaith dialogue, this project will build a brand targeting millennials in order to engage in discussions revolving around common human experiences within a religious context.

College of Education

Osman Aksit
Graduate Program: Science Education
Advisor: Eric N. Wiebe
Poster Number: 5

Investigating the Impact of Computational Modeling on Students' Conceptual Understanding of Force and Motion

This study investigated how a sample of seventh-grade students' conceptual understanding of the Newton's Laws of Motion changed as a result of participating in a five-day classroom intervention where students constructed simulation-based computational models of physical phenomena (e.g., a car moving on a frictionless road) using a block-based programming environment called Scratch. Data sources included students' pre- and post-test scores and interview responses. A paired-samples t-test was conducted to determine if there were any statistically significant differences between students' pre- and post-test scores. Students' responses to the interview prompts were qualitatively analyzed by two researchers using an open-coding approach to identify the emergent themes. The findings indicated that engaging in building computational models through Scratch programming environment in regular science classrooms resulted in significant conceptual learning gains for the sample of this study. The affordances of the dynamic nature of computational models let students both "observe" and "interact" with the target phenomenon in real time while the generative dimension of model construction promoted a rich classroom discourse facilitating conceptual learning. This study contributes to the evolving literature on integrating computational modeling into science curricula by emphasizing the affordances and generative dimension of model construction through block-based programming.

Charlotte Russell Cox
Graduate Program: Adult and Community College Education
Advisor: Diane Chapman
Poster Number: 36

A Descriptive Case Study of Adult Learners' Completion in the Coaching Digital Learning Massive Open Online Course

The massive open online course (MOOC) phenomenon allows diverse learners from around the world to enroll and participate in a free course to learn specific content. However, numerous MOOC participants fail to finish the course in which they enroll (Rivard, 2013). Many MOOCs have a high dropout rate, which is approximately 90% (Hew & Cheung, 2014). This research investigates MOOC completion through the lens of two theoretical frameworks (self-efficacy theory and self-determination theory). The North Carolina State University (NCSU) Friday Institute (FI) is an entity of the NCSU College of Education. The FI MOOC is a free professional development initiative known as MOOC-Ed. MOOC-Ed is designed for kindergarten-twelfth grade (K-12) and higher education leaders globally. The Coaching Digital Learning MOOC-Ed teaches educators how to facilitate technology integration. The research is a qualitative embedded case study to describe the drivers, barriers, and strategies to complete the Coaching Digital Learning MOOC-Ed professional development. The case study also uncovered descriptions about how MOOC-Ed completers changed their professional practice after the course. Three types of data collection methods (questionnaires, interviews, and documents) were used to address four research questions. Two groups of the Coaching Digital Learning MOOC-Ed were my target sample: Spring 2016 and Spring 2017 course completers. A total of 16 interviews were conducted. Various types of coding methods were used to analyze the study data and 31 codes were collapsed into seven themes. The findings of the study will be explained. Personal motivation and relevant content/resources were MOOC-Ed completion drivers. In contrast, time and personal obligations were MOOC-Ed completion barriers.

Nicholas Fortune
Graduate Program: Mathematics Education
Advisor: Karen Keene
Poster Number: 45

Supporting Instructional Change in Undergraduate Mathematics: Connections between Faculty Collaboration and Instructional Practice

To reform instruction by moving towards student-centered approaches, research has shown that faculty need and could benefit from support and collaboration (Henderson, Beach, & Finkelstein, 2011; Henderson, Dancy, & Niewiadomska-Bugaj, 2012; Speer & Wagner, 2009; Wagner, Speer, & Rossa, 2007). In this qualitative instrumental case study I examined the ways in which a mathematician's instruction unfolded during his participation in a faculty collaboration geared towards reforming instruction and aligning it with inquiry oriented instruction (Kuster, Johnson, Keene, & Andrews-Larson, 2017; Rasmussen & Kwon, 2007). This research provides a detailed analysis of a faculty's instructional practice, something that is currently unreported in extant literature (Speer, Smith, & Horvath, 2010). Further, his participation in the faculty collaboration was analyzed, with the ultimate goal of connecting his experiences in the faculty collaboration to changes in his instructional practice. Results indicate that faculty collaboration played a role in influecing his instruction on a holistic scale. Further results indicate that factors that influence the use of student thinking in instruction are the mathematical content itself and beliefs about that mathematical content. In this study, when the content of the course aligned with the research interests of the mathematician, even though he wanted to use student thinking, he was less likely to use his students thinking and more likely to get his students to his "way of thinking" about differential equations. Implications from this work indicate that for large scale instructional change, when faculty collaborate on instruction, they must consider their own understanding on the content.

Kathleen M. Gray
Graduate Program: Science Education
Advisors: Margaret Blanchard and Catherine LePrevost
Poster Number: 52

Informal Educators' Environmental Health Knowledge and Science Teaching Beliefs: Implications for Communicating Fish Consumption Advisories

All 50 states and some tribes and US territories issue advisories to inform people who eat locally-caught fish about potential exposure to harmful chemicals in fish. Research has shown that awareness of advisories is generally low, particularly among populations most at-risk of adverse effects; yet limited research has been conducted on the informal science learning contexts in which such communications occur and the role of educators in these contexts. The purpose of this study was to understand how advisory information is communicated and characterize the knowledge, beliefs and science teaching efficacy of informal educators who share advisory information with fishermen. Semi-structured interviews were conducted with 24 educators representing local governments, nonprofits, state agencies and universities. Participants also completed a knowledge questionnaire, a science teaching efficacy survey and a demographic survey. The theoretical frameworks of social-cognitive theory and environmental health literacy informed this study. Participants described a range of educational activities, only a subset of which were focused on advisories. Notably, none of the participants were solely tasked with advisory education, and for some, it was incidental to their positions. Participants who engaged fishermen most frequently were housed in the state wildlife agency, while those who regularly addressed advisories were housed in local governments and environmental nonprofits focused on water quality. Most participants were familiar with the harmful chemicals commonly included in advisories, and many were able to describe relevant environmental health and ecology concepts; however, the health effects of consuming contaminated fish were not well understood. Participants' science teaching efficacy scores were lower than what has been reported in other settings, and only a subset of participants described practices that suggested responsive teaching beliefs. These results underscore potential challenges to communicating advisory information and opportunities for more effectively deploying existing informal science education resources.

Jill S. Jones
Graduate Program: Curriculum and Instruction
Advisors: Angela M. Wiseman and Jill F. Grifenhagen
Poster Number: 72

Examining Small-Group Reading Instruction for Students Identified as Having Difficulty with Reading: A Multi-Case Study

This qualitative case study examined two first-grade teachers' scaffolding within daily small-group reading instruction for students identified as having the most difficulty with reading and how the scaffolds supported students' reading development. This research occurred in two first-grade classrooms at Springville Elementary School, a school in a rural town outside a larger city in the Southeastern United States. Participants consisted of the purposefully selected teachers, Emily and Julie, and seven students they identified as having the most difficulty with reading. Data collection occurred over eight weeks and consisted of participant observations, field notes, teacher and student interviews, students' reading assessment results, and instructional artifacts. Data analysis entailed the process of open coding using Miles, Huberman, and Saldaña's (2014) method of First Cycle and Second Cycle coding and collapsing data into five overall themes. The first three themes focused on teachers' scaffolding forms, the small-group instructional focus, and students' engagement with text. The final two themes addressed how students determined unknown words through teacher scaffolding and the need for varied levels of teacher support in students' word solving process. The findings from this study align with prior research on teacher scaffolding forms. Furthermore, they highlight the importance of the instructional focus, opportunities for students to read text, and the implementation of various levels of support within small-group reading instruction. These findings have implications for policy, practice, and future research.

Rebecca Kimble
Graduate Program: Teacher Education and Learning Sciences – Educational Psychology
Advisor: Margareta Thomson
Poster Number: 75

The Manifestation of Collective Attributions: Opportunities to Learn Mathematics in a Tracked Middle School

Often beginning in middle school, it is common practice for students to be placed into leveled mathematics classes based on the perception of their academic ability. In theory, these ability groups are crafted to help teachers mold their instruction to meet the needs of students. However, with students placed in leveled groups, teachers may provide inequitable learning opportunities as they grapple with the pressures of accountability measures and the desire to help students learn. The leveling of mathematics courses primes teachers to pre-judge student capabilities; judgments directly related to the types of societal beliefs that have become prominent regarding math ability. These beliefs are consequential for students because they influence the learning opportunities that teachers provide to them. This study followed an ethnographic case study design. A combination of teacher observations, observations of grade-level mathematics team meetings, teacher interviews, and team-level focus groups provided the necessary context to best understand how teachers formulate and operate upon collective beliefs pertaining to students' mathematics capabilities. Situated in a school that tracks students into leveled groups for mathematics instruction, patterns connecting these collective beliefs to the learning opportunities afforded to students have been identified. An external model of social motivation assisted with the interpretation of data. Preliminary analysis suggests that teachers are overwhelmed by the volume of school and district-level initiatives to the point where they primarily provide low-level, procedural learning opportunities to students at every perceived level. Further, the collective nature of teacher's ideas is dependent upon the amount of time they have worked together and how often they meet informally to plan and evaluate student performance.

Teresa McDonald
Graduate Program: Adult and Community College Education
Advisor: Diane Chapman
Poster Number: 104

Voices of Warrior Women: A Narrative Analysis of Female Post-Deployment Veteran Perceptions of the Transition to Two Southeastern Community Colleges

Improvements to the GI Bill in 2008 have resulted in a significant increase in female veteran enrollment in community colleges that is predicted to steadily increase through 2020 (Foster & Vince, 2009). Research on the unique transition of female post-deployment veterans from service member to community college student is timely and relevant because more female veterans are returning from deployments (after being allowed in all combat zones in 2015) and enrolling on community college campuses. Applying Schlossberg's Transition Theory, this narrative inquiry, qualitative research study explored the perception of the transition experiences of female post-deployment veterans. Conducted at two southeastern community colleges, this study also explored female post-deployment veterans' perceptions of the community college response to their unique transition needs. Preliminary findings indicate that female post-deployment veterans are sometimes operating in isolation on college campuses because there are little to no outreach or consultative efforts that are unique to their experiences and needs. Examples of these needed efforts are orientations specific to veterans, social activities and organized support for women veterans' groups, dedicated spaces within the college (not fish-bowl type), and notices throughout the college and in classrooms of services available to veterans (versus just in the building that veteran services offices are in). This research will add to existing literature on veterans (combat and non-combat) who are returning to community colleges after their military service. It will also add to the literature on the unique experiences of female post-deployment veteran transition experiences to community colleges. This research study has implications for the Department of Defense and its transition programs, women veterans' advocacy groups, and community college staff and administrators.

Whitney McLaughlin
Graduate Program: Educational Leadership, Policy, and Human Development
Advisor: Stanley Baker
Poster Number: 106

A Thematic Analysis of the Perceptions and Experiences of Self-Care Among African American Women with Multiple Sclerosis: An Exploratory Study

Emerging research suggests that out of all major racial and ethnic groups, African American women have the highest risk of developing multiple sclerosis (MS). Despite the vast research on MS, there has been little focus on African American women living with this chronic disease. Therefore, a focus on self-care among this population is needed. In counseling, self-care is essential to overall quality of life and primarily focuses on improving health and wellness. However, for individuals living with a chronic disease, self-care is more multifaceted. The purpose of this study was to explore how African American women living with MS understand and experience self-care and how their perceptions influence their overall health and wellness. Using a narrative inquiry approach, this study examined the lived experiences of two African American women living with MS to understand their perceptions of self-care and how they practice it in their lives for both health promotion and chronic illness management. Participant data were collected through semi-structured interviews. Prior to conducting the interview, participants were asked to complete a demographic questionnaire which was used to confirm established criteria for participation in the study. Two questions were used to guide this study: How do African American women with MS understand self-care and what meaning does it have in their lives? What are the experiences of self-care among African American women with MS? The data collected from participant responses were analyzed using thematic analysis. Six themes emerged from the data. The data analysis revealed that participants' experiences of self-care are impacted by their perceptions which are influenced by personal characteristics, cultural factors, and pre- and post-diagnosis experience. The results of this study provided clarity on how participants understand and perform self-care while living with a complex neurological disease like MS.

Casey Medlock Paul
Graduate Program: Teacher Education and Learning Sciences (Literacy and English Language Arts)
Advisor: Hiller A. Spires
Poster Number: 107

Critical Literacy Pedagogy: Establishing the Factors of Critical Literacy Instruction through a Mixed Methods Approach

Though prior research has examined critical literacy through qualitative case studies, no known study has conducted a cross-case mixed methods exploration of the methods used to teach critical literacy. Furthermore, in the literature, critical literacy is typically described as a theory rather than a practice. This study will employ a mixed methods exploratory sequential design (qual+QUAN) to operationalize and validate the construct of critical literacy as teacher practice and determine the factors of critical literacy instruction. The first phase of the study explored how 20 teacher educators and K-12 teachers' definitions of critical literacy and the ways they teach the construct in the classroom. Findings revealed 6 factors of critical literacy pedagogy: Relevant, Reflexive, Deconstructive, Dialogic, Empowering, and Transformative. From these findings an instrument was developed that collects data regarding teachers' instructional practices. The second phase utilized the instrument to quantitatively collect data and determine the factors of critical literacy pedagogy by using Confirmatory Factor Analysis (CFA). Results from the second phase indicated a 7-factor structure, with the 6 factors from the qualitative phase confirmed and a 7th factor, termed Intersectional, discovered. Model fit was excellent (CLI = .95; TLI = 0.94; RMSEA = .05, SRMR = .05; alpha = 0.89).

Dr. Robert L. Moore
Graduate Program: Curriculum and Instruction (now TELS)
Advisor: Kevin M. Oliver
Poster Number: 118

Analyzing MOOC Discussion Forums: Leveraging Educational Data Mining on Large Datasets

Learning analytics focuses on extracting meaning from large amounts of data and is one of the ways instructors can make informed class decisions. Amongst the largest datasets in education are those from Massive Open Online Courses (MOOCs), typically featuring enrollments in the tens of thousands. The focal points of many MOOCs, and consequently the most significant sources of data, are student discussion forums. The analysis of discussion forums within MOOCs presents many logistical issues, resulting chiefly from dataset size, and posing challenges for adequately interpreting student behaviors. This study reports on differences between the courses in word counts, complexity of sentences and measures of substantive quality of posts, including cognitive processing and analytical thinking. In this research study, the author details how the combination of Excel, the computational linguistic tool Linguistic Inquiry Word Count (LIWC; Tausczik & Pennebaker, 2010) (pronounced "Luke"), and Stata 14 were combined to analyze the substantive qualities of discussion forum posts from six HarvardX MOOCs. The data were provided by Harvard's Vice Provost for Advancement in Learning (VPAL) Research Group. Each of these MOOCs was offered in two iterations – instructor-paced and self-paced – and this study outlines the differences in discussion forum activity between these conditions. The analyzed dataset included 57,650 discussion posts generated by 13,495 students across these six courses. In the analysis of the discussion posts, no evidence was found that students in the self-paced versions of the courses had higher average cognitive processing scores than students in the instructor-paced courses. Analysis further showed that there was some evidence that students in the self-paced versions wrote longer (in terms of word count) posts, and strong evidence was found that longer (in terms of word count) posts made as discussion posts feature higher levels of cognitive processing.

Michelle Nugent
Graduate Program: Science Education
Advisor: Margaret Blanchard
Poster Number: 128

Investigating the Experiences and Persistence Factors of Underrepresented Students Enrolled in Undergraduate Biological Science Courses that Implement Active Learning Strategies

National innovation and economic development greatly benefit from the diverse perspectives of underrepresented groups. However, the Science, Technology, Engineering, and Mathematics (STEM) population is not representative of the diverse society of the United States. While university enrollment of underrepresented minority (URM) groups is increasing, there are substantially higher attrition rates for URM students in STEM majors. Through efforts to diversify the STEM population researchers have identified numerous factors that contribute to achievement outcomes and persistence of undergraduate students in STEM degrees. Promising findings suggest that implementing active learning strategies in large-lecture introductory science classes has positive impacts on student persistence factors. However, we as educators and researchers know little about which active learning strategies are most beneficial. This qualitative study investigates the experiences of students in an undergraduate biology course, with a particular focus on the relative impact of active learning strategies for underrepresented minority groups. Three educational constructs guide the development of this study: social cognitive theory, community of practice, and expectancy-value theory. The research questions investigate students' perceptions of their abilities and self-efficacy in biological science, their sense of belonging, how they identify as a STEM major and future professional, and their perceptions of how particular active learning experiences have shaped those beliefs. Data collection includes classroom observations and student interviews to assess the impact of active learning strategies in fostering a sense of community and inclusion in undergraduate biology classes. This research informs future studies to improve persistence and success of underrepresented student groups in STEM.

Meetal Shah
Graduate Program: Mathematics Education
Advisor: Jere Confrey
Poster Number: 156

Applying a Validation Framework to a Learning Trajectory on Similarity Using Learning Science and Psychometric Lenses

Significant attention is being paid to how learning trajectories (LTs) can be used as a means to locate students' progress in learning big ideas in mathematics over time and derive information to move instruction forward. That information can be used to enrich classroom discussion and to target instruction more precisely to needs. However, for LTs and accompanying classroom assessments aligned to LTs to become credible sources of evidence on student learning, it is vital for researchers to study the validity of assessments that claim to measure them. This mixed-method study reports on the application of a validity argument framework to a learning trajectory on middle grades similarity. Three years of field testing across two districts are analyzed using an Item Response Theory models to support validity claims. However, analyses of qualitative data from think-aloud interviews underscore the importance of adopting a learning science lens as well as a psychometrics lens to study the validity of assessments that function in close proximity to instruction.

Kevin G. Sutton
Graduate Program: Technology Education
Advisors: Cameron D. Denson and Aaron C. Clark
Poster Number: 169

Investigating Performance Assessment Practices in Post-Secondary Fundamental Technical Graphics Courses and Reliability of a Current Performance Assessment Method

Performance assessment is a common method of determining proficiency and what students can do with that knowledge. Students in engineering design graphics courses engage in performance tasks, such as creating technical sketches or solid computer models of parts, and instructors must determine how well students can execute tasks aligned with the course objectives. The extant literature contains documented changes in the objectives taught in the classes, skills required for industry, and methods of assessing students' proficiencies in the desired skills. Documented approaches to assessing student performance in engineering design graphics courses are presented and used for further investigation. This study examines the current performance assessment practices utilized in post-secondary introduction to engineering design graphics (EDG) courses. A survey was developed, distributed, and employed to investigate course performance objectives, the importance of performance assessment, type of work assessed, and performance practices in introductory EDG courses. Responses from current introductory EDG instructors provided insights into the current practices and guided a follow-up study that investigated the reliability of current performance assessment methods in introductory EDG courses. Three example projects of different quality were randomly selected from existing student portfolios that were stratified by the original instructor grades. Instructors from other universities assessed these projects independently, and the scores were analyzed with Kruskal-Wallis and post-hoc Dunn's tests to determine if there was a difference in the scores given by eight introductory EDG instructors. Inter-rater reliability, project, and type of work were measured to examine the consistency of ratings provided by the participants. Results of the study were consistent with other investigations of inter-rater reliability for rubrics in the field. There were some overall reliability but still room for improvement in the area of consistency for technical graphics performance assessments methods.

Shwanda Williams
Graduate Program: STEM Education
Advisors: Aaron Clark and Cameron Denson
Poster Number: 184

An Intrinsic Case Study Exploring Non-persistence of African American Students in Undergraduate Engineering

Engineering is a prominent discipline and a subset of the science, technology, engineering and mathematics (STEM) field. African American students have been found to persist in engineering majors at a much lower rate than their peers. This study seeks to present research that explores the reasons African American students do not persist in engineering at the undergraduate level in the College of Engineering and serve as an effort to institute practices that may help educators and administrators further understand this phenomenon. A single case study methodology has been carried out at North Carolina State University with 5 participants. Participants were asked to participate in one-on-one interviews in an effort to explore the case of non-persistence. This paper will introduce the self-worth achievement motivation theory as a framework to discuss the influences that contribute to the non-persistence of African American students pursuing engineering majors at the undergraduate level in the College of Engineering.

College of Engineering

Ali Ajami[1], Sanjay B. Shah[1], Lingjuan Wang-Li[1], Praveen Kolar[1], Larry Stikeleather[1], Miguel Castillo[2], and Marc Deshusses[3]
Graduate Programs: Biological and Agricultural Engineering, North Carolina State University[1]; Crop and Soil Sciences, North Carolina State University[2]; Civil and Environmental Engineering; Duke University[3]
Advisor: Sanjay B. Shah
Poster Number: 3

Windbreak wall-vegetative strip system to reduce pollutant emissions from fan-ventilated swine and poultry barns

Air emissions of gases, particulate matter (PM), and odor from livestock barns impacts the environment, public health, and quality of life. Industrial air pollution control technologies are expensive and impose excessive pressure drops which can severely restrict ventilation. Since trapping PM could substantially reduce gas and odor emissions, a porous windbreak wall (to facilitate PM deposition) - vegetative strip (to provide treatment) was used and evaluated in swine finishing and egg-layer barns. The windbreak wall was modeled using Computational Fluid Dynamics (CFD) to minimize backpressure on the fans as well as system footprint. A box-shaped windbreak wall made of mosquito screen with a 0.25-m opening at the bottom was selected. Over a year, in the swine barn where the system treated exhaust from one 1.07-m and two 1.22-m fans, the maximum pressure increase was <5 Pa while over 6 months, PM and NH3-N emissions were reduced by 46% and 17%, respectively. Limited monitoring of the switch grass and soil revealed N enrichment and reduced pH and increased conductivity in the soil. During summer and fall of 2017, in the layer barn where the system treated exhaust from one 1.07-m fan, the maximum pressure increase was <12.5 Pa while PM and NH3-N emissions were reduced by 74% and 44%, respectively. Limited monitoring of odor showed 30 fold reduction in odor concentration. In the layer house, feathers clogged down the porous windbreak wall. Thus a non-porous windbreak wall was built and is being monitored.

Zeinab Alsmadi and Ryan Schoell
Grduate Programs: Nuclear Engineering
Advisor: Djamel Kaoumi
Poster Number: 8

Grain boundary Migration and Grain Coalescence under Ion Irradiation in Nanocrystalline Copper

Nanocrystalline materials have been the subject of widespread research over the past few decades, they are structurally characterized by a large volume fraction of grain boundaries; which can significantly improve their physical, mechanical, and chemical properties in comparison with coarse-grained polycrystalline materials. Therefore, it is important to study the stability of nano-crystalline materials and understand the mechanisms of the evolution of their microstructure under irradiation in order to understand and predict the performance of these materials under irradiation before they can be used in a reactor for structural and cladding applications for instance. In this study, a nanocrystalline copper thin film of 100 nm thickness was irradiated with 1 MeV Kr ions in-situ in a TEM at ambient temperature to a fluence of 1016 ions/cm2, which allows to follow the kinetics of the observed phenomena and follow the evolution of the same population of grains under irradiation. Grain boundary migration under the impact of ion bombardment was observed for grain boundaries of higher curvature while others seemed to remain stable. In one instance, contiguous grains of limited relative mis-orientation seemed to coalesce under irradiation, a process not often reported under irradiation. The occurrence of such processes and their mechanisms are discussed in light of the available literature.

Arnab Bose
Garduate Program: Chemical and Biomolecular Engineering
Advisor: Phillip R. Westmoreland
Poster Number: 19

Understanding Pyrolysis Kinetics of Xylan and D-Xylose

Pyrolysis of xylan polymers plays a crucial role in the pre-treatment of biomass. It falls under the class of hemicellulose biopolymers, which are the least thermally stable components of lignocellulosic biomass. Different lumped models are available to understand xylan's decomposition kinetics, but little insight into various reaction pathways can be obtained from those models. To obtain a detailed view of its pyrolysis kinetics, extracted xylan from beech wood and D-xylose are flash-pyrolyzed (Pyroprobe, CDS Analytical) at 200˚C – 400˚C and gas-phase products are analyzed with GC x GC/TOFMS (Pegasus 4D, Leco). After the pyrolysis, various C/H/O compounds having zero carbon atoms (water) to eight carbon atoms were identified with at least 80 % confidence. In general, their chemical structures contain alcohol, carbonyl, ether and ester groups. Different saturated and unsaturated cyclopropanyl, cyclopentanyl, furyl, and pyranyl rings were also observed. The number of identified products was higher from xylan pyrolysis than from D-xylose pyrolysis. A higher number of linear compounds was identified in xylan pyrolysis. In order to understand the furfural yield, furfural from GC x GC/TOFMS was calibrated via the direct injection of methanol-furfural solution. A much lower g/g % furfural yield was observed in xylan pyrolysis above 300°C than that of D-xylose. The lower furfural yield in xylan pyrolysis above 300°C than that of D-xylose suggests that the xylopyranosyl backbone goes through end-chain scission, like cellulose.

Shelby Boyd
Graduate Program: Materials Science and Engineering
Advisor: Veronica Augustyn
Poster Number: 20

Tuning the Interlayer of Layered Manganese Oxides for Aqueous Energy Storage: Effects on Material Stability and Electrochemistry

Layered manganese oxides are of interest for aqueous sodium-ion electrochemical energy storage due the abundance and safety of manganese. Their structural stability and relatively high capacity retention makes them suitable for sustainable, low cost, and high safety aqueous rechargeable batteries, and energy-efficient and redox-active desalination electrodes. The complex interlayer of these oxides often includes structural water and cations such as Na+, K+, and Mg2+. Tuning the transition metal content in addition to manganese controls the oxide structure and reactivity, subsequently affecting the interlayer and electrochemical performance. While some layered, manganese-rich sodium oxides experience structural changes due to water or carbon dioxide intercalation in moist air, neither the electrochemical implications from these structural changes, nor the mechanisms of ion intercalation in neutral pH aqueous electrolytes are well understood. Further investigation is required to determine whether these materials out-perform current materials studied in neutral pH aqueous electrolytes, which experience low capacities and dissolution within the potential stability window of water. This work investigates the electrochemical behavior of the layered P2-type oxides NaxNi0.22Mn0.66M0.11O2 (where M is Co, Fe, or Cu) in neutral pH aqueous electrolytes as a function of the transition metal content. Initial studies show an irreversible phase transition to a hydrated birnessite-like structure during aqueous electrochemical cycling with approximately 25 mAh/g of reversible capacity. A systematic investigation on the effect of transition metal doping shows that adding Cu increases stability in aqueous electrolytes. The Co- and Ni-free NaxMn0.66Cu0.34O2 appears to not transform to a birnessite-like phase, suggesting that Cu reduces the electron density of interlayer O2- and minimizes interlayer repulsion with Na+ removal. This work provides an understanding of factors affecting stability of layered oxides in aqueous sodium-ion electrolytes using electrochemistry, ex situ X-ray diffraction, and transmission electron microscopy, and discusses the implications for aqueous sodium-ion electrochemical energy storage.

William Brockelsby
Graduate Program: Computer Science
Advisor: Rudra Dutta
Poster Number: 21

Software Defined Networking: Insertion Points and Instantiation Approaches

Software defined networking (SDN) is a relatively new paradigm that enables computer networks to quickly adapt to changing requirements and conditions in order to realize a variety of use cases such as traffic engineering and policy based approaches to computer networking. SDN can be deployed in an evolutionary manner alongside traditional network infrastructure to minimize both cost and risk while providing operational flexibility but the insertion points must be carefully selected. This research examines traffic patterns within typical enterprise campus networks across a variety of contexts to help identify candidate insertion points for SDN forwarding elements. This research also analyzes performance and capacity tradeoffs associated with different approaches to problem decomposition while instantiating use cases within SDN forwarding elements.

Parth Chansoria and Rohan A. Shirwaiker
Graduate Program: Industrial and Systems Engineering
Advisor: Rohan A. Shirwaiker
Poster Number: 28

Ultrasound-assisted Manipulation of Micro-particles in Fluid Matrix to Create Highly Aligned Anisotropic Composite Structures

Structural anisotropy, often observed in naturally occurring materials such as wood and human tissues, is central to the function in several engineered and non-engineered applications. In this study, we present the theory and proof-of-concept demonstration of an ultrasound-assisted non-contact manufacturing approach to create well-defined spatial patterns of micro-particles within a fluid matrix. A chamber with opposing pair of ultrasonic transducers was designed and prototyped based on standing bulk acoustic wave theory, and it was used to study the effects of ultrasound frequency (1, 1.5, 2, 3 MHz) and voltage amplitude (80, 160 mVpp) on alignment characteristics of polymer micro-particles (mean Ø = 8 μm) suspended in water (0.01 g/ml). The experimental results were consistent with theory in that the micro-particles aligned along linear strands, with the inter-strand spacing reducing with increasing frequency ($p < 0.05$). Increasing voltage amplitude reduced the time taken to align the particles, but it did not significantly change the observed spacing ($p > 0.05$). However, the observed spacing was higher than the theoretical spacing of half-wavelength, for each frequency and amplitude. The alignment of living human adipose derived stem cells in viscous alginate hydrogel matrix was also successfully demonstrated. The approach presented herein can be scaled up into manufacturing processes, including layered manufacturing, to create highly functional mechanically and/or electrically anisotropic composites through controlled spatial geometry, as well as to biofabricate engineered tissues with aligned cells and extracellular matrix components to mimic natural tissues.

Jonathan Coburn
Graduate Program: Nuclear Engineering
Advisor: Mohamed Bourham
Poster Number: 33

Innovative Plasma-Facing Materials for Fusion Devices: Erosion Characterization on the DIII-D Tokamak

Plasma-facing materials (PFMs) in future large-scale fusion reactors must be designed to exhaust thermal loads while adequately protecting in-vessel components. In particular, materials must withstand high heat fluxes from extreme off-normal events such as edge localized modes (ELMs), thermal quench phases, and plasma disruptions. A comprehensive erosion study was conducted with a plasma exposure experiment at the DIII-D National Fusion Facility. Candidate PFMs were exposed to plasma fluxes in the lower DIII-D divertor using the Divertor Material Evaluation System (DiMES). The experiment's main objective was to compare each material's erosion characteristics under reactor-relevant heat flux conditions, determining which material erodes the least in a sputtering-dominated erosion regime. The materials include polycrystalline 3C silicon carbide, MAX phase ceramic Ti3SiC2, and silicon carbide coated graphite foam, all of which were exposed alongside tungsten. For erosion loss measurements, a focused ion beam (FIB) was used to carve micrometer-scale trenches into polished sample surfaces. The micro-trenches have a well characterized depth measured via scanning electron microscopy and atomic force microscopy, as well as fiducial depth markings etched into trench walls that are shadowed from plasma impact. The integrated, post-exposure changes in trench geometry combined with in-situ diagnostics provide a measure of the average erosion rate. The candidate PFMs were successfully exposed to heat fluxes of 5-10 MW/m2 with no visible macroscopic damage. The observed sputtering patterns matched simulation predictions, and preliminary microscopy results give gross material erosion as a function of both height and radial distance from the plasma strike point. The polycrystalline SiC eroded ~10x more than Ti3SiC2, with maximum thickness losses of ~1200nm vs ~140nm, respectively. Shadowed erosion patterns also allowed for calculation of the average ion impact angle, estimated to be 30° with respect to the magnetic field and -51° with respect to the surface normal.

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Graduate Programs: Mechanical Engineering[1]; Biomedical Engineering[2]
Advisor: Kathrine Saul[1] and Jacqueline Cole[2]
Poster Number: 39

Osseous Deformities and Changes in Muscle Architecture Following a Brachial Plexus Birth Injury (BPBI): A Computational and a Rat model study

Brachial plexus birth injury (BPBI) is the most common nerve injury among children. Sequelae include shoulder postural and bone deformities. While overall presentation differs depending upon injury location relative to the dorsal root ganglion (e.g. pre/post-ganglionic), the effect of injury location on interactions of affected muscle and bone are unclear. This study investigated muscle-bone structure and shoulder range of motion (ROM) in a rat model of pre- and post-ganglionic BPBI and analyzed mechanical effects of muscle alterations on bone deformity with a novel computational tool. We used an NCSU-IACUC approved rat model to study preganglionic (n=25) and postganglionic BPBI injury (n=22). Neurectomies were performed at postnatal 3-5days on a single limb. We measured changes in glenoid morphology (micro-CT), ROM (anesthetized), and muscle architecture (laser-diffraction of muscle-tissue). Differences between groups were assessed with two-sample t-tests. Experimental measures of muscle structure were incorporated into a novel computational Integrated Iterative Musculoskeletal Modeling framework to predict glenoid morphology after 8-weeks of growth in response to biological (proportional to cell density) and mechanical (proportional to stress) stimuli. Finite element growth modeling using a thermal analog (Abaqus) was informed at each time step by boundary conditions derived from musculoskeletal modeling (OpenSim). We observed marked increase in glenoid declination (-13.24o, p=0.03) and restriction in ROM (-25.6o, p=0.001) in postganglionic injury. While preganglionic injury has more restricted muscle growth ($p<0.05$) which could increase passive forces and lead to contracture, our simulations suggest that the reduced muscle mass lowers joint loads responsible for lower resistance to passive rotation and less severe glenoid deformation (postganglionic Δdeclination=58o, Δcurvature=4.0mm; preganglionic Δdeclination=42o, Δcurvature=3.2mm). Thus, the overall effect of both restricted growth and atrophy must be considered to determine joint loading ultimately leading to bone deformity. This work provides crucial evidence for understanding the contributions to shoulder deformity in BPBI to develop improved treatment.

Lingnan Gao
Graduate Program: Computer Science
Advisor: George Rouskas
Poster Number: 49

Virtual Network Reconfiguration with Load Balancing and Migration Cost Considerations

Network virtualization is seen as a promising new way to reshape Internet. With virtualization techniques, it allows heterogeneous networks to co-exist on a shared infrastructure, and hence, it is widely considered as the most promising vehicle for research, experimentation, and deployment of innovative solutions for the next generation Internet. And yet, efficient allocation of resources is a challenging problem in a virtual network environment, especially in an online setting whereby virtual network requests may arrive, depart, or be modified in real time. Virtual network reconfiguration can help to improve network performance by remapping a subset of virtual nodes or links to better align the allocation of resources to current network conditions. To this end, we develop a virtual network reconfiguration scheme that aims to balance the load on the substrate network by dynamically reconfiguring the embedding of both virtual nodes and links. Our solution consists of decomposing the problem into two subproblems: i) virtual node selection, for which we present a multi-commodity flow based algorithm to select the virtual nodes to be migrated, and ii) virtual node remapping, for which we make use of random walk on a Markov chain to reduce the search space for the identification of new substrate nodes on which to map the migrated virtual nodes.

Raghav H. Venkatnarayan and Muhammad Shahzad
Graduate Program: Computer Science
Advisor: Muhammad Shahzad
Poster Number: 53

Gesture Recognition Using Ambient Light

Contact-less gesture recognition systems have gained significant research attention lately, with researchers exploiting patterns of user movements in ubiquitous modalities such as sound and radio frequency signals. In this presentation, we explore another such modality, namely ambient light, and describe LiGest, an ambient light based gesture recognition system that it is agnostic to changes in lighting conditions, position and orientation of users, and who performs the gestures. The general idea behind LiGest is that when a user performs different gestures, the shadows of the user move in unique patterns. LiGest first learns these patterns using training samples and then recognizes unknown samples by matching them with the learnt patterns. While the general idea behind LiGest seems straightforward, it is actually very challenging to put it into practice because the intensity, size, and number of shadows of a user are not fixed and depend highly on the position and orientation of a user as well as on the intensity, position, and number of light sources. We developed a prototype of LiGest using commercially available light sensors and extensively evaluated it with the help of 20 volunteers spanning multiple lighting environments. Our results show that LiGest achieves an average accuracy of 96.36% across all volunteers.

Koohee Han[1], C. Wyatt Shields IV[1,2], Bhuvnesh Bharti[1,3], Gabriel P. López[4], and Orlin D. Velev[1]
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Advisor: Orlin D. Velev
Poster Number: 54

A New Class of Microbots Assembled from Magnetically Interacting Metallo-Dielectric Microcubes

The directed assembly of colloidal particles into active structures represents a rapidly emerging area in soft matter, evoking intense interest due to their unusual interactions, dynamics, and structure formation abilities. They also have a range of advanced applications, for example, in miniaturized robotic devices for remote sensing, cell-level diagnostics, drug delivery, and microsurgical devices, which are typically made by reductive (“top-down”) microfabrication, but could be made much more efficiently by colloidal-scale assemblies that reconfigure on demand. I will demonstrate how magnetically responsive patchy microcubes can be assembled into self-reconfiguring microclusters and employed as microbots. The key feature of these assemblies is their storage of magnetic energy in the asymmetrically coated metallic patches in the form of residual magnetic dipoles. As a result, on-demand dynamic reconfiguration of the assemblies can be achieved by switching between directional field-dipole and dipole-dipole interactions via turning the magnetic field on and off, where the pattern of reconfiguration is encoded in the sequence of the orientation of the cubes. I provide examples of assemblies of specific sequences that can be actuated to perform microscale operations such as capturing and transporting live cells, acting as prototypes of microbots. Field-directed active colloidal clusters with sequence-determined folding pattern and function may find applications in soft robotics, microsurgery, biological separations and bioinspired colloidal origami. The principles of this simple platform actuator can be extended to future advanced, hierarchical, structures by using more complex particle shapes, compositions, and field parameters to address a broad range of exciting applications, from robotics and micromanipulation to the next generation of responsive and self-healing materials.

Zisu Hao
Graduate Program: Civil Engineering
Advisors: Morton Barlaz and Joel Ducoste
Poster Number: 55

Heat Generation and Accumulation in Municipal Solid Waste Landfills

Elevated temperatures have been reported in some municipal solid waste (MSW) landfills in North America and often require increased monitoring and management. At elevated temperature landfills (ETLFs), a number of exothermic reactions occur when MSW and other non-hazardous wastes are buried in landfills, including both aerobic and anaerobic biodegradation, anaerobic metal corrosion, acid-base neutralization, ash hydration/carbonation, and thermochemical (pyrolytic) reactions in biomass. Recently, a batch reactor model demonstrated that anaerobic Al corrosion, ash hydration/carbonation, and hypothesized pyrolysis reactions have the potential to significantly increase landfill temperature. In the batch reactor model, the landfill temperature and concentrations do not vary spatially, which is not appropriate for actual landfills. In this work, a transient finite element model was developed to incorporate gas-liquid-heat reactive transfer in a landfill with biological and chemical reactions. The heat balance equation considered the effects of heat generation from abiotic and biotic reactions, conduction, evaporation and condensation, and liquid and gas convection. The impacts of local air intrusion, local disposal of ash, anaerobic Al corrosion, the synergistic effect of ash hydration/carbonation on metal corrosion, and the spatial distribution of gas and leachate collection systems will be presented to display the accumulation and transport of heat in a landfill. Transient and spatially resolved temperature profiles will illustrate the initiation and hypothesized propagation of elevated temperature events.

Idris Jeelani
Graduate Program: Civil Engineering
Advisors: Alex Albert and Kevin Han
Poster Number: 69

Hazard Recognition- A visual search perspective

Construction workplaces report an unacceptable number of fatal and non-fatal injuries. For example, at least one fatal and many more non-fatal-injures a reported among construction workers every 9 minutes. To prevent such injuries, workers must first identify workplace hazards that can cause injuries and adopt appropriate safety measures. Unfortunately, recent research has demonstrated that construction workers fail to recognize a large number of hazards. These unrecognized hazards expose them to unexpected safety risk that increase the likelihood of injuries. To improve hazard recognition levels and reduce injury likelihood, our first study focused on answering a fundamental question: Why do construction workers fail to recognize safety hazards? Using a hazard recognition activity with construction workers, we identified 13 impediments to field-level hazard recognition from a visual search perspective. Next, we used eye-tracking technology to understand visual search patterns that are predictive of hazard recognition performance when workers actively participate in hazard recognition activities (i.e., Study 2). The results suggested that the amount of time a worker devotes to recognizing hazards (i.e., search duration), and the amount of attention measured using fixation counts and fixation time were predictive of hazard recognition performance. Using the new knowledge and understanding, the third study focused on developing and testing a Virtual Reality (VR) /Augmented Reality (AR)-based personalized intervention to improve hazard recognition skill among construction workers. The preliminary results reveal an improvement of over 40% in hazard recognition. Finally, to study visual search patterns on a large scale, we developed a vision-based system that automatically maps eye-tracking data of workers in real work-environments and computes various visual search metrics that are predictive of hazard recognition levels (i.e., Study 4). The system will provide a new mechanism to gather large-scale data that will support proactive safety management efforts. The results of the research can potentially reduce the risk of injuries among construction workers.

Laura L. Lee[1], Sara E. Blumer-Schuette[1], Javier A. Izquierdo[1], Jeffrey V. Zurawski[1], Andrew J. Loder[1], Jonathan M. Conway[1], James G. Elkins[2], Mircea Podar[2], Piet C. Jones[2], Marek J. Piatek[2], Daniel A. Jacobson[2], Michael W.W. Adams[3], and Robert M. Kelly[1]
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Advisor: Robert M. Kelly
Poster Number: 85

Re-assessment of genus-wide biodiversity of the extremely thermophilic Caldicellulosiruptor by genomic, pan-genomic and metagenomic analysis

Thirteen genome sequences and metagenomic data from Obsidian Pool (Yellowstone National Park, USA) were used to re-assess genus-wide biodiversity for the extremely thermophilic Caldicellulosiruptor genus. The pan-genome, which remains open, includes a variety of multi-domain glycoside hydrolases, some of which are co-located in the Glucan Degradation Locus (GDL) and are specific determinants for crystalline cellulose utilization. Three recently sequenced species, Caldicellulosiruptor sp. str. Rt8.B8, "Thermoanaerobacter cellulolyticus" str. NA10, and Caldicellulosiruptor sp. str. Wai35.B1 have only increased our understanding of this pan-genome, and added new carbohydrate active enzymes (CAZymes) to those previously found in this genus. All new species degraded Avicel and lignocellulose (switchgrass), with Rt8.B8 exceeding Caldicellulosiruptor bescii in this regard. Rt8.B8 differs somewhat from the other twelve species examined here, based on genome content, organization, and specific features of conserved glycoside hydrolases. Metagenomic analysis of lignocellulose-enriched samples from Obsidian Pool revealed new information for genus biodiversity. Enrichments yielded genomic signatures closely related to Caldicellulosiruptor obsidiansis, but also evidence for other thermophilic fermentative anaerobes (Caldoanaerobacter, Fervidobacterium, Caloramator, Thermoanaerobacter, and Thermovenabulum). One enrichment, a co-culture containing approximately 90% Caldicellulosiruptor and 10% Caloramator, had the highest capacity for switchgrass solubilization, comparable to Rt8.B8. Both metagenomic communities and isolates have highlighted the importance of key glycoside hydrolase domains, connecting the presence of specific catalytic protein families to cellulolytic abilities. Overall, the results presented here further define the known biodiversity of the genus Caldicellulosiruptor and also indicate that additional efforts to isolate new species could lead to more prolific lignocellulose-degrading bacteria.

Mengnan Li
Graduate Program: Nuclear Engineering
Advisor: Igor A. Bolotnov
Poster Number: 88

High-Resolution Simulation of Boiling Phenomenon using Interface Tracking Method

Boiling, as one of the most efficient heat transfer mechanisms, is widely used in various engineering systems. Better understanding and modeling of this process remains a major challenge in multiphase flow research. In light water reactor (LWR) nuclear power plants, the distribution of vapor in the reactor core sub-channels affects the heat transfer rate and may cause unfavorable conditions, such as departure from nucleate boiling (DNB) phenomenon. DNB, in turn, may cause fuel cladding damage, which may lead to reactor unplanned shutdowns and even accidents. The behavior of boiling crisis is usually dependent on local fluid conditions due to bubbles behavior and heat transfer. Therefore, high-resolution simulations which could provide more detailed information about the regimes of interest have been developed in recent years. The advances in high-performance computing (HPC) make it possible to apply interface tracking simulation (ITS) to a wide variety of bubble hydrodynamics and heat transfer studies. ITM approach provides not only detailed physical description associated with thermal and hydrodynamic processes (e.g. instantaneous velocity and temperature field) but also the shape of the interface, which cannot be obtained by other methods.

The evaporation and condensation model is developed and implemented in the ITM multiphase flow solver−PHASTA. This model is designed to resolve 3D interface in complex geometries represented by an unstructured grid. This unique capability allows us to investigate the boiling phenomenon in various conditions with lower cost compared to uniformly-refined structured meshes. To represent more accurate contact angle during nucleate boiling, the contact angle control algorithm developed in the research group has been coupled with the evaporation and condensation model. The Bubble Tracking Algorithm which collects the detailed information regarding the individual bubble is brought into the evaporation and condensation model to support multi-bubble growth simulations and collect essential heat transfer information under various boiling conditions.

Brian B. Lynch, Andrew P. Kelliher, Alexander Japit, Bryan D. Anderson, and Joseph B. Tracy
Graduate Program: Materials Science and Engineering
Advisor: Joseph B. Tracy
Poster Number: 97

Sulfidation and Selenidation of Nickel Nanoparticles

Transition metal chalcogenide nanoparticles (NPs) have been proposed for applications in batteries, solar cells, and supercapacitors because of their electrical properties. Many methods have been established for synthesizing Ni NPs. Conversion chemistry to form Ni oxide and phosphides from template Ni NPs is well understood, but sulfidation and selenidation on Ni NPs have been much less explored. The aim of this study was to develop a method for the conversion of template Ni NPs to their corresponding sulfide and selenide NPs using four different sulfur precursors and two different selenium precursors at a constant precursor ratio. Transmission electron microscopy (TEM) and X-ray diffraction were employed to analyze the reaction products. When injected into the reaction mixture after synthesizing Ni NPs, the sulfur and selenium precursors showed a particular affinity to create products with molar ratios near 50:50 S:Ni or Se:Ni, which were identified on their phase diagrams. TEM also revealed the larger size of the sulfide and selenide products (100-300 nm) relative to the Ni template NPs and voids of varying sizes in all of the NP products. This study showed not only that conversion chemistry is an effective approach for synthesizing Ni sulfide and selenide NPs with morphological control, but also that trends can be identified in how precursors control the composition and morphology of the products.

Landon Mackey
Graduate Program: Electrical Engineering
Advisor: Iqbal Husain
Poster Number: 98

Direct Current Circuit Breakers: Protecting Microgrids and Distributed Renewable Energy Resources

The world is embarking on a paradigm shift from alternating current (AC) to direct current (DC). Energy loads such as LED lighting, computers, and motor drives are growing in popularity while similarly, DC energy resources such as photovoltaic systems, battery energy storage, and off-shore energy harvesting are expanding exponentially. Achieving fast and efficient circuit protection is critical to DC system safety, with scholars focusing on hybrid direct current circuit breakers (DCCB) to facilitate next-generation DC distribution systems. However, fault isolation in distributed renewable energy systems requires additional protection and speed that is not yet available for medium-voltage DC systems. NC State University, in collaboration with the North Carolina Coastal Studies Institute, is addressing DC system protection challenges with high speed, high efficiency, medium-voltage DCCB devices and DC Microgrid protection coordination strategies. In our work, DC system dynamics were explored using advanced computer modeling, simulation, and laboratory experimentation. Using the discovered DC system characteristics, we proposed and constructed a new ultra-fast mechanical switch and an advanced solid-state switch control scheme to develop a bidirectional, millisecond-level, hybrid DCCB. Our coordinated operation of the new mechanical and solid-state switches is capable of fault isolation in medium-voltage DC systems in 2 milliseconds. This vastly improves upon the 60 millisecond actuation time of prior-art electromechanical circuit breakers. The new hybrid DCCB design and control system is being produced in conjunction with other facilitating technologies to develop a next-generation smart DC Microgrid distribution system. This bidirectional, medium-voltage distribution system enables harvesting clean and sustainable energy from the wind, sun, and ocean while promoting a more robust and adaptive infrastructure to ever-changing global energy needs.

Adam Mischler, Jessica Mahinthakumar, and Balaji Rao
Graduate Program: Chemical and Biomolecular Engineering
Advisor: Balaji Rao
Poster Number: 111

The Differentiation of Trophoblasts from Human Embryonic Stem Cells: Understanding the Signaling in Early Gestation

Specification of the inner cell mass (ICM) and the trophectoderm (TE) is the first major differentiation event in the developing human embryo. The ICM ultimately forms the developing fetus while TE gives rise to the major trophoblast (TB) cell types of the placenta – the villous cytotrophoblasts (vCTBs); syncytiotrophoblast (STB); and the extravillous cytotrophoblasts (EVTs), which comprise the column cytotrophoblast (cCTB) and invasive cytotrophoblast (iCTBs). Our understanding of human TB differentiation and early placental development is limited due to ethical and regulatory constraints on research with human embryos, limited availability of primary tissue samples from early gestation, and lack of a suitable in vitro model system. In this context, TBs derived from human embryonic stem cells (hESCs) emerged as an attractive system for mechanistic studies on TB development. Previous studies in our group have shown that the activin/nodal signaling pathway plays an important role in the terminal fate specification of hESC-derived TB. Here we expand upon this work to develop a completely defined and serum free culture system for generation of bona fide TB from hESCs. We show that the bioactive phospholipid Sphingosine-1-Phosphate (S1P) is required for generation of TB in hESCs in the absence of serum. Furthermore, we show that both Rho/ROCK signaling and activation of Yes-associated Protein (YAP) are required for establishment of bona fide TB from hESCs. Significantly, this system elucidates the signaling pathways for determining TB fate and the role of lipid-mediated signaling in TB specification from hESCs. This media system provides an attractive new way of studying bona fide TB and deliver new insights to TB differentiation and development.

Adele Moatti, Ritesh Sachan, John Prater, and Jagdish Narayan
Graduate Program: Materials Science Engineering
Advisor: Jagdish Narayan
Poster Number: 113

Electrical and structural phase transition correlations in VO^2 thin films

VO^2 is currently used to make infrared sensors, however, there are some problems such as limited lifetime and delayed response time. For military applications, sensor technology needs to be able to sense, manipulate, and respond to data quickly. For this purpose understanding, the sensing mechanism in VO^2 is critical. Unstrained VO^2 single crystals undergo structurally (from elevated temperature tetragonal to low-temperature monoclinic phase) and electronic transitions, simultaneously. In thin films, however, in the presence of epitaxial strains, structural (Peierls) and electronic (Mott) transitions are affected differently, and are separated. In this study, we have used in situ X-Ray diffraction measurements to study the structural (Peierls) transition and employed resistance measurements to investigate the electrical (Mott) transition in epitaxially grown vanadium dioxide films on c-sapphire substrates. The structural transition shift is discussed using a combined kinetic and thermodynamic approach, where the velocity of phase transformation is controlled largely by kinetics, and the formation of intermediate phases is governed by thermodynamic considerations. The electrical transition shift is explained by d-orbital occupancy and changes in the bandgap. A delay is found between the onset of structural and electrical transitions in the presence of strains, which is explained by our model. With this study, we suggest that the control of structural and electrical transitions is possible by varying the transition activation barrier and bandgap through strain engineering. This control and tuning will impact the design of VO^2 smart sensors.

Hamed Mohammadbagherpoor
Graduate Program: Electrical and Computer Engineering
Advisor: Edward Grant
Poster Number: 114

Hip Prosthesis Loosening Detection Using Inductive Proximity Sensors

Recent Electromagnetic (EM) research plays an important role in biomedical applications; because it helps surgeons diagnose diseases without exposing patients to radiation from the imaging devices. There are numerous applications of EM in biology: (1) imaging techniques using EM field, (2) in vivo applications, implantable devices for monitoring the health and body functions, and (3) diagnosing the diseases and cancers.

A total hip joint replacement is one of the most common surgeries worldwide. In this procedure, the hip is replaced by a prosthesis. Although there are over ten million of these prosthetic implant surgeries every year worldwide, none includes embedded sensors to detect any loosening of the implant prosthesis. A variety of methods are used to detect the loosening of implants. First, imaging techniques are the primary technique used to detect loosening, but imaging methods are unreliable in early detection and dangerous for long-term use due to the radiation exposure. Second, vibration methods are used. Here, the implant is excited by an external vibrometer and the induced vibration of the implant is captured by sensors. Analyzing data recorded in the frequency domain does help to detect the loosening of a prosthetic implant; however, these methods do not accurately measure the extent of the loosening.

The main goal of this study was to design an electronic sensor system, one based on an inductive sensor, that can be implemented inside the bone to detect the early loosening of an implanted prosthesis. The electronic system then detects implant loosening by analyzing the electromagnetic (EM) field, generated by the inductive proximity sensor, around the implant. The EM field transfers energy into the implant and that generates an eddy current. The induced eddy current alters the inductance of the proximity sensor, the inductance value is then a function of implant displacement. By measuring the inductance of the proximity sensor, the extent of the loosening of the implant can be determined.

Siddhartha Nambiar and Maria E. Mayorga
Graduate Program: Industrial and Systems Engineering
Advisor: Maria E. Mayorga
Poster Number: 121

Resource Allocation Strategies Under Dynamically Changing Health Conditions

Consider patients being treated for a disease (such as Sepsis), whose condition changes over time. Resources allocated to a patient influence disease progression and outcomes. Our goal is to allocate the limited number of resources to patients, depending on their health states, to maximize outcomes. We formulate an MDP model with resources allocated dynamically, and a jackson queueing network, where the number of resources is assigned in advance. The performance is then tested against existing practices and heuristics.

Lokesh Karthik Narayanan, Rohan Shirwaiker, and Binil Starly
Graduate Program: Industrial Engineering
Advisor: Rohan Shirwaiker
Poster Number: 122

Non-destructive Quality Assessment of 3D-Biofabricated Constructs using Dielectric Impedance Spectroscopy

3D biofabrication processes focus on the manufacturing of engineered living systems using cells and biomaterials. The ability to assess critical quality attributes of the biofabricated constructs (e.g., viable cell number, size, and metabolic activity) in real-time using non-destructive methods is a critical enabler for the scale-up and translation of these processes. Current state-of-the-art quality assessment methods are destructive in nature and involve immunostaining or biochemical assays developed primarily for 2D cell environments. This study focuses on dielectric impedance spectroscopy as a new non-destructive non-invasive method to assess the critical quality attributes of 3D biofabricated constructs. The first objective was to determine if the changes in cell concentration (2 to 5 million cells/mL) and cell type/size – osteosarcoma cells (Ø = 14 μm) and human adipose-derived stem cells (hASC) (Ø = 22 μm) – had a detectable effect on the dielectric parameters of cellular constructs – relative permittivity ($\Delta\varepsilon$), critical frequency (fc), and Cole-Cole-alpha (α). We have also determined the effect of cell viabilities of constructs containing 5 million hASC (n=3) with viabilities of 100%, 85% and 50% on DIS parameters. Finally, we have investigated the ability of DIS to identify cell quality attributes of 3D bioprinted constructs associated with the changes in 3D bioprinting process parameters. Results show that cell concentration and cell type had a statistically significant effect on $\Delta\varepsilon$ and α (both $p < 0.05$) whereas fc varied with cell type. Results also show that cell viability significantly affected $\Delta\varepsilon$ and α (both $p < 0.05$). Early results support the feasibility of using dielectric impedance spectroscopy to monitor the quality of 3D bioprinted constructs.

Vivek Samu
Graduate Program: Civil Engineering
Advisor: Murthy Guddati
Poster Number: 152

Effective Dispersion Analysis of Reflections: A Nondestructive Evaluation Method for Estimating Embedded Pile Length

Bridge foundation, for which the foundation length is unknown, can be susceptible to scour and this has been a longstanding problem threatening the safety of bridges. There are still about 28,000 highway bridges with unknown foundations in 2016 according to the National Bridge Inventory records along with numerous other local bridges facing the same issue. Several methods have been developed over the years, including the sonic echo/ impulse response method, bending wave method, borehole methods and many extensions and modifications of these methods. The borehole methods are considered reliable but are expensive, and the surface based methods are inexpensive but lack the same level of reliability as borehole methods. Towards filling this gap, we developed a new surface based NDE method named Effective Dispersion Analysis of Reflections (EDAR), that is shown to be accurate and reliable. The method is based on accurately capturing the wave dispersion as it propagates through the pile, and applicable to both longitudinal and bending waves. Specifically, EDAR processes measured accelerations at two distinct locations on the pile due to hammer impact, resulting in an estimate of pile length, by examining the phase oscillations due to reflection as a function of wavenumber. Experimental validation of EDAR was conducted using side impact on concrete filled steel tubes, consistently resulting in less than 5% error in laboratory setting, and about 10% in field conditions.

Bharadwaja S.T.P.[1], Richard J. Spontak[1,2], Reza A. Ghiladi[3], and Behnam Pourdeyhimi[4]
Graduate Programs: Chemical and Biomolecular Engineering[1]; Materials Science and Engineering[2]; Chemistry[3]; The Nonwovens Institute[4]
Advisors: Richard J. Spontak and Reza A. Ghiladi
Poster Number: 165

Photoactive Polymers for Anti-Infective Materials

Increase of antibiotic resistance in pathogens has directly impacted healthcare industry. With only a few novel discoveries in the field of antibiotics since last two decades, often referred to as the discovery void, drug-resistance in pathogens has increased. Previously, infections that were easily treatable have now become fatal. Infections caused by antibiotic-resistant pathogens can occur anywhere, but, it is observed to take maximum effect in healthcare settings such as hospitals and nursing homes. Adherence and proliferation of microbes on surfaces such as counter tops, drapes, linens, door handles, monitory and sanitation equipment in health-care settings contribute to increase in HAIs. As increase in microbial drug resistance causes conventional methods of treatment to fail, researchers are looking at alternative routes to tackle the infections. Photodynamic therapy (PDT) is such a technique that uses a photosensitizer (PS) and a light source, to treat medical conditions such as acne, wet-age macular degeneration and initial stages of skin cancer. Initially, the PS is applied on a target area of cancer cells. Subsequently, the target area is illuminated by visible light (typically of red color), thus, activating the PS. The activated PS, through interactions with ground state triplet oxygen diffusing through the cells, converts it into singlet state oxygen. Being very reactive, singlet oxygen can oxidize various components in the cancerous cells leading to its death. Rather than a cure by intracellular absorption, we intend to incorporate the PS on surfaces that will result in inactivation of microbes by continuous surface disinfection and serve as a preventive measure.

In this study, we have incorporated a PS, belonging to the porphyrin class, in an olefin block copolymer (OBC). Melt pressed PS/polymer films were prepared. Thermal gravimetric analysis (TGA) revealed that OBC and PS were thermally stable up to 330°C and 250°C respectively. Scanning electron microscopy (SEM) and Energy-dispersive x-ray spectroscopy (EDX) analysis showed dispersion of PS on the surface of the films. Time-of-flight secondary ion mass spectrometry (ToF-SIMS) analysis revealed higher concentration of PS on surface relative to the bulk concentration. Five bacterial and two viral strains were tested and all showed at least 99.9% inactivation after 60 min exposure to non-coherent visible light.

OBC, typically manufactured for nonwoven applications and PS being thermally stable up to 450°C, are potential materials to produce melt spun fibers. Higher concentration of PS leads to increased antimicrobial efficacy. Hence, surface migration of PS is beneficial to the antimicrobial efficacy of films. The films showed excellent antimicrobial properties at ~1% w/w PS concentration. The mechanism of disinfection will be continuous and would be superior to other conventional methods such as chemical antimicrobial agents or radiative techniques. In the future, more robust materials and method of incorporation of PS will be explored along with durability studies.

Arun Vishnu Suresh Babu
Graduate Program: Mechanical and Aerospace Engineering
Advisor: Ashok Goapalarathnam
Poster Number: 200

Low order aero-elastic model for wind-energy harvesting mechanism

Piezoelectric energy harvesting devices driven by aero-elastic vibrations have been studied by various researchers in the past few years. These could be used as an alternative or to complement existing environmental energy harvesters. This work aims at developing a low-order model for extracting energy from an oscillating airfoil mounted on elastic supports. Low order theoretical aerodynamic models can deliver sufficiently accurate results in much less time compared to extensive numerical simulations or experiments. They can be used to gain insight about the system behavior in huge parameter spaces during initial design phase. An unsteady aerodynamic theory called LDVM (LESP-modulated Discrete Vortex Method) developed in previous research has the capability to predict Leading Edge Vortex (LEV) shedding from airfoils undergoing pitching or plunging motion. LDVM is a time-stepping method in which the flowfield is modeled using discrete vortices shed from the leading and trailing edges of the airfoil. DVs are shed from the leading edge based on the criticality of a Leading Edge Parameter (LESP) while DVs are shed from the trailing edge based on Kelvin condition. An aero-elastic model of a rigid airfoil supported by elastic springs in pitch and plunge degrees of freedom based on LDVM exhibited self-sustained limit cycle oscillations in flow regimes dominated by LEV shedding. The current work focuses on implementing a model-reduction strategy to control DV count in this model by amalgamating DV pairs. It is proposed to augment the aero-elastic model with an electrical sub system that converts the mechanical energy of the aero-elastic limit cycle oscillations of the airfoil into electrical energy. The resulting model with a coupling between the electrical, aerodynamic, and electrical properties of the system can be used in the design of future piezoelectric energy harvesting systems based on LCOs.

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Advisor: J. Casey Dietrich
Poster Number: 173

High-Resolution Modelling of Surge during Hurricane Matthew (2016)

This research addresses the question of how changes in the timing or speed of a hurricane can change the amount and extent of coastal flooding. Storm surge due to hurricanes can cause significant damage to property, loss of life and long-term damage to coastal landscapes. Hurricane Matthew was a category 5 storm that made landfalls along the coasts of Haiti, Cuba, Grand Bahama Island and South Carolina during October 2016. This research employs the spectral wave model Simulating Waves Nearshore (SWAN) and the shallow water circulation model Advanced CIRCulation (ADCIRC): a coupled model that has achieved prominence in coastal flood forecasting and analyses. Results have indicated that the model was able to accurately predict water levels and peak surges during Matthew in comparison to observations along the U.S. east coast. The impact of Matthew varied significantly along the U.S. east coast and we hypothesize that this is due to the storm interacting nonlinearly with tides. By changing the time of occurrence of the storm by both half and full tidal periods, it was seen that there were differences in storm surge along the coast due to regions coinciding with different periods in the tidal cycles. These differences were as high as one meter at certain locations. Looking at the influence of the storm forward speed on the surge, it was seen that as the speed of the storm was reduced, there was an increase in flooding due to the storm having more time to impact the coastal waters. The faster storm moved quickly across the shoreline, thus flooding only a narrower section of the coast.

Anurodh Tripathi
Graduate Program: Chemical and Biomolecular Engineering
Advisors: Saad A. Khan and Orlando J. Rojas
Poster Number: 175

Recipe to synthesize aerogels with tunable properties: from design principles to application

In last decade, aerogels gained attention in insulation applications due to their extremely low thermal conductivity. Aerogel's additional properties such as a high pore volume and light-weight also make them an attractive material in automotive and aviation industry, interior design, specialty garments such as a bulletproof vest, fire-retardant suits, protective gear and many others. In spite advances in the field of aerogel synthesis, the fundamental understanding of aerogel development in relative to their density and mechanical properties is lacking. A high strength to weight ratio of an aerogel is highly dependent on its density, and the reduction in aerogel density is usually achieved by reducing the precursor concentration. However, this approach compromises the mechanical integrity of the corresponding aerogel. To overcome this current limitation, we introduce a versatile recipe to synthesize aerogels with a range of mechanical properties from a given precursor polymer concentration. The design recipe, based on the solubility parameters approach allowed us to synthesize aerogels from cellulose acetate with mass densities ranging from 0.02 to 0.11 g/cm3. Consequently, it was possible to tailor the stiffness, toughness and compressive strength of the aerogels, in the ranges between 14-340, 4-103 and 22-373 kPa, respectively.

An extremely high pore volume (>98%) of these aerogels inspired us to use them in oil-spill remediation. Current approaches to deal with oil-spill include oil skimming, in-situ burning, mechanical containment and utilization of dispersants. However, all these methods are either inefficient or heavily detrimental to the ecosystem. The cellulose acetate aerogels used in our study demonstrate unprecedented oil and water uptake of 92 and 112 g/g of aerogel respectively while affording wet-strength. These aerogels are reusable and they do not disintegrate in the rough oceanic environment, which prevents the risk of any secondary contamination.

Andrea Villanes
Graduate Program: Computer Science
Advisors: Christopher G. Healey and Michael Rappa
Poster Number: 180

Dengue Fever Surveillance in India Using Text Mining in Public Media

Despite the improvement in health conditions across the world, communicable diseases remain among the leading mortality causes in many countries. Combating communicable diseases depends on surveillance, preventive measures, outbreak investigation, and the establishment of control mechanisms. However, delays in obtaining country-level data of confirmed communicable disease cases, such as dengue fever, are prompting new efforts for short- to medium-term data. We propose an alternative method for near real-time estimation of disease outbreak, spread, and response based on text analytics of public media sources like newspapers and social media. Our method includes extensive topic analysis, and the creation of a communicable diseases sentiment dictionary, which has not been used before in public health surveillance systems. We will support the: (a) identification of topics extracted from epidemiological news articles using text mining cluster analysis; (b) comparison of existing text mining classification techniques to accurately predict news article topics; (c) creation of a communicable disease sentiment dictionary by extending an existing dictionary with epidemiological terms and their associated sentiments. Our main findings to date are to: (a) uncover topics from news articles that discuss dengue in Asian countries; (b) analyze the life cycle of dengue news articles in India; (c) relate the topics to rainfall, monthly reported dengue cases, and the Breteau Index. We show that the five main topics discussed in the newspapers in Asia in 2014 correspond to (a) prevention; (b) reported dengue cases; (c) politics; (d) prevention relative to other diseases; and (e) emergency plans. We identify that rainfall has 0.92 correlation with the reported dengue cases extracted from news articles. Based on our findings, we conclude that the proposed methods facilitate the effective surveillance of dengue fever. Moreover, this tool can be used as the basis to monitor not only dengue fever, but other communicable diseases in the future.

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Advisor: Michael A. Daniele
Poster Number: 189

Multiplexed Cardiac Biomarker Assay

B-type natriuretic peptide (BNP) is a cardiac-derived neurohormone regulated by intra-cardiac pressure. N-terminal pro-B-type natriuretic peptide (NT-proBNP) is a bio-inert product of BNP production, and it has been identified as a key biomarker in blood for cardiac distress. Rapid, point-of-care quantification of NT-proBNP concentration is challenging because accurate recognition in blood samples is often masked by interference of BNP. Most commercially available antibodies for NT-proBNP have relatively high cross-reactivity with BNP. Recently, monoclonal antibodies were engineered with high specificity to the tail, i.e. cleaved region, of NT-proBNP. Herein, we present the design and characterization of a novel, disk-based lateral flow sandwich assay for NT-proBNP that is faster, more accurate, and with lower limits of detection than current industry standards.

Bio-layer interferometry was used for preliminary screening of the commercially available antibodies for NT-proBNP. The antibodies were modified in the Fc region with biotin-hydrazide and binding constants (KD) were measured. Based on preliminary results, capture-detection pair, 15C4-29D12 was selected for use in the study. Variants with the greatest affinity for NT-proBNP versus BNP were selected for integration into the assay. Both antibodies were evaluated as the primary capture ligands via coupling with amine-functionalized quantum dots (QDs, λemission=450 nm) by orthogonal reaction with the Fc region.

A multi-chamber microfluidic PMMA disk was fabricated to pair with a motor capable of high rotation speed resolution. The force needed to move from chamber to chamber was modified to control sample dwell time with both capture and detection antibodies. After rinsing, the capture chamber was illuminated by a UV light source (λemission=360 nm), which was then filtered so that only the 450nm emitted by the QDs reached the photodiode. This signal is amplified by a transimpedance amplifier and correlated back to a known concentration of NT-proBNP fit to a calibration curve.

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Advisor: Michael A. Daniele
Poster Number: 196

Epidermal Biosensor Platform with Variable Recognition Elements

Wearable sensors offer new opportunities for continuous monitoring of human physiology and wellness. There has been a growing interest in sweat and interstitial fluid (ISF)-based biochemical sensors in the last decade for measurement of human biochemistry. Sweat and ISF contain biomarkers that are closely related to human metabolism and respiration (e.g., metabolites, electrolytes). Therefore, there is a need for flexible epidermal systems with biofluid extraction, sample handling and multiplexed biomarker sensing capabilities. Herein, we present our initial efforts towards development of an epidermal biosensor platform for ISF extraction and multiplexed measurement of biomarkers of cellular metabolism (e.g., glucose, lactate, oxygen and pH). The platform includes nanocellulose-based microneedles for ISF extraction and fluid handling. It employs amperometric and optoelectronic sensing techniques for cutaneous detection of metabolically relevant analytes (i.e., glucose and lactate) and arterial blood oxygenation, respectively. The amperometric sensing scheme implements a multi-array electrode detection technique to increase the precision and sensitivity of glucose and lactate detection from biofluids. Up to date, we developed nanocellulose-based microneedle arrays of various sizes and characterized initial fluid handling capabilities. Moreover, we demonstrated detection of glucose, lactate and pH levels in physiologically relevant range (<1 mM and pH 3-8). This platform enables a wide range of applications such as diabetes management, cardiovascular disease and, athletic performance monitoring.

Omid Yousefian[1,2], Rebekah White[2], H.T. Banks[2], and Marie Muller[1,2]
Graduate Programs: Mechanical and Aerospace Engineering[1]; Center for Research in Scientific Computation[2]
Advisor: Marie Muller
Poster Number: 197

Inferring Micro-Architecture Parameters from the Ultrasonic Attenuation in Cortical Bone

Osteoporosis changes the micro-structure of both cortical and trabecular bone which leads to fragility fractures, higher morbidity and mortality, and reduction of life expectancy by 1.8 years. The micro-architecture of cortical porosity impacts the macroscopic mechanical properties of cortical bone. It is therefore highly relevant to develop methods for the quantitative assessment of the micro-architecture of cortical porosity, and we hypothesize that tracking the micro-structural changes in cortical bone could benefit the diagnosis of osteoporosis and may enable treatment monitoring. The correlation between micro-architectural and ultrasonic parameters could be a key factor for the ultrasonic characterization of the micro-architecture of cortical bone.

The overall goal of this research was to investigate a phenomenological relationship between parameters of the porosity (pore density and diameter) and frequency dependent attenuation. In order to do this, we developed a phenomenological model that describes the attenuation of ultrasonic waves in cortical bone. We changed the micro-structure of the bone models by changing the pore size and pore density. We numerically generated data using a finite-difference, time domain SimSonic research freeware, which simulates elastic waves propagating in heterogeneous media. We then fit the developed phenomenological model to the simulated data using an ordinary least squares framework for the inverse problem. With the resulting estimates, we performed local sensitivity analysis and calculated confidence intervals for the parameters estimated.

With this we could propose a model as $\alpha(f) = a(\varphi,\rho)fb(\varphi,\rho) + c$, where the sensitive model parameters (“a” and “b”) are themselves a function of the micro-architectural ones. With a model of this form, one could infer pore diameter and density from the estimates of “a” and “b”. We determined via analytical partial derivatives that the model is not sensitive to “c”. We also determined that the model sensitivity to the parameter estimates depends on pore diameter(φ) and density (ρ). Namely, for small diameters (20 – 40 micron) the model is sensitive mainly to estimates of “a”; whereas for large diameters, (100 micron) the model is sensitive mainly to estimates of “b”. For intermediate diameters (60-80 micron) sensitivity depends on pore density, where the model is more sensitive to “a” at low densities and more sensitive to “b” at high densities. In general, the 95% confidence intervals for these estimates were wider at high densities (ρ>14 pore/mm2).

Benjamin Zeldes, Andrew Loder, Christopher Straub, and Robert Kelly
Graduate Program: Chemical and Biomolecular Engineering
Advisor: Robert Kelly
Poster Number: 199

Recovering chemolithoautotrophy in Sulfolobus acidocaldarius: progress and potential applications

Autotrophy is at the core of all bio-based chemicals and fuels production. While most biofuels research has relied on the photoautotrophy of plants, chemolithoautotrophic microbes offer the potential to use energy from inorganic chemicals to fix carbon directly into a chemical molecule. Sulfolobus acidocaldarius (Saci), and other members of the crenarchaeal order Sulfolobales are extreme thermoacidophiles growing optimally above 70°C and below pH 3. Some species grow chemolithoautotrophically by oxidizing sulfur and fixing carbon dioxide via the 3-hydroxypropionate/4-hydroxybutyrate (3HP/4HB) carbon fixation cycle, genes for which are found throughout the order.

Current understanding of sulfur oxidation in the Sulfolobales is limited to in-vitro studies of a few key enzymes, however we have been able to study multi-enzyme interactions of the 3HP/4HB pathway by heterologous expression of multiple enzymes in other archaeal thermophiles. A recently developed genetic system for Saci opens up the possibility of performing pathway studies within a member of the same Order. While current lab strains of Saci do not grow autotrophically, comparison with the genomes of related species that do suggests only a few genes are missing, meaning it can be used to express a combination of the most interesting metabolisms found within the Sulfolobales.

Addition of a single gene from the closely related S. tokodaii was sufficient to allow Saci to oxidize elemental sulfur to sulfuric acid, and a second gene results in even higher oxidation rates and hints at possible synergistic pathway effects. Portions of Saci's native 3HP/4HB cycle have been proposed as routes for biological production of various chemicals, facilitating attempts to turn it into a microbial platform for biochemicals production. We propose genetically modified S. acidocaldarius strains as a means to use elemental sulfur as an unconventional bioenergetic feedstock to generate fuels and chemicals, with sulfuric acid as a co-product.

Kaiyue Zeng
Graduate Program: Nuclear Engineering
Advisors: Jason Hou and Kostadin Ivanov
Poster Number: 168

Uncertainty Quantification on Pressurized Water Reactor Coupled Core Simulation Using Stochastic Sampling Method

In nuclear reactor design, traditional approach to meet the safety criteria was to make conservative modelling assumptions. Although the required safety margins could be satisfied, this approach usually tends to produce excessive conservatisms. In recent years, best estimate predictions with confident bounds is regarded as an alternative approach and OECD/NEA has developed an international UAM benchmark for the examination of various code systems and uncertainty propagation methodologies. The objective of the present work is to develop an uncertainty propagation mechanism using stochastic sampling method considering the uncertainties from both neutron kinetics and thermal-hydraulics calculations in the simulation of Pressurized Water Reactors (PWRs) using the conventional best-estimate simulation methodology. More specifically, the Three Mile Island Unit 1 (TMI-1) core based on the LWR-UAM benchmark specification has been modelled using the coupled neutronics/thermal-hydraulics code system TRACE/PARCS with a 3-D neutronics model and a 3-D thermal-hydraulics reactor core model.

The input uncertainties of the neutronics simulation include the few-group cross sections and kinetics parameters, and several heat transfer related variables were considered as sources of input uncertainty of the thermal-hydraulics (TH) simulations, including thermal conductivity of fuel and cladding, and the gap conductance. Two types of simulations have been conducted: steady-state hot full power core conditions and transient core behavior initiated by the spatially asymmetric rod ejection accident (REA). The safety performance of the reactor was evaluated by calculating the best estimated results with associated uncertainties of core peak reactivity and peak temperatures.

College of Humanities and Social Sciences

Lala AlSaeedi
Graduate Program: Master of Arts in Liberal Studies
Advisor: Shelley Garrigan
Poster Number: 7

Educational Programs in Refugee Camps. What type of educational program would address the needs of youth and adult refugees in camps?

How effective are current educational programs in refugee camps? And what types of education can be provided for young and adult refugees in camps? These are the questions that the paper of this project aims to discuss. Currently, educational programs that target the adult population in refugee camps are limited. Typically, the available program include handcrafts, art and music, photography, English and computer courses (basic skills), and training in development of other simple skills. In this study, I explore a model of an effective and successful educational program -- specifically, The Leadership Center (TLC) of Honduras -- and propose that with further research, the program can be developed and offered to young and adult refugees in camps. In addition, I will provide a general view of the current educational programs offered in refugee camps; one refugee camp was selected for this purpose: Zaatari camp in Jordan. The data collected and presented in the paper is based on media reports and documentaries, and reports of aid agencies operating in refugee camps, including UNHCR, UNICEF, UNESCO, DVV-International, NRC, ILO, AVSI, BBC Arabic, Sky News Arabia, and DW Arabia. In addition to these references, I will conduct two interviews with the directors of two successful educational initiatives: QuestScope programs (Zaatari refugee camp), and The Leadership Center program. Ultimately, I argue that in addition to being a source of empowerment and stability (employment opportunities), effective educational programs help build bridges among refugees, build trust towards aid agencies, and, most importantly, restore self-confidence, and sense of achievement and dignity to refugees and their communities.

Claire Carrington
Graduate Program: Communication
Advisor: Nicholas Taylor
Poster Number: 24

'I'll Support You': Communication Work in Maintaining an Inclusive Collegiate League of Legends Club

E-sports, which possess many of the same elements as other sports such as competition and spectatorship, continue to explosively grow and thrive on college campuses with significant funding dedicated to e-sports scholarships. Many such collegiate organizations centered around League of Legends (League) by Riot Games. A surprisingly diverse group of participants on campus, including officers predominantly consisting of women of color, have established and maintained an e-sports club focused on League and committed to inclusivity since 2014. As a participant observer, the researcher attended club meetings and played games with the club, alongside conducting in-depth interviews with the current club officers and members, in order to describe these practices. This research is part of an ongoing ethnography aiming to document the communicative practices and efforts necessary to maintain a supportive space for diverse participants to play and socialize. It strives to bring to light the efforts necessary to construct and maintain such a supportive space in an area traditionally centered around competition and dominance, particularly through the lived experiences of its officers and members. Some major themes that I have identified include the use of humor to address potentially problematic or 'toxic' behavior, officers' organization of social support, and the role of the players' physical environment in shaping the culture and activities of the group. Future research should follow the trajectory of this club, addressing how the meaning of diversity evolves and changes over time for participants in the club in addition to how the rising publicity of eSports influences such a socially-based club.

Sarah C. Neal, Mary E. Haskett, and Kate Norwalk
Graduate Program: School Psychology
Advisor: Mary E. Haskett
Poster Number: 25

Patterns of behavioral adjustment and social skills of children in Head Start who are unstably housed.

Young children residing in transient housing demonstrate higher rates of mental health and behavioral problems compared to low-income, housed children (Bassuk et al., 2015). However, variability has been found in the adjustment of children who are unstably housed and many of these children appear to be resilient to the potential negative impact of homelessness (Huntington, Buckner, & Bassuk 2008; Masten, Cutuli, Herbers, Hinz, Obradovic, & Wenzel, 2014). The purpose of this research project is to identify differential patterns of behavior adjustment and social skills among high-risk children residing in transient housing who attend Head Start. This study used extant data from the Head Start Classroom-based Approaches and Resources for Emotion and Social skill promotion (CARES) study for this investigation. 307 classrooms participated from 107 Head Start Centers. Teachers rated the behavioral adjustment and social skills of 2114 three and four year old children at baseline. This study includes 321 children whose parent reported that they are residing with friends or relatives. Measures included teacher report on the Behavior Problems Index, Social Skills Rating System, and the Cooper Farran Behavioral Rating Scales. Latent Profile Analysis was used to identify subgroups of children based on patterns of internalizing behaviors, externalizing behaviors, and social skills. Results of this study indicate that there is variability in social and behavioral adjustment among four-year old children attending Head Start who are residing in “doubled-up” settings. While some children show clinical levels of behavior difficulties, many of these children demonstrate low levels of behavior difficulties and strengths in social functioning. The variability in social and behavioral functioning indicates a need for varying levels of intervention intensity.

Maureen Catlow
Gradute Program: International Studies
Advisor: Stacy Nelson
Poster Number: 26

Solar Panel Site Suitability in North Carolina: Opportunities for Scaling International Development Projects

The use of LiDAR or DEM data in conjunction with open-source satellite imagery can be leveraged as accessible information sources and tools for sustainable growth and development. The objective of this small research project is to produce an initial analysis of site suitability for solar panel installation using publicly available LiDAR and satellite imagery. The goal is to highlight the value of GIS analysis and scalability of this technique for large-scale international projects. This research requires a “multi-step geoprocessing analysis of open-source data through ArcMap. Initially, satellite imagery will be classified to identify land-use coverage and then overlaid with a slope data extracted from LiDAR sources. This will be reclassified to show appropriate places for solar installation, and what those attributes of those locations (area, slope, relation to building locations) are. The results of this small, scalable research project determine if locations have suitable attributes for solar panel installation. This project focused on Research Triangle Park, North Carolina and found that this tract of land was not suitable for solar panel installation for both economic and geospatial reasons.Potential direct applications for this method include sustainable development planning into urban and suburban landscapes. Considering the new political landscape surrounding sustainable energy in addition to the new tax on solar panel materials, this may serve as a better international intervention plan. With edits and adjustments to the criteria matrix, this methodology could be utilized for natural disaster rebuilding, geospatial information collection, and informing both emergency response and infrastructure growth policy decisions.

Jianfen Chen
Graduate Program: Technical Communication
Advisor: Huiling Ding
Poster Number: 29

Risk Communication about Smog in China

Smog, as a byproduct of industrialization and modernization, is plaguing and will plague China for years to come. Most current researches on risk communication about smog in China are centered on public engagement and behavior change (Oltra and Sala, 2015; Zhou and Dai, 2017) with scant attention paid to the communication dynamics of smog and how such communication impacts the policy decision at the national level. The purpose of this research is to examine individualism, personal and local experiences of smog to delineate the risk communication about smog in China from a grassroots perspective. This research highlights that the grassroots experience of smog facilitates setting up environmental policies at national level. Case study methodology was adopted by chronologically tracing and analyzing 37 articles on smog published on a nation-wide Chinese newspaper called Southern Weekly. Specifically, rhetorical textual analysis with special focus on ethos as the "controlling faction" in persuasion (Katz and Miller, 1996) was conducted. These articles were then divided into three time stages to reflect the causal link between public participation and policy change. The analysis highlights that grassroots smog communication as reflected by 37 news coverages has become the strong force in smog communication in China. In the process of analyzing grassroots communication of smog, attention should be paid to local context, political and ideological structures and priorities, economic interests and stakeholders that play key roles in shaping environmental policy. Technical communicators who have the strong and advantageous research and analytical ability are most time absent in smog communication network. China is in great need of technical communicators to enable more engaging, ethical, sustainable, and dynamic communication of smog.

Sarah Chetty
Graduate Program: Foreign Languages and Literatures
Advisors: Jim Michnowicz and Rebecca Ronquest
Poster Number: 30

To /b/ or not to /b/: On the Production of the Graphemes -bv- in Heritage Spanish

In contemporary standard Spanish, the graphemes -b- and -v- both correspond to the phoneme /b/, where /b/ is realized as an occlusive [b] in post-pausal and post-nasal positions and as an approximate [β] in all other contexts (Hualde 2005). However, heritage speakers of Spanish (HSS), who have at least one native Spanish-speaking parent (Escobar & Potowski, 2015), do not always exhibit equal pronunciations of -b- and -v-, likely due to the fact that /b/ and /v/ are phonemic in English. Rao (2014) found that HSS of Mexican heritage pronounce more v's than b's as tense approximants and more b's than v's as stops. In Face and Menke's (2009) study in which L2 learners with varying years of study completed a reading task, a significant effect of grapheme was found regarding the proportions of stop, spirant fricative, and spirant approximant realizations of /b/. Given the impressionistic nature of most previous studies on bilingual b/v production, the present study seeks to find an automated, quantitative acoustic measure that can be used to differentiate between -b- and -v-. Two males and two females of central Mexican heritage were interviewed using standard sociolinguistic methods. For each token, the duration, center of gravity, band energy, and intensity difference compared to the following vowel were measured in PRAAT (Boersma & Weenink, 2015). Statistical analyses were computed using R (R Core Team, 2016). The results suggest that orthography does not have a significant effect on intensity difference or or band energy. There is a significant effect of grapheme on duration, though the difference is highly context-specific. Orthography also exhibits a significant effect on center of gravity, with the grapheme -v- corresponding to a significantly higher center of gravity than -b-. The final version of this project will include a comparison with productions from immigrant speakers.

Timothy P. Clark
Graduate Program: Sociology
Advisor: Stefano Longo
Poster Number: 31

Who Would Eat Such a Fish? A Sociological Study of Elite Sushi and the Intersection of Culture and Production.

In the United States, the best sushi is the freshest sushi. It is the sushi that is almost too beautiful to eat, prepared by a chef who is more artist than a cook. It is the sushi that offers a gateway into a minimalistic, ancient, and unchanging Japanese culture. Yet, the sushi that is served at the best restaurants is frozen and shipped across continents. Such elite sushi can be beautifully prepared, but is not purely, other-worldly art. Rather, it often comes from the flesh of threatened species harvested by exploited workers. And the demand for contemporary sushi is just that: contemporary. It is a relatively new culinary phenomenon, determined largely by changing patterns and capabilities in production, preservation, and transportation technologies. By performing a content analysis on elite sushi discourse, I demonstrate how haute sushi in the U.S. is depicted as fresh, ethereal, and the embodiment of Japanese traditional culture. I define elite, fine, or haute sushi according to Zagat ratings of the best sushi restaurants and parallel my analysis with discussions on how sushi is actually harvested, produced, and transported. In doing so, I hope to show some of the contradictions that are so problematic in concealing unsustainable aspects of an ever-expanding industry.

Alison Cooke[1], Amy Halberstadt[1], Dejah Oertwig[1], Grace Shaughnessy[1], Pamela Garner[2], and Sherick Hughes[3]
Graduate Programs: Lifespan Developmental Psychology, North Carolina State University[1]; Integrative Studies, George Mason University[2]; Education, University of North Carolina - Chapel Hill[3]
Advisor: Amy Halberstadt
Poster Number: 34

Accuracy and Anger Bias: Judging Black and White Children's Emotion

Racism is a well-documented issue in the school system, however the processes by which it is inadvertently maintained are less understood. Because children's emotions are frequent in elementary school and may be understood differently for Black and White children, we studied teachers' emotion understanding of Black and White children's emotions. We measured 178 preservice teachers' (elementary education majors) judgments in an emotion recognition task capturing dynamic facial expressions of 72 children (half female, half Black) showing one of six emotions. This task enabled us to study teachers' emotion recognition accuracy and also their errors, particularly in relation to perceiving anger when it did not exist. There were no differences in teachers' overall accuracy by child race. However, when teachers were unable to identify an emotion, they falsely transformed it into anger for Black, but not for White, children. Thus, the well-documented misperceptions of anger and threat for Black adults are perpetrated upon young Black children and may help to explain disproportionality in suspensions and expulsions of Black children.

Emilia Codero Oceguera[1], Sarah Bowen[2], and Sinikka Elliott[3]
Graduate Programs: Sociology, North Carolina State University[1,2]; Sociology, University of British Columbia[3]
Advisor: Sarah Bowen
Poster Number: 35

Resisting Neoliberal Foodways? Low Income Latina Women's Access to Food in North Carolina

The Latino population in North Carolina has increased more than a thousand percent since 1990; sixty percent are part of the Mexican community, thirty percent live in poverty, and more than half are women. Access to nutritious, fresh and culturally appropriate food is a daily struggle in the lives of low-income Latina women living in North Carolina. Their strategies to access food are shaped by cultural and socioeconomic factors and affected by their position as immigrants in the United States. As primary food providers for their children, can their struggle to access food within a neoliberal state transform into acts of resistance to the industrialized food system? We draw on semistructured interviews and surveys conducted in 2016 and early 2017 with 23 Latina women, as well as ethnographic observations of 3 of these families, in one urban and two rural counties. Mixed methods analysis of these women's and children's narratives about strategies to access food, perceptions of food, life experiences in their home countries and the US, and everyday well being will demonstrate the complex ways neoliberal policies directly affect their lives. Furthermore, it will explore how they navigate and challenge the industrialized food systems through their strategies to access food.

J.W. Decker
Graduate Program: Public Administration
Advisors: Bruce McDonald and RaJade Berry-James
Poster Number: 37

The Diffusion of Merit Aid Policies Across State Lines

States award merit aid scholarships as a tool to motivate student achievement in high school and college. For states, merit aid policies also eliminate the movement of high-performing students to out of state institutions and increase the access to postsecondary education for low-income families. With the benefits seen for both students and the state, 42 states have adopted the policies. Using an event history analysis approach and data for all 50 states from 1993 to 2016, this paper explores the mechanisms of how merit aid policies diffuse across state lines.

Kari Doyle
Graduate Program: Technical Communication
Advisor: Huiling Ding
Poster Number: 40

An Analysis of Job Advertisements for Technical Editors

As the discipline of technical communication continues to develop, roles within the discipline are becoming more specialized. Previous research on technical communication included a study conducted by Rainey, Turner, and Dayton. The findings of their research included the following core competencies within the discipline: collaboration, writing, knowledge of technologies, and initiative (Rainey, Turner, & Dayton, 2005). However, little research has been conducted specifically on the job title of technical editor within the field of technical communication. The only recent study published in May 2017 written by Kreth and Bowen provided survey results of technical editors. This study was unique as the research was performed through various surveys completed by editors themselves, not those writing about technical editors. Current research indicates the need for a more robust availability of competency information of technical editor positions, in order to properly inform students preparing for positions as technical editors in the field of technical communication. This study concentrated on job responsibilities of technical editor positions in a variety of entities. The research method was conducted by analyzing 40 job advertisements through job search engines indeed.com and glassdoor.com. The data was analyzed through text mining tool Antconc. The results of the study provided the ten top job responsibilities of technical editors, and the necessary competencies required to perform tasks successfully. In addition, this study analyzed the importance of quality control, symbolic-analytic work, and interpersonal skills within the role of technical editor.

Meredith Foulke
Graduate Program: Communication
Advisor: Lynsey Romo
Poster Number: 46

Speaking of Ink: What Motivates Young Adults to Disclose Their Tattoos

Although tattoos provide ways for people to create an identity and communicate with the public and getting inked has become more mainstream, tattoos are predominantly viewed negatively. Young adults (aged 18 -24) with tattoos are at a particular disadvantage of being heavily stigmatized, because the rate that they are getting tattoos and the number of tattoos they have is rising faster than other age groups. Using Communication Privacy Management Theory (Petronio, 2002) as a theoretical framework, this study examines what motives young adults to reveal or conceal that they have a tattoo. This study found that young adults are aware of the repercussions that tattoo stigma has on perceived perceptions from others and carefully managed their privacy depending on whether they believed revealing they had a tattoo was risky or not. Young adults verbally revealed their tattoo status when they perceived disclosing helped develop their personal identity and help build relationships. However, young adults concealed having tattoos when they feared disclosing could harm their professional identity and/or result in judgement from their family and friends. This research provides unique insight into the communication boundary management of young adults with tattoos.

Elmas Hasanovic
Graduate Program: Master of International Studies
Advisor: William A. Boettcher III
Poster Number: 71

Regional Organizations as a Tool for Enhancing Security, with Special Focus on Balkan Countries

In the past, inter-governmental organizations have played crucial role in solving disputes between countries, maintaining peace and security and facilitating the cooperation between various state and non-state actors. For example, the Conference for Security and Cooperation (CSC), which later became Organization for Security and Cooperation in Europe (OSCE), has played as a platform for political dialogue among East and West during the Cold War in decreasing the disputes and solving the issues through peaceful means only, in particular among the United States and Russia.According the Harvard Law School, intergovernmental organizations (IGO) are legal entities "created by treaty, involving two or more nations to work in good faith on issues of common interest," whereas if there is "absence of the treaty, a IGO does not exist in the legal sense"(Harvard Law School, n.d.). The European Union rushes to integrate whole Western Balkan by 2025, while NATO takes more cautious approach regarding the enlargement and integration of new members. Nevertheless, there are a lots of issues that need to be solved before the Balkan countries could be integrated either in EU or NATO, or both. However, the questions that here arise are, whether integration of Balkan countries are possible or not, and how that can be achieved. Hence, the main research question of this paper is to examine whether a successful integration of the Western Balkan countries in EU and NATO is possible or not, and what are the best tools for achieving this aim? What makes interesting this paper is that under the current political, economic and security circumstances on the Balkans, having successful and functional integration of the Balkans countries in EU and NATO it is less likely to be achieved by 2025 without having appropriate tools for facilitating the dialogue between countries in solving all disputes.Thus, the main objective of this paper is to develop a proper model - regional intergovernmental body as a tool for enhancing security, facilitating and fostering the integration process of the Western Balkan countries to EU and NATO. The independent variable is inter-governmental organizations whereas the dependent variable is the integration process.The empirical and theoretical puzzle of this paper is that contributes to the literature on international security and global governance, and plays as a practicable solution for policymakers in the Balkan region, EU and NATO for achieving the abovementioned goals.

Jessica Haynie and Jason Coupet
Graduate Program: Public Administration
Advisor: Richard Clerkin
Poster Number: 58

The Overhead Ratio is Not a Measure of Efficiency

Past literature in nonprofit management uses the overhead ratio of nonprofits as a measure of efficiency. While the overhead ratio might measure top-heaviness, we argue that it does not measure nonprofit efficiency. To investigate this, we use financial and operational data to rank efficiency of Habitat for Humanity affiliates with the overhead ratio, as well as Data Envelopment Analysis (DEA) and Stochastic Frontier Analysis (SFA), two of the most popular efficiency measures. While the DEA and SFA rankings are stastically correlated, overhead ratio rankings are unrelated to SFA rankings, and are very weakly correlated with DEA rankings. We argue that nonprofit scholars, managers, and foundations should move away from measures of efficiency based on financial ratios.

Joshua Jackson
Graduate Program: Communication Rhetoric and Digital Media
Advisors: Helen Burgess, Nicholas Taylor, and Andrew Johnston
Poster Number: 68

The Matilda Effect in Game Studies: A Citation Analysis of Game Studies and Games and Culture Articles

The videogame production industry is notorious for pervasive gender bias, erasure of marginalized bodies' contributions, and precarity regarding the wellbeing of its workers. Its academic counterpart, game studies, parrots much of the toxic working and living conditions of the industry it critiques. Female, People of Color (POC), and queer scholars' contributions often go underrecognized, undercited, and largely ignored, and then their work is often coopted by straight, white, and male scholars who claim credit for the ideas themselves. There is currently very little work regarding the effects of citational practices in game studies. Citational consideration in game studies is more than a passive, passing quandary: who is being cited and what they are talking about will set the tone for generations of game studies scholars to come. Using role congruity theory as the theoretical underpinning of this study, an analysis of the citation components of 200 articles published between 2012 and 2017 in Game Studies and Games and Culture was conducted. Utilizing the work of Knobloch-Westerwick and Glynn (2013), in which they examine the "Matilda Effect (underrecognition of female scientists)" and the implications of female scholars' works going undercited and underrecognized in over 1000 articles published in Communication Research and Journal of Communication, I applied this general framework to the area of game studies citations to find that, in line with their work, and in line with Rossiter (1993)'s initial hypothesis of the phenomenon, female scholars' works received fewer citations. Hypotheses regarding: the impact and complicity of the gendered nature of the field of game studies and subsequent gendering of research topics; author productivity; author's sex; as well as on change in the hypothesized Matilda Effect's extent across the time period examined were derived from the theoretical framework. Four of the five hypotheses posited were supported.

Evan T. Johnson
Graduate Program: Communication, Rhetoric and Digital Media
Advisor: Andrew Johnston
Poster Number: 70

The Evolution of the Public Sphere in Networked Society

The 1960s proved to be a tumultuous decade in both Europe and the Americas, as their respective citizenries pushed back against political forces in order to shape a new social identity for the generations ahead of them. It the midst of that turmoil, scholars attempted, in various ways, to theorize the domains of culture and politics. German thought leaders, such as Theodor Adorno, Walter Benjamin, Herbert Marcuse, and Max Horkheimer anchored what came to be known as the "Frankfurt School", famous for their critical philosophy and social theory that attempted to address national social development. While these scholars doubtless had tremendous influence, Jürgen Habermas was not content with speculative or philosophical scholarship. Instead, he proposed a more robust methodology that drew upon a variety of disciplines including cultural history, legal history, mass media theory, and empirical social science. What emerged from his efforts was a new gestalt that consolidated previous thought, reformulating the dialectical relationship of socio-cultural and political systems in what he termed as the Öffentlichkeit, or public sphere. This study traces the scholarly discourse that followed the 1989 English translation of Habermas' seminal work The Structural Transformation of the Public Sphere and shows that the conversation has centered around five key areas: classical theory, feminist critique, identification, rhetorical space, and democratization. The research presented here was undertaken by means of an exhaustive review of the most influential public sphere literature. The findings suggest that much of contemporary thought has focused on counterpublics, especially with regard to virtual publics, but that many new challenges lie ahead for the field such as the attention economy, misinformation, and privacy in an increasingly networked world. However, this study also finds evidence for the reemergence of a healthy public sphere online, which carries powerful democratizing potential.

LaTonya Johnson
Graduate Program: Liberal Studies
Advisor: Craig C. Brookins
Poster Number: 57

A Curriculum for Psychological Empowerment with Urban Black Female

Much of the data on urban black girls is based on a deficit perspective that focuses more on the problems they face as opposed to their strengths (Travis & Leech, 2014). Moreover, young black girls are being seen as in need of less guidance and nurturing than that of white girls their ages (Epstein, Blake, González, & Georgetown University. Law Center. Center on Poverty and Inequality, 2017). The goal of this research is to create a curriculum that can be used in community-based agencies that work with these youth to develop empowerment and leadership skills to help them effectively deal with racialized and gendered adversity. The curriculum will be developed using scholarly literature, experiences as an intern with the Raleigh Girls Club, and my personal experiences growing up in an urban environment.

Jerica Knox
Graduate Program: Psychology
Advisor: Eui Kyung Kim
Poster Number: 77

Adolescent Help-Seeking from Peers and Adults and Engagement in Risk Behavior

Adolescent risk behavior (ARB) indicates a set of adolescent behaviors that are likely to result in increased injuries and illnesses. Such ramifications can make the developmental transition into adulthood difficult for adolescents, suggesting a need to examine ARB in order to identify protective factors against ARB engagement among teens. Previous literature lacks the implication of adolescent help-seeking (AHS) in ARB. This research will examine AHS preference and its relation to ARB by dichotomizing the preference choices — (a) parents, teachers, and other adults (PTA) preference and (b) peer preference. Chi Square analyses were employed to examine AHS preference in 4 ARB categories: alcohol use, sexual behavior, interpersonal injury and violence (physical fighting), and intrapersonal injury and violence (suicide attempt). The sample included 3,275 participants (1,995 [61.3%] females, 1261 [38.7] males) in the 2015 Youth Risk Behavior Surveillance System (YRBS) Survey (CDC). Findings indicated that AHS preference was significantly related to interpersonal and intrapersonal injury and violence, but not related to alcohol use and sexual behavior. Results suggest individual differences in ARB characteristics and negative receptivity to PTA preference outcomes. Implications and future directions are discussed.

Reina B. Kornmayer, Jena Caiazza, and Chelsey Juarez
Graduate Program: Anthropology
Advisor: Chelsey Juarez
Poster Number: 80

Investigating socioeconomic status in historic Charleston, through dietary analysis of urban Sus scrofa

Stable carbon and nitrogen isotopic analyses can be utilized to investigate dietary differences in protein consumption and trophic level. When this analysis is applied to animals raised for food, dietary differences in kept animals may reflect diversified husbandry practices and the socioeconomic status of owners. Carbon and nitrogen isotopes from thirty-six samples of Sus scrofa bone fragments from six archaeological sites (five high SES and one lower SES) dating from 1700 to the late 1800s in Charleston, South Carolina were made available from the Charleston Museum for study. The primary hypothesis is that bones of pigs from low SES sites would be statistically distinct from high SES sites. Namely, urban pigs from low SES localities would have higher δ15N values reflecting the incorporation of table scraps including meat products in the diet, while rural free range pigs would have lower δ15N reflecting a diet mix of C3/C4 vegetables. In contrast to the 2015 study by Reitsema and colleagues on Bos taurus remains from the same time period and location, this study found that there were no statistically significant differences between individual sites in δ13C: F (5,30)=1.030, p=0.418; or δ15N: F(5,29)=0.912, p-0.487 or time periods (1700s vs. 1800s). This finding suggests that both low SES and high SES pigs were fed similar diets, possibly indicating an established animal husbandry practice for pork that obscured differences in SES between owners or localities.

Darya Levchenko
Graduate Program: English - Film Studies
Advisor: Franklin Cason
Poster Number: 87

Loving Digital: How Romantic is Sci-Fi in Eternal Sunshine of the Spotless Mind

Romantic comedy has always been a very human genre as it appeals to the basic instincts of social recognition and procreation. Multiple successful synergies with the genre elements of sci-fi, thriller, and puzzle films are topped with one of the best sci-fi romantic comedies of the 21 century, a feature film written by Charlie Kaufman and directed by Michael Gondry: Eternal Sunshine of the Spotless Mind (2004). Multiple scholars have interpreted the film as a comedy of remarriage and a screwball comedy and explored the leitmotif of memory and love from a standpoint of human philosophy and psychoanalytic theory. I deconstructed the two main heroes as simulacra and analyzed their multiple selves through a lens of digital media philosophy, and argue that fractured personalities of Joel and Clementine, who are the central romantic couple, should be reconsidered as the opposing concepts of a digital mind and a Manic Pixie Dream Girl. I assert that what has previously been analyzed as a modern interpretation of a traditional romantic arc of their relationship is, in fact, a postmodern instance of defining love through antagonism. I also apply the concept of atemporality as a necessary element for the understanding of the central romantic conflict. I conclude that Joel and Clementine are a non-conventional Hollywood couple that accepts mutual anxiety rather than overcomes it. In my view, the elements of romantic comedy are not essential, but complementary to the digital hero-driven drama of Joel, framed by humor and a musical montage. Thus, romance, comedy, and audio sequence become a necessary medium for a viewer to comprehend the digital romantic philosophy as an instance of a performed act of emotional intelligence and postmodern romantic union.

Chao Liu and Steve McDonald
Graduate Program: Sociology
Advisor: Steve McDonald
Poster Number: 92

Structural Sources of Project Involvement in GitHub's Online Community

Objectives: Collaboration in workplace teams is an important topic for sociological study. The advent of online "open-source" coding communities have raised new questions about the conditions under which work-based collaboration is possible in a virtual platform. While existing research has explored the attributes of individual team members that are associated with project involvement in online, less is known about the relational dynamics that may affect collaboration. Specifically, how does network embeddedness within an online community impact contributions to production in teams?

Methods: To address these questions, we use data collected from github.com's application programming interface (API). The data represent a random sample of 272,683 users, 43,558 organizations, and 259,399 projects from 2015. We examine two outcomes associated with different levels of project involvement. First, we count the number of times that an individual "commits" to a user-generated project (i.e., submits changes to a project's source code). Second, we code for whether a user "watches" a user-generated project (i.e., requests updates on the progress of a project), compared to not watching the project. Analyses take place at the user-project level. When the dependent variable is "commits," we use multi-level linear regression with bootstrapped SEs to account for network dependencies. When the outcome is "watching," we use multi-level logistic regression with bootstrapping. All models control for a user's status on the project (owner, collaborator, or contributor) and their degree centrality (i.e., the number of organizations they are affiliated with).

Findings: Based on network theory, we predict that embeddedness in densely connected online communities will be negatively associated with the extent of involvement in team projects. We will have a full set of results in time for presentation at the conference.

Jose Martinez
Graduate Program: English
Advisor: Agnes Bolonyai
Poster Number: 100

You Can't Play With "Us," The Discursive Exclusion of Colin Kaepernick

As per Colin Kaepernick's 2016 protest he was excluded from the National Football League (NFL)—his livelihood—for attempting to raise awareness of racial inequality, systematic injustice, and police brutality in America. Due to the event's recency, prior scholarship is not as specific as identity politics of athletes as related to nationalism. However membership categorization studies in political discourse reveal world leader's use of similar discursive incumbents to regulate and maintain social groups after the events of 9/11. Use of the incumbents "us" and "them" perpetuates social "in" and "out" groups to promote national agendas while justifying acts of violence (Leudar, Marsland, and Nekvapil, 2004). My investigation of the discursive role of identity and categorization involving Kaepernick's Self-Representation (De Fina, 2006) aligns him with marginalized, oppressed, people of color. This alignment with social "out groups" is contested by U.S. President Donald Trump. Trump misconstrues Kaepernick's protest and exacerbates nationalist ideals which result in Kaepernick's exclusion from the league. Trump does not construct his own identity, rather he plays off nationalism, membership categorization (De Fina, 2006), and the Rhetoric of Exclusion (Wodak, 2008). Trump uses divisive rhetoric to bully the institution of the NFL and player protests while drawing attention away from issues of Kaepernick's protest—issues of oppressed American communities. While (in theory) such discourse can be inherent or deliberate, it is clear Trump openly ostracizes a national athlete and activist for making use of their platform. As a result, the NFL responds as apolitical and does not defend Kaepernick. Instead NFL commissioner Roger Goodell releases statements making use of membership categorization to positively portray his institution. In exploring these discursive exchanges between Kaepernick, Trump, and Goodell, I aim to reveal the covert/overt power at stake in discourse, between social actors, and the complexity behind commonplace discourse.

Stephanie Oliver
Graduate Program: Foreign Languages and Literatures
Advisor: Jim Michnowicz
Poster Number: 129

Subject Pronoun Expression in Raleigh-Durham

Subject pronoun expression in areas of contact between Spanish and English has been of interest to sociolinguists because of the insight it provides into the nature of language contact. In Spanish, subject pronouns may or may not be overtly expressed; because of the morphological system, information about the subject is indicated in the verb, allowing omission of the subject. This contrasts with English, where null subjects almost never occur due to the ambiguity of the verbal system (Hualde et al., 2010). Choice of overt or null subject pronouns in Spanish depends on a variety of factors, including the person of the verb, verb tense, reflexivity, and switch reference (Otheguy & Zentella, 2012). American-born Spanish speakers, or heritage speakers, tend to show a higher overt pronoun rate and a different ranking of and sensitivity to the constraints for pronoun expression than do speakers born and raised in Latin America due to English influence (Otheguy & Zentella, 2012). The purpose of this study was to analyze subject pronoun expression in the emerging Spanish-speaking community in Raleigh-Durham. This was accomplished through analysis of thirteen sociolinguistic interviews from the Corpus del español de Raleigh-Durham: seven interviews with native Spanish speakers and six with heritage speakers, all either from Mexico or of Mexican heritage. The first 100 eligible verbs were coded according to the manual found in Otheguy & Zentella (2012). Preliminary results found an overall pronoun rate of 16.8%. A mixed-effects regression model found significant effects of person and number, switch reference, definiteness, TMA distinctiveness, reflexivity, and generation. Native speakers showed a higher pronoun rate than heritage speakers, which was opposite of the expected results, seeming to suggest a lack of English influence. However, heritage speakers showed less sensitivity to the switch reference constraint than native speakers, which suggests influence from English.

Shalina Omar
Graduate Program: English - Linguistics
Advisor: Walt Wolfram
Poster Number: 130

“It’s true; ain’t nobody got time fo dat”: Linguistic Subordination and the Humor of Black Speech

Viral videos have become a barometer of cultural interest on the internet and deserve sociolinguistic examination as a representation of popular language ideologies. This study inspects the phenomenon of the viral local news celebrity videos that have been replicated and memeified through video clips, song remixes, image macros, and hashtags. One of the initial memes of this genre arguably came from a TV interview with Antoine Dodson, a resident of an Alabama housing project whose outraged and incredulous reaction to a man attempting to rape his sister (catchphrase: “Hide yo kids, hide yo wife”) spread rapidly across the internet. Analogous phenomena have been replicated a number of times since Dodson’s viral newscast, most often with working-class Black interviewees using vernacular versions of African American Language (AAL).

I argue that the memeification of these videos is a product of the linguistic subordination of Black speech in America. I identify features of AAL within the videos and present examples of YouTube comments in which viewers index these features and characterize them as humorous. I maintain that some comments demonstrate Mock AAL and are meant to denigrate the language and its speakers. This exemplifies the marginalization of those who do not conform to the language of the dominant group, which Rosina Lippi-Green defines as one step in the model of language subordination (2012, p.70).

The study reveals that culturally entrenched myths of the illegitimacy of Black speech underlie the videos’ humor and factor into their successful viralization and memeification. These instant celebrities replicate the image of the “hilarious” hysterical black neighbor whose reaction to a distressing situation is viewed as comically dramatic through their vernacular language. From a critical, raciolinguistic perspective, the videos exist within an environment of linguistic subordination that must be addressed in the struggle for the linguistic legitimacy of AAL.

References: Lippi-Green, R. (2012). English with an Accent: Language, Ideology and Discrimination in the United States. London: Routledge.

Caitlyn R. Owens and Mary E. Haskett
Graduate Program: School Psychology
Advisor: Mary E. Haskett
Poster Number: 132

The Association between Providers' Use of Triple P- Positive Parenting Program and Attendance at Peer Assisted Supervision Sessions

This study was designed to contribute to a growing literature on factors associated with uptake of evidence-based practices in real-world settings. Triple P- Positive Parenting Program is an evidence-based parenting intervention associated with reductions in child maltreatment indicators at a population level. Although there is strong evidence for positive effects, many providers trained in large-scale adoptions of Triple P implement the intervention with very few families, perhaps limiting the positive impact. We sought to examine the association between attendance at Peer Assisted Supervision and Support (PASS) sessions and use of Triple P with families among providers in a state-wide adoption of Triple P and to identify characteristics of providers most likely to attend peer supervision. In addition, we examined (a) fidelity to the PASS model as a moderator of the link between attendance at supervision sessions and use of Triple P by providers and (b) providers' perceived fit of Triple P with typical services as a moderator of the association between providers' attendance at peer support and use of Triple P with families. Correlational analyses revealed that providers who attended a greater number of peer support sessions used Triple P with more families. However, results of regression models indicated that fidelity to the PASS model and provider's perceived fit were not a significant moderators. This study highlights the potential importance of attending PASS sessions in terms of serving families. Implications of the findings for implementation of Triple P and other evidence-based parenting interventions and suggestions for further studies are provided.

Kristen N. Pender, Elan C. Hope, and Kristen N. Riddick
Program: Applied Social and Community Psychology
Advisor: Elan C. Hope
Poster Number: 138

Queering Black Activism: Exploring the Relationship between Racial Identity and Black Activism Orientation among Black LGBTQ Youth

The literature on Black activism in the United States of America emphasizes Black youth's leadership and participation in sociopolitical resistance in and for the Black community throughout history. However, sociopolitical movements of the past have also been critiqued for perpetuating the marginalization of lesbian, gay, bisexual, or questioning (LGBTQ) individuals within the Black community. Given this experience, the oppression of LGBTQ Black youth is uniquely distinct from their cisgender and heterosexual counterparts and thus informs a disparate perspective of how Black LGBTQ youth become involved in sociopolitical action. It has been suggested that linked fate, or connection to the Black community, may be a pathway to engagement in social justice action for Black liberation among Black individuals with multiple intersecting identities (e.g. LGBTQ, women). The purpose of this study is to understand the role of racial identity on Black LGBTQ youths' orientation towards Black activism. We used hierarchical linear regression to examine relationships between dimensions of racial identity and Black activism orientation among 142 LGBTQ-identified Black youth. We found that racial centrality and racial ideologies predicted high risk and formal political activism orientation. Additionally, assimilationist ideology moderated the relationship between racial centrality and high risk activism orientation. Results suggest the degree to which Black LGBTQ youth feel race is central to their self-concept relates with their intent to engage in Black activism. Further, these findings demonstrate that racial ideologies matter distinctively to activism orientation and offer that perception of risk nuances linked fate as a pathway to activism for Black LGBTQ youth.

Lucía Planchón
Graduate Program: Foreign Languages and Literatures
Advisor: Jim Michnowicz
Poster Number: 141

Del ʒeísmo a ʃeísmo en hablantes Uruguayos

This study investigates zheismo vs sheismo in Uruguayan Spanish, specifically how age and gender influence whether speakers produce /ʝ/ as voiced [ʒ] or voiceless [ʃ]. Following Chang (2008), participants were told to read aloud a series of Mafalda comics chosen specifically by the researcher to limit variables while their speech was recorded. Following Chang's 2008 study, the present study measures percent unvoiced using Praat and LVS – Language Variation Suite. The purpose of the study is to determine whether age and gender affect speech patterns of this variable. This study is a replica study of Chang's 2008 study, changing the location from Buenos Aires to Montevideo, to determine if the pattern found in Buenos Aires also holds true for Uruguayan speech. Traditionally, Montevidean speech has been considered the same as Buenos Aires speech but only Buenos Aires speech has been thoroughly studied (Fontanella de Weinberg 1978; Wolf y Jiménez 1979; Chang 2008; Colantoni 2013; Rohena-Madrazo 2013). The study finds that while the change in progress has been declared completed in Buenos Aires' youngest generation (Chang 2008), it is still ongoing in all three generations of Uruguayans. The results reveal that there is a significant difference in production in the younger generation between genders, as well as a significant difference between generations in males. Chang specifically found that younger speakers of Buenos Aires are producing more voiceless palatal-alveolar fricatives, while the older generations are producing the voiced equivalent with more prominence. The present study finds that the results for Chang hold true, as the older generations in Uruguay are also producing more voiced variants and this differs from the youngest generation. Additionally, it is clearly noted that the older generations experience a larger amount of variation than the youngest generations.

Robert J. Sall
Graduate Program: Psychology
Advisor: Jing Feng
Poster Number: 151

Better off Alone: Detecting a Single Hazard Prevents Drivers from Finding a Second

Despite the abundance of technology produced to improve driver safety, the frequency of automobile collision incidences is persistent. Given that many of these collisions are a result of a limitation in drivers' attentional capacity, it is crucial for researchers to understand how these cognitive limitations may influence driving performance. Some of the more notable demonstrations of limited attention in driving revolve around attention being divided to process different types of information (e.g., texting and driving). However, little consideration has been made to investigate how drivers might be limited in their abilities to simultaneously process multiple, homogeneous stimuli (e.g., two separate pedestrians). In order to test this researchers adopted a dual-target visual search paradigm, called Satisfaction of Search, to study hazard perception in transportation. Research on this paradigm has shown that the correct identification of one target can impede the detection of a second when they're both presented in a cluttered visual field. In two experiments presented here, researchers successfully demonstrated that this classic pattern of faulty visual search may be present when drivers scan their environments for hazards. Participants here were given between 1000ms (Experiment 1) and 5000ms (Experiments 2) to determine whether or not there were any hazards present that would prevent safe passage. The results demonstrated that accuracy for hazards' identification was significantly reduced when they appeared alongside another hazard, compared to scenes where they appeared by themselves. In other words, after finding one hazard on the road, drivers may become "satisfied" with their efforts and prematurely appraise the path as safe before locating a second hazard on the same street.

Joel Schneier
Graduate Program: Communication, Rhetoric, and Digital Media
Advisor: Jason Swarts
Poster Number: 155

What's Left Unsent: Deletion & Revision Patterns from Mobile Keystroke Data

While keystroke logging methodologies an incredibly powerful tool for observing writing processes along temporal dimensions (Leijten et al., 2014), keystroke logging privilege computer-based writing interfaces in which there is a clear separation between input and output mechanisms (i.e., the keyboard and monitor). The application of keystroke logging to mobile touchscreen interfaces (in which input and output mechanisms are joined) is therefore critical as compositional practices on mobile devices become increasingly ubiquitous. This paper intends to examine the efficacy as well as challenges to synchronously observing textual deletion and revision processes on mobile devices through keystroke-logging data.

In order to observe mobile writing processes, this study collected keystroke data from a mobile device with a custom chat application intended to log keystrokes from the touchscreen keyboard. Using the designated mobile device, participants (N = 5), engaged in numerous tasks per instructions via the chat application, and communicated with the researchers via the device in order to simulate text messaging (Schneier & Kudenov, 2017). In this paper, revision and deletion analyses of the keystroke data was conducted for intra-word, inter-word, and multiword deletions and revisions, as well as the inter-key intervals prior to deletion and prior to the start of revision.

Findings demonstrate that deletion and revision processes on a mobile device are largely devoted to intra-word deletion and revision, typically single characters (i.e., 'typos'), and that pauses between deletion and revision were longer for mobile keystrokes when compared to a sample of computer-based keystroke data. Additionally, pauses between deletion and revision were generally longer for mobile keystroke data when users were revising textual content inputted through autocorrect/autosuggest features. These findings suggest a greater degree of attention to a short range of textual content (i.e., one or two word units) when compared to computer-based writing.

Ben Siegelman
Graduate Program: Cultural Anthropology
Advisor: Nora Haenn
Poster Number: 203

Lies Build Trust: Social Capital, Manhood, and Common Pool Resources in a Mexican Small-Scale Fishery

Social capital is an important concept for commons theorists and environmental managers, but simplistic models of community-wide trust undermine the concept's analytical and practical power. This poster presents research conducted in San Evaristo, Baja California Sur, Mexico, to show how fishermen earn social capital, transfer it into other forms of capital, and thereby maintain gendered practices of natural resource extraction. Through participant observation and semi-structured interviews, my research demonstrates that San Evaristeños value the appearance of a conflict-free environment, even when conflicts do arise. This constitutes a case of "harmony ideology," a strong insistence on preventing and settling the conflicts that easily arise from ill-defined ownership of natural resources. To this end, San Evaristeño men draw on local ideas of manhood to create and maintain peace amidst the tensions of common pool resource management. One such practice is the spinning of specific kinds of lies that build trust among fishers. Male fishers use these lies to avoid conflict in the fishery, and also to create opportunities for material gain. These lies- many of which focus explicitly on fishing and expressions of manhood such as physical capability or sexual prowess- show gendered labor at work in the material, social, and cultural capital associated with fisheries management. The paper concludes that ethnographic research and attention to gendered social practices offer a rich application of social capital theory. It also suggests insights for fishery regulation and environmental management strategies, including MPA design, land trust strategies, and the formation of fishing cooperatives.

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Advisor: Shevaun D. Neupert
Poster Number: 194

Emotional Reactivity Changes to Forecasted and Actual Stressors Surrounding the 2016 U.S. Presidential Election

Background: Results from the Nov. 8, 2016 U.S. presidential election largely contradicted debate results, pre-election polls, and predictions, which indicated a popular and electoral majority for the democratic candidate. Although the date of the election was known, the result was not anticipated. We examined potential changes in within-person emotional reactivity to personally-relevant stressors as a function of the more distal, U.S. presidential election. Methods: During October and November of 2016 we conducted a daily diary study of stressors and well-being. A subsample (n = 29 individuals aged 18-22 reporting on 235 days total) of the larger project (n=107) began the 9-day study protocol on Nov. 2 and completed it on Nov. 10. The U.S. Presidential election took place on Nov. 8. Participants reported on sociodemographic variables on Day 1 and daily stressors, daily negative affect, and forecast of future stressors on Days 2-9.

Results: We found significant increases in emotional reactivity to forecasted and actual stressors from before the election to after the election. Conclusions: Our results suggest that emotional reactivity became amplified in the short term after the election, highlighting the importance of considering multiple systems over time for understanding reactivity.

Andrew R. Smolski[1], Javier Sethness Castro[2], and Alexander Reid Ross[3]
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Advisor: Stefano B. Longo
Poster Number: 163

Exile as a Determinant of State (De)Formation During Revolution

This poster presents the findings of a comparative historical study of the Mexican and Russian Revolutions utilizing an exilic analytical framework. We argue that post-Revolutionary states are the result of competing factions during revolution that are typologically distinct relative to the development of alternative political-economic practices and political institutions. Utilizing Grubačić and O'Hearn's theory of exile, we typed factions in both the Russian and Mexican Revolutions, and then reconstructed the historical struggles that occurred during this rupturous events. Typing is based on whether or not a faction had substantive reproduction, practiced mutual aid, had an egalitarian sharing of political power, and made decisions through a political institution of direct democracy. Factions exhibiting none of these characteristics are incorporative, while factions exhibiting a mix or all of these characteristics were typed on an exilic continuum. Based on our analysis, the post-revolutionary state in both instances is the result of exilic factions being removed and incorporative factions becoming dominant. Yet, in order for exilic factions to be removed, incorporative factions to varying degrees had to co-opt demands and practices exilic factions employed. Thus, the formation of a post-revolutionary state is based, in part, on both a doing away with exile and a co-opting of exile. This adds a new explanatory dimension for our understanding of why specific policies and institutions were set up in each case post-revolution. Therefore, this study adds exile as a specific determinant of the state (de)formation process during revolution.

Steven W. Tisdale
Graduate Program: Communication
Advisor: Melissa A. Johnson
Poster Number: 174

Web of Hate: The Anti-diffusion Campaign to Purge the Internet of Neo-Nazi Website The Daily Stormer

Following the deadly 2017 clash between white supremacists and anti-racist protesters in Charlottesville, Virginia, internet host GoDaddy banished from its domain the neo-Nazi website The Daily Stormer. GoDaddy's actions catalyzed a spontaneous, uncoordinated attempt by other internet giants to disrupt The Daily Stormer's messaging operations by expunging it from the World Wide Web. This study evaluates the effectiveness of this unprecedented anti-diffusion campaign while examining The Daily Stormer's counter communication tactics in the face of existential threat. Both initiatives are viewed through the lens of Everett M. Rogers's Diffusion of Innovations (DoI) Theory. However, as Rogers did not develop guidelines on anti-diffusion, the present research expands theory by operationalizing elements of failed pro-innovation programs to create a framework for such campaigns. Reconfigured this way, attributes set forth by DoI predicting success or failure of diffusion suggested efforts by internet companies like GoDaddy's would prove ineffectual. Employing these same predictive attributes, the study also evaluated the effectiveness of The Daily Stormer's efforts to reach its target audience and maintain patron loyalty at a time of crisis. Using a priori coding methods based on psychological characteristics of alt-right adherents, content analysis was performed on messaging from three critical publications in the website's history. Analysis pinpointed strategic shifts in communication tactics during this crisis phase and predicted these efforts to be operationally successful. The present study asserts acknowledging the strengths and weaknesses of both campaigns contributes to knowledge toward greater success in anti-diffusion programs or organizational responses to crises.

María Tudela
Graduate Program: Liberal Studies
Advisor: Shelley Garrigan
Poster Number: 202

Power as a Decolonized Transgressive: An act of Displacing and Recentering

Resistance, resilience, and revolution are common themes that fill the pages of feminist theoretical literature regarding the location of marginalized individuals in a heteronormative, capitalist context. An underlying component to the multidimensional layers of resistance, resilience, and revolution is that they incorporate dynamics of power that, through a postmodern lens, exist on a two-dimensional plane. However, this flat, horizontal fixture improperly captures the complexities that involve the multidimensionality, not only inherent in power, but the individual marginalized identities that embody power. In order to unpack these issues, I focus on the experiences of incarcerated women of color and their positions within American capitalism. Drawing on work by postmodern and postcolonial scholars such as Michel Foucault, Judith Butler, Gloria Anzaldúa, and Chela Sandoval, I argue that within these dynamics resides a transgressive element to power that displaces oppressive forces and recenters colonized positionalities, by existing on a three-dimensional plane. Finally, through a brief deconstruction of power dynamics, I hope that my work will contribute to the conversations and debates dedicated to understanding forgotten and overlooked experiences and further reveal the legitimacy of those intricate collective and independent voices.

KellyNoel Waldorf
Graduate Program: English
Advisor: Agnes Bolonyai
Poster Number: 182

Lavender Labels: Perceptions of LGBTQ+ Identity Labels by In- and Out-group Individuals

Issues of language and identity for LGBTQ+ individuals have recently been brought to the forefront of the United States political arena. The politically correct terminology for LGBTQ+ individuals has seen rapid shifts in the past few decades and issues of gender neutral inclusive terms have been in the spotlight alongside battles over bathroom bills. It is crucial, especially in this political climate, to examine ways in which LGBTQ+ individuals use labels for self-identification and identity construction and how these terms are perceived by non-LGBTQ+ individuals. It is important to determine whether in- versus out-group individuals of different demographic groups have differing understandings of which terms are considered positive or negative to combat offensive usages. This study addresses the questions: How do identifying versus non-identifying individuals react to terms linked to the LGBTQ+ community? Which words are perceived as positive versus negative by different social groups (gender, sexuality, class, region, age)? Do identifying versus non-identifying individuals prioritize aspects of their identity (gender and sexuality) differently through the use of key identity words? I analyze LGBTQ+ labels through a survey exploring how identifying versus non-identifying individuals of various demographics react to 50 lexical items linked to LGBTQ+ identity. Furthermore, participants identify terms important to their self-identity. Responses from approximately 150 participants will be analyzed using mixed effects logistic regression to explore variation in affective response to lexical items for various social groups. In- versus out-group individuals are split on the affective response to some terms, especially those related to specific subgroups, with greater agreement on the perception of other labels including several established umbrella terms. The range of reactions to particular labels reveals potential points of tension and contestation regarding their usage. Investigations of this nature could prove useful for communities striving to use politically correct and inclusive language.

Karey Danielle Wall
Graduate Program: Anthropology
Advisor: Chelsey Juarez
Poster Number: 183

A Test of the Modified Rapid Manual Method on Sus scrofa Teeth

Maat et. al. (2001) modified Frost's Raped Manual Method to create a faster and more economical method of histological preparation and showed its success with the preparation of bone samples. This study follows the modified method to test its applicability on the preparation of 26 Sus scrofa (pig) tooth samples. Pig teeth were used as a proxy for human teeth because of a lack of access to human teeth. If this method is successfully expanded for use on teeth, it will provide a method that is more time and cost-effective and can be easily followed without the extensive training required for histology. After preparation, the teeth were examined under a light microscope and a polarized light microscope with successive magnifications of 10X, 30X, and 40X to determine whether specific dental microstructures (cementum annuli, rods, interrods, Striae of Retzius, dentinal tubules, and cementocyte lacunae) could be properly viewed and analyzed using the method.Sample preparation mandated that each sample maintain the same thickness, however, 11 samples were too opaque to be viewed under a microscope. For the 15 viewable samples, the polarized light microscope showed evidence of the crystalline structure of enamel with the presence of birefringence. At 40X magnification, linear demarcations were present in all samples that likely indicate the relationship between the rods and interrods of the enamel prism. The irregular outline of enamel crystals was seen in four samples under polarized light microscope. Striae of Retzius were only seen in one sample. Dentinal tubules were viewable in all samples under both types of microscopy. Cementocyte lacunae were visible only under polarized light microscopy and were viewable in every sample. Cementum annulations were not visible under either microscope. In sum, the Matt modified method is not appropriate for viewing cementum annuli of Striae of Retzius, but can be used to view cementocyte lacunae and dentinal tubules. While this method is not necessarily better than histology for viewing microstructures, it is a more easily accessible method for individuals who do not have the time, money, or training to conduct histological preparation on their own.

Kayla Pack Watson
Graduate Program: Master of Science in Communication Student
Advisors: Elizabeth Craig and Jessica Jameson
Poster Number: 185

Exit, Voice, and Millennial Loyalty: An Authoethnography Examining Psychological Contract Breach and Generational Values

According to PEW Research, Millennials are now the largest generation in the workforce and are changing jobs at an average rate of once per 18 months. This can be costly for companies for both money and time, and can be problematic for millennial workers who would like to find a steady job where they feel valued. As a millennial in the workforce, this autoethnographic study uses the framework of Hirschman's (1960) Exit, Voice, and Loyalty as it relates to psychological contract breach. With the setting of the narrative held at a group of radio stations in rural North Carolina that have had a recent restructuring of roles due to the departure of a longtime leader, the differences in generational values are examined, along with what contracts were broken due to conflict and miscommunication. The study revealed that implicit and other values held as a Millennial were leading factors in the eventual exit from a once-loved organization, and that closer examination of these and other values are needed. By working through and describing my own experiences through research and narrative, it is my hope that scholars will continue to dig deeper into the organizational values of millennials in a way that would be beneficial to the overall well-being and mental health of organizational members so they will not have to endure the same struggle that I had to overcome.

Xiqian Zhang
Graduate Progam: Anthropology
Advisor: Tim Wallace
Poster Number: 201

Cycling on China's Route G318: Body, Modernity, and Masculinity

For three months in the summer of 2017 I did research on the journey of cyclists who ride China's Route G318. This is an arduous, one-month, 2000 km., high altitude cycling journey from Chengdu to Lhasa. My study explores what the journey consists of, as well as the riders' motivations for the journey, and the gender relationships that emerge during the journey. My data is primarily qualitative, gained from participant observation as a cyclist, in addition to 256 valid, in-depth interviews and 510 questionnaires. Tourism itself is a phenomenon that has natural links to modernity. The special touristic journey is one way of constructing a self-identity through bodily movement. In my analysis I reflect on earlier research on existential authenticity and tourism re-examining it in the light of my own data. The research and analysis shows that the risks and bodily suffering from the journey is one way to demonstrate male cyclists' masculinity which is hard to find in their regular lives, wherein female cyclists who complete the journey are usually viewed as "manly" women. I conclude that cycling G318 is a journey for challenging, enjoying, and contemplating one's place in life, transcending oneself, and escaping modernity temporarily, through the efforts being made by one's body as he or she completes the 2000 km. journey.

College of Management

Carmen Buckner
Graduate Program: Global Luxury and Management
Advisor: Kristie McGowan
Poster Number: 23

The Fine Line Between Inspiration and Commodification of Cultures

Clothing as a material culture historically has had an important role in stratifying societies by symbolizing differences between and across different groups. Modern high fashion continues to serve a similar purpose which is bound to implicit and explicit sociocultural contexts and histories as well as power relations. While Parisian runway shows are considered as some of the most innovative and influential sources of fashion and style, they are also showcasing how high profile designers traverse the line between appropriation and appreciation when exploring elements from cultures outside of their own. The aim of this study is to survey how designers and fashion houses are incorporating or appropriating foreign cultures into high fashion. It also tries to explore the more appropriate ways for high fashion designers to demonstrate their admiration for other cultures instead of commodifying them. The methodology consisted of systematic content analysis of 245 Paris fashion runway show photographs from the 90's to today as curated by Vogue, combined with semi-structured interviews. Results showed that the designers and fashion houses reviewed are struggling to find a balance between paying homage to a cultural group and commodifying it. A key finding shows that there are issues with appreciation without representation: while at least half of the runway looks were inspired by African regions, less than a fifth of the models were models of color. Another key finding shows that designers are most likely to decontextualize the use of jewelry and accessories creating a "mix and match ethnic" dilemma. The study concludes that there should be a more holistic approach from designers wanting to incorporate outside cultural influences into their collection. It should include consulting with local designers, education about the cultural histories and contexts, and incorporation of more models of color to better depict the cultural landscape.

William Harris
Graduate Program: Economics
Advisor: Umut Dur
Poster Number: 56

Housing Problem with Multiple Preferences

In the standard housing allocation problem there is a single group of students that are applying to a group of rooms where each room has enough space for a single student. While this simple version has led to various theoretical implications it does not necessarily represent the real-world problem that university housing faces. In an attempt to more accurately depict the problem university housing faces I have modified the standard housing problem to increase the number of available beds in a room as well as divided the students into groups. One group of students, noisy, is only interested in getting the room highest on their rankings and the other, quiet, is concerned with who their roommate is in addition to the room. Under this framework, I show that the standard mechanisms does not achieve its desired properties and I introduce a dynamic mechanism which has better properities.

Kersey C. Moseley
Graduate Program: Global Luxury and Management; North Carolina State University and Skema Business School Paris
Advisor: Kristie McGowan
Poster Number: 119

The Loudest Horsepower on Social Media: A study on select luxury automotive brands and their social media engagement levels

Once feared by the luxury industry, social media has been adopted by a multitude of luxury brands. With a focus on the luxury automotive industry, the overall purpose of this study is to provide a better understanding of social media engagement of select luxury automotive brands and their consumers across specific social media accounts. This research exploited a qualitative research method approach with a focus on content analysis, specifically netnography. The question answered over the course of this dissertation is what luxury automotive brands are taking advantage of social media and outperforming their competitors. Through research and analyzation of select luxury automakers and their social media, the final outcome of the study is to identify the leaders and laggards on social media and better comprehend and differentiate the motives that drive engagement and reach for each autonomous luxury car brand. Using social media engagement features (likes, comments, followers, views, etc.), numerous engagement rates were calculated to help gain insight into each select automaker and their social media platforms, Facebook and Instagram. Based off the findings, Mercedes-Benz and Ferrari were the identified leaders while Porsche and Rolls-Royce were the laggards of this study. The results provided overall theme recommendations and key insight that can be applied to luxury automakers and brands beyond this research. The following recommendations drawn from this research goes as follows: no brand is too prestigious for social media, understand your audience and their needs, cultivate relationships, and gain engagement by leveraging news and events.

Kelly Nelson, Zachary Brown, and Lee Parton
Graduate Program: Economics
Advisor: Zachary Brown
Poster Number: 110

Biofuels Policy and Innovation Spillovers: Evidence from Patent Indicators

Policies intended to mitigate climate change or reduce energy dependence can influence firms' research and development (R&D) decisions. Policies intended to increase demand for a product can also result in increased innovation in that product due to incentives to develop new technologies (Clancy and Moschini, 2017). Firms investing R&D effort into one area may experience enhanced research productivity in additional fields via a "spillover" effect.

According to previous studies, alternative energy policies produce mixed results in generating innovation (Johnstone et al 2009; Nemet 2009; Dechezlepetre and Glachant 2014). In an effort both to reduce emissions and to develop domestic energy sources, governments have implemented policies to increase biofuels production and develop new technologies through directed R&D.

This paper uses raw and quality-weighted patent counts as measurements of, respectively, effort toward innovation and output of innovative activities (Hausman et al 1984; Griliches et al 1986; Griliches 1990; Hall et al 2005). We examine the impact of biofuels policies on three categories of patents: biofuels, biofuel-related plant technology (BP), and non-biofuel-related plant (plant) technologies. We use Bayesian model averaging to overcome issues with collinearity in the set of control variables. Ethanol mandates increased quality-weighted biofuels patenting while having no significant effect on quality-weighted plant innovation. Several policies had a null or negative effect on biofuels innovation and a null or negative effect on BP and plant innovation. Sustainability criteria increased innovation in biofuels technologies and plant technologies while decreasing innovation in BP technologies. Subsidies for R&D increased weighted plant patenting while decreasing quality-weighted and raw BP patents. Our findings support the hypothesis that certain policies induce innovation in biofuels with less support for the spillover hypothesis.

Alexandra N. Simpson
Graduate Program: Global Luxury and Management; North Carolina State University and Skema Business School Paris
Advisor: Kristie McGowan
Poster Number: 159

Athleisure in Luxury: A study on athleisure in the apparel industry and how it has affected luxury apparel brands

The apparel industry has generated many trends over the years but one trend has become a lifestyle for many consumers: athleisure. Athleisure falls under the activewear category, which has contributed greatly to the growth in the apparel industry over the past few years. Because of strong growth and a movement in consumer lifestyles, athleisure is an attractive venture for many brands. The purpose of this study is to research the current state of athleisure and discover how it has affected luxury apparel brands in particular. Secondary research was initially conducted in order to better understand the activewear industry and the drivers behind its growth. Netnography and content analysis were then used to conduct online observations based on brand websites and to quantify results in order to determine which luxury and premium brands currently offer activewear and athleisure. In addition, social media was observed to make conclusions about the marketing messages of luxury brands and their activewear collections. Finally, small, private label activewear brands were observed and consumer content was explored to make conclusions based on the importance of athleisure to the luxury consumer. It is evident from this research that athleisure is present in the luxury industry, specifically, and is important to the luxury apparel consumer. It was found that a significant portion of the luxury brands studied offered athleisure products to their customers. In addition, by studying the marketing of the brands and consumer content, it is clear that athleisure has become an important part of the luxury consumer's everyday wardrobe, worn in and out of the gym. This research confirms the presence of athleisure in the luxury apparel industry and indicates the importance of future research for luxury brands.

College of Natural Resources

Claudia Alberico[1], Dustin Fry[2], Oriol Marquet[1], Elizabeth Mazak[1], Gina Lovasi[3], J. Aaron Hipp[1], and Myron Floyd[1]
Graduate Programs: Parks, Recreation, and Tourism Management, North Carolina State University[1]; Epidemiology, Columbia University[2]; Epidemiology and Biostatistics, Drexel University[3]
Advisor: J. Aaron Hipp
Poster Number: 6

Park use and physical activity of children in low-income, racial and ethnic minority communities (PARC3 Study): results from systematic observations in New York City parks

Childhood obesity is a public health challenge and physical activity promotion, specially in parks, is recognized as an ally in prevention strategies. However, it is not well understood how children from racial and ethnically diverse backgrounds in low-income neighborhoods use parks and their attributes. The aim of this study was to describe patterns of park use and physical activity among children from low-income and ethnic minority populations, and associations between park attributes and level of adult supervision. Twenty NYC public parks were selected in low-income neighborhoods with high presence of Latino and Asian populations (>25%). Target areas (n=167) were scanned with SOPARC between one and four times during one-hour observation periods (10am, 3pm, 4:30pm, or 6pm); two weekdays and two weekend days in spring and summer 2017. Preliminary results show over 26,000 counts observed in all parks; 58% in Asian neighborhood parks, 63% male. More children and adults (30% and 31%, respectively) were observed compared to younger children (14%), teens (23%), and seniors (2%). Physical activity levels were predominately moderate for young children (53.5%), children (53.3%), and teens (51.3%) while sedentary for adults (50%) and seniors (72.7%). Mean number of people observed in the different target areas show diverse use of space in Asian and Latino area parks: seating areas (n=15.2, SD=7.6), fields (13.6, SD=6.7) and basketball courts (9.2, SD=5.3); general courts (15.4, SD=7.5), volleyball court (7.9, SD=5.1), and baseball fields (7.6, SD=8.1), respectively. Future analyses include physical activity levels within the different types of target areas and comparisons between park ethnicities and individual variables. It is important to explore the data further to understand how the presence and participation of adults could constrain the child's use of space and levels of physical activity. There seems to be an opportunity to promote more active park visits for adults.

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Advisors: Christopher E. Moorman, Dennis W. Hazel, and Cathryn H. Greenberg
Poster Number: 17

Impact of Logging Residue Retention on Small Mammals in the Southern Appalachian Region

There is growing interest in the use of wood for bioenergy. However, removing low value woody material for renewable energy could reduce downed wood important as food and cover for ground-dwelling wildlife that use young forest. We examined the relationship between levels of downed woody debris and occurrence of mice (Peromyscus spp.) following timber harvests in western North Carolina. We sampled mice in 10 sites that were clearcut or shelterwood harvested in 2013-2015; 5 of the sites were hardwood stands prior to harvest and the other 5 were dominated by white pine (Pinus strobus). From May to August of 2016 and 2017, we captured mice using 60 Sherman traps per site spaced every 15 m and checked for 5 consecutive days. Traps were categorized as either ≤5 m from coarse woody debris (near debris) or >5 m from coarse woody debris (far from debris). Variables for analysis also included vegetation structure and composition at each trap and site-level woody debris volumes, measured using prism sweep sampling. Approximately 67% of the traps were located near debris and 33% were far from debris. Likelihood of capture was lower in hardwood sites than in white pine sites (estimate -0.38, standard error 0.15, p-value 0.01). Logistic regression analysis indicated a greater likelihood of capture at traps near coarse woody debris and a lower likelihood of capture at traps surrounded by more grass and forb cover. Piles of logging debris retained following harvest may provide critical resources for mice and other early succession wildlife.

Bruno Kanieski da Silva
Graduate Program: Forestry and Environmental Resources
Advisors: Frederick W. Cubbage and Robert C. Abt
Poster Number: 73

Is Pellet Production causing structural change in the Pulpwood market in the US South?

The southern United States is one of the largest wood producers in the World. There are thousands of landowners and timber consumer interacting over time in a complex timber market web. Pulpwood has the most substantial volume share, and its consumers were concentrated in Pulp and Paper Industries and Composite Panel. However, in the last decade, the European energy policies have attracted wood-pellets facilities and increased the competition for wood residuals and pulpwood in the US South. Between 2005 and 2015, the capacity of wood pellet production went from 68 thousand to 6.4 million green ton per year. We investigated how pellet mills have impacted pulpwood market structure in the US South. Rather than focusing exclusively on price elasticities, we progress by examining how wood pellet production has impacted spatial transmission of pulpwood prices. Pairwise price ratios were modeled using Smooth Transition Regression (STR) to identify changes in the cointegration (linkage) between markets over time. The market linkage was fitted as a function of market distances, industry concentration and capacity of pellet wood production. Initial results show that US South is composed of different markets clusters of which its configuration varies over time. Distance was the only factor driving market linkages; the capacity of pellet and Pulp and Paper industries had no effect. Our research suggests spatial price transmission is not constant over time and pellet mills have not caused structural change in the pulpwood market in the US South.

Jason Matney
Graduate Program: Geospatial Analytics
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Poster Number: 101

Decision Support for Parks and Protected Areas: Leveraging big data to estimate visitation & examine visitor behavior

Recreation and tourism researchers have long sought robust visitation estimates for parks and protected areas. For instance, the U.S. National Park Service combines data derived from diverse collection methods such as on-site tallies, automated counters, and administrative sources to generate recreation visitation estimates. Due to these inconsistent approaches, resulting estimates may suffer in robustness and, consequently, validity. Newly-available digital big data offer potentially consistent alternatives for investigating visitation across parks and protected areas (Sessions, Wood, Rabotyagov, & Fisher, 2016; Walden-Schreiner, Leung, & Tateosian, 2018). Social media in particular is a relatively new source of volunteered data, wherein geotagged photographs can provide spatial, temporal, and demographic information related to visitors of these protected areas. Recent studies have shown that concentrations of geotagged posts within a given protected area are broadly consistent with worldwide visitation patterns (Wood, Guerry, Silver, & Lacayo, 2013). With increased use of mobile technologies that support photo geotagging and hashtag indexing, volunteered social media posts can effectively be incorporated into visitation estimation models and visitation predictive models. Additionally, the consideration of site-specific attributes such as land features, facility amenities, and information derived from overnight reservations, can improve modeling efforts. We will incorporate concentrations of geotagged photos and site-specific attributes into both linear mixed models that capture local variation between sites as well as hierarchical linear models that incorporate spatial random effects. By improving the precision and consistency of visitation estimates for parks and protected areas, natural resource managers will be better supported as they make decisions relevant to balancing visitor impacts and visitor experiences. Preliminary analysis consisted of exploring relationships between geospatial data, leveraging general linear models. Initial findings showed a larger proportion of variance in NPS visitation estimates explained by Panoramio geotagged photographs than variance in Recreation.gov reservations.

Shahab Nazariadli, Duarte B. Morais, Kyle Bunds, Perver Baran, and Stacy Supak
Graduate Program: Parks, Recreation and Tourism Management
Advisor: Duarte B. Morais
Poster Number: 123

Rural tourism microentrepreneurs' representations and urban tourists' perceptions of rural geographies: Hearing voices of subaltern

Developing tourism microentrepreneurship is often considered a key strategy for enabling economic rejuvenation of rural communities. However, tourism representations are reportedly characterized by Orientalist and Urbanormative biases, stereotyping the subordination of the Rural Other by the superior Urban Centers. In the context of rural tourism, microentrepreneurs' success has been linked to their control over how local histories and identities are represented to visitors. Unfortunately, subaltern rural communities are generally relatively passive in the process of influencing visitors' images and resort to complying with external representations. Conversely, the unscripted spaces created by tourism microentrepreneurship have been reported to afford opportunities for self-representation and improved livelihoods. Therefore, the purpose of this research is to examine the self-representations of rural tourism microentrepreneurs in contrast with the images urbanite tourists have of them. Namely, first, I engaged a small set of rural tourism microentrepreneurs in an autophotography activity to deeply examine the ways they wish to represent themselves to visitors. Second, I developed and validated an online web application, named "VQMethod," designed to enable the online administration of Q-Methodology. And third, I used Q-Methodology to examine the dissonance between the self-representations by rural tourism microentrepreneurs in the NC Piedmont region with the images potential urban tourists have of them. The findings revealed four different viewpoints among rural and urban participants about rural Piedmont, NC namely, "antiquated and boundless rural", "healthy-conscious of mass unhealthy", "peaceful rural" and "authentic rural". The findings shed light on the prominence of peoples' voices in inclusive tourism development. Besides, the VQMethod web application showed high levels of reliability, validity and agreement with the paper-based Q method research.

Justine A. Neville and Ryan E. Emanuel
Graduate Program: Forestry and Environmental Resources
Advisor: Ryan E. Emanuel
Poster Number: 126

When high waters recede and the floodplain reemerges: Evaluating the lingering effects of extreme flooding on stream N processing

In 2016 Hurricane Matthew brought immense flooding and devastation to the Lumbee (aka Lumber) River basin. Some impacts are obvious, such as deserted homes and businesses, but other impacts, including long-term environmental, are uncertain. Extreme flooding throughout the basin established temporary hydrologic connectivity between aquatic environments and upland sources of nutrients and other pollutants. Though 27% of the basin is covered by wetlands, hurricane-induced flooding was so intense that wetlands may have had no opportunity to mitigate delivery of nutrients into surface waters. As a result, how Hurricane Matthew impacted nitrate retention and uptake in the Lumbee River remains uncertain. The unknown magnitude of nitrate transported into the Lumbee River from surrounding sources may have lingering impacts on nitrogen cycling in this stream. With these potential impacts in mind, we conducted a Lagrangian water quality sampling campaign to assess the ability of the Lumbee River to retain and process nitrogen following Hurricane Matthew. We collected samples before and after flooding and compare first order nitrogen uptake kinetics of both periods. The analysis and comparisons allow us to evaluate the long-term impacts of Hurricane Matthew on nitrogen cycling after floodwaters recede.

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Advisor: Helena Mitasova
Poster Number: 139

Generalized 3D fragmentation index derived from lidar point clouds

Point clouds with increased point densities create new opportunities for analyzing landscape structure in 3D space. Taking advantage of these dense point clouds we have extended a 2D forest fragmentation index developed for regional scale analyses into a 3D index for analyzing vegetation structure at a much finer scale. Based on the presence or absence of points in a 3D raster (voxel model) the 3D fragmentation index is used to evaluate the configuration of a cell's 3D neighborhood resulting in fragmentation classes such as interior, edge, or patch. In order to incorporate 3D fragmentation into subsequent conventional 2D analyses, we developed a transformation of this 3D fragmentation index into a series of 2D rasters based on index classes. We applied this method to a point cloud obtained by airborne lidar capturing a suburban area with mixed forest cover. All processing and visualization was done in GRASS GIS, an open source, geospatial processing and remote sensing tool. The newly developed code is also publicly available and open source. The entire processing chain is available and executable through Docker for maximum reproducibility. We demonstrated that this proposed index can be used to describe different types of vegetation structure making it a promising tool for remote sensing and landscape ecology. Finally, we suggest that processing point clouds using 3D raster methods including 3D raster algebra is as straightforward as using well-established 2D raster and image processing methods.

Anna Petrasova[1], Payam Tabrizian[1], Garrett Millar[1], Brendan Alexander Harmon[1,4], Vaclav Petras[1], Helena Mitasova[1,2], and Ross Kendall Meentemeyer[1,3]
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Advisor: Helena Mitasova
Poster Number: 140

Learning Topography with Tangible Landscape Games

Understanding topography and its representations is crucial for correct interpretation and modeling of surface processes. However, novice earth science and landscape architecture students often find reading topographic maps challenging. As a result, many students struggle to comprehend more complex spatial concepts and processes such as flow accumulation or sediment transport.

We developed and tested a new method for teaching hydrology, geomorphology, and grading using Tangible Landscape—a tangible interface for geospatial modeling. Tangible Landscape couples a physical and digital model of a landscape through a real-time cycle of hands-on modeling, 3D scanning, geospatial computation, and projection. With Tangible Landscape students can sculpt a projection-augmented topographic model of a landscape with their hands and use a variety of tangible objects to immediately see how they are changing geospatial analytics such as contours, profiles, water flow, or landform types. By feeling and manipulating the shape of the topography, while seeing projected geospatial analytics, students can intuitively learn about 3D topographic form, its representations, and how topography controls physical processes. Tangible Landscape is powered by GRASS GIS, an open source geospatial platform with extensive libraries for geospatial modeling and analysis. As such, Tangible Landscape can be used to design a wide range of learning experiences across a large number of geoscience disciplines.

As part of a graduate level course that teaches grading, 16 students participated in a series of workshops, which were developed as serious games to encourage learning through structured play.

In this poster, we introduce Tangible Landscape, describe the games, and present results of a user experience survey we conducted as part of the workshops. All developed materials and software are open source and available online.

Ann Savage
Graduate Program: Parks, Recreation, and Tourism Management
Advisor: Carla Barbieri
Poster Number: 153

Sowing Seeds of Success: A Systemic Evaluation of Women in Agritourism

Background: The public's burgeoning interest in local foods and farmers' interest to increase their incomes is currently driving the development of agritourism (educational or recreational activities offered on working farms). Although women often initiate agritourism, the extant literature indicates they earn less than men do, possibly because women define success holistically. However, a holistic evaluation of women in agritourism's success is yet to exist. Therefore, a feminist philosophical framework was used to compose a holistic definition of women's success and identify elements affecting their achievements.

Methods: A survey was used to query women farmers in North Carolina about their farming values, indicators of success, challenges faced, agricultural trends, and their socio-demographic, farm and family characteristics. The survey, launched in spring 2017, yielded 180 usable responses (59.1% response rate). Data were analyzed using descriptive statistics, exploratory factor analysis, and simultaneous multiple linear regressions ($p<.05$) to identify associations between women's success (dependent variables) and their values, farm household attributes, and societal trends and challenges (independent variables).

Results: A typical respondent averaged 49 years old, worked full-time on-farm (56%) and were first generation farmers (61%). Women indicated self-fulfillment (M=4.6) and business continuance (M=4.5) are the most important dimensions of their success, followed by family connectedness (M=4.1), personal aspirations (M=4.1), and civic recognition (M=3.9). Statistically, significant models indicate that farmer and farm household attributes are associated with all success dimensions (except self-fulfillment) while societal trends and challenges are associated with civic-recognition, self-fulfillment, and business continuance.

Conclusions: Results enhance the cross-disciplinary understanding of agritourism incorporating a systemic approach intersecting agriculture, gender, rural entrepreneurship and tourism studies. Study results are also critical to strengthen and maximize the growth of agritourism by identifying the attributes that increase the chances of success among women farmers.

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Advisor: Ryan E. Emanuel
Poster Number: 166

Tree water sources and residence times in a southern Appalachian forest

The development of accurate hydrologic models is key to describing changes in hydrologic processes due to land use and climate change. Hydrologic models typically simplify biological processes associated with plant water uptake and transpiration, assuming that roots take up water from the same moisture pool that feeds the stream; however, this assumption is not valid for all systems. Novel combinations of climate and forest composition and structure, caused by ecosystem succession, management decisions, and climate variability, will require a better understanding of sources of water for transpiration in order to accurately estimate impact on forest water yield. Here we examine red maple (Acer rubrum), rhododendron (Rhododendron maximum), tulip poplar (Liriodendron tulipifera), and white oak (Quercus alba) trees at Coweeta Hydrologic Laboratory, a long-term hydrological and ecological research site in western NC, USA, and explore whether source water use differs by species and landscape position. We analyzed stable isotopes of water (18O and 2H) in tree cores, stream water, soil water, and precipitation using laser spectrometry and compare the isotopic composition of the various pools. We place these results in broader context using meteorological and ecophysiological data collected nearby. These findings have implications for plant water stress and drought vulnerability. They also contribute to process-based knowledge of plant water use that better captures the sensitivity of transpiration to physical and biological controls at the sub-catchment scale. This work aims to help establish novel ways to model transpiration and improve understanding of water balance, biogeochemical cycling, and transport of nutrients to streams.

Matt Stillwagon, Melinda Martinez, and Marcelo Ardón
Graduate Program: Forestry and Environmental Resources
Advisor: Marcelo Ardón
Poster Number: 167

Increasing Salinity in the Albemarle-Pamlico Estuary System

The Albemarle-Pamlico estuary system (APES) is the second largest estuary in the lower 48 States, and surrounds one of the largest expanses of coastal freshwater wetlands in the country. The Intergovernmental Panel on Climate Change predicts that by the end of this century the global sea level will rise by as much as 82 cm, which could result in a loss of 1260 to 3020 km2 of wetland habitat around the APES. Before this large-scale inundation occurs, many coastal ecosystems are already experiencing elevated salinity and saltwater intrusion. Saltwater intrusion can be expected to lead to shifts in the biotic and chemical composition of these systems as well as altering biogeochemical cycles. In this study, we used surface water data from the NC Department of Water Quality to investigate change in the salinity of the APES over the last 45 years. During this time, salinity has been increasing in the APES, with the saltwater/freshwater divide moving further inland. There is high variability in salinity both between and within years, with the highest salinity occurring in late summer, following years with low precipitation. Annual average salinity in the APES has increased by 2 ppt from 1970 to 2015, and the annual maximum increased nearly 15 ppt from the 1970s to the 2010s. With the APES contributing half of fish nursery area from Maine to Florida, this could have serious consequences for Atlantic fisheries. At this point it is unclear what is driving the increase in salinity in the estuary, but decreases in river discharge, changes in precipitation regimes, and sea level rise could all be contributing to the long-term pattern. This work is contributing to our understanding of the effects of climate change on the estuary, and could help us forecast how coastal ecosystems will respond to accelerating sea level rise.

Payam Tabrizian[1,2], Perver Baran[1,2], Anna Petrasova[1], Helena Mitasova[1,3], and Ross Meentemeyer[1,4]
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Advisors: Perver Baran and Ross Meentemeyer
Poster Number: 170

Viewscape modeling for urban environments using LiDAR and Immersive Virtual Environments

Viewscape modeling- a process of defining, parsing and analysis of landscape visual space's structure within GIS- has been commonly used in applications ranging from landscape planning and ecosystem services assessment to geography and archaeology. While viewscape models have been increasingly used to assess landscape characteristics across continental, regional, and landscape scales, their application for modelling perceptions in urban environments, particularly at the site scale, remains surprisingly unexplored.Modeling urban environments however, require incorporation of fine-grained landscape structure (eg., vegetation) and patterns (e.g, landcover) that are typically omitted from visibility calculations or unrealistically simulated leading to significant error in predicting visual attributes. This poster demonstrate a multi-method approach for modeling viewscapes for urban environments using LiDAR data and Immersive Geovisualization. We develop a viewscape model for an urban park based on a high-resolution LiDAR sourced DSM with improved vegetation visibility and a detailed landcover obtained from high-resolution multi-spectral imagery. We compare the model output with human subject's assessment of photorealistic immersive panoramas captured from candidate location across study area to assess the capacity of the viewscape model to predict visual characteristics.

College of Sciences

Omadillo Abdurazakov[1], Avinash Rustagi[1], James K. Freericks[2], and Alexander F. Kemper[1]
Graduate Programs: Physics, North Carolina State University[1]; Physics, Georgetown University[2]
Advisor: Alexander F. Kemper
Poster Number: 1

Ultrafast Electron and Lattice Dynamics In Pump-Probe Spectroscopy: Role of Excited Phonon Populations

With the ability to probe/control matter at the timescales intrinsic to many-body interactions, pump-probe spectroscopy has become a driver of recent advances in uncovering the physics of quantum materials. Despite the richness and complexity of phenomena out-of-equilibrium, the understanding mostly rely on phenomenological models such as the two-temperature model or the semi-classical Boltzmann equation. A comprehensive understanding of nonequilibrium phenomena is at the frontier of ultrafast physics. We study the dynamics of electrons weakly interacting with the lattice by treating them quantum mechanically using the nonequilibrium Keldysh formalism. Particularly, the role of excited phonons in the relaxation dynamics of electrons is of interest. When significant energy is deposited by the pump, or when the phonons are resonantly excited, the effect of excited phonons on the electrons plays an important role. To address this, we incorporate the changes induced by electrons on the phonons by solving a self-consistent equation of motion for phonons. Our results reveal several novel aspects of the population dynamics that are otherwise absent. We show that the excited phonon populations can determine the population relaxation pathways, which are no longer governed by equilibrium physics. They suppress the decay rates significantly and induce strong time dependence. These dynamic changes concomitantly renormalize the lattice properties. As the heating by electron relaxation causes efficiency losses in solar cells, controlling the relaxation rates by the excited phonons could be used in energy devices. Our work is an important step toward a comprehensive understanding of the phenomena out-of-equilibrium and the opportunities offered to tune the material properties for desired functionalities by ultrafast lattice modulations.

Farida S. Akhtari
Graduate Program: Genetics
Advisor: Alison Motsinger-Reif
Poster Number: 4

Dose Response Analysis in Cell Line Models for Cancer Pharmacogenomics

The American Cancer Society estimated over 1.6 million newly diagnosed cases of cancer and over 600,000 deaths due to cancer in 2017, in the United States alone. While therapeutic options for several forms of cancer have been improving, predictive markers for selecting the most efficient anti-cancer drug regimen remain elusive. Understanding the genetic factors responsible for the variability in individual response to a drug is critical for cancer pharmacogenomics, as failed treatments are often fatal.

Towards this goal, we are investigating the genetic factors influencing the variation in drug response to 45 commonly used, FDA-approved anti-cancer drugs, which include 15 tyrosine kinase inhibitors (TKIs) and 2 monoclonal antibodies in cell lines derived from the racially and ethnically diverse 1000 Genomes Project. Results from our multivariate genome-wide association study (GWAS) have identified 40 unique SNPs across 21 unique drugs, associated with drug response. These putative markers are in 15 unique genes, several of which, such as NFAT5 and NQ01, are involved in the cell signaling and cell proliferation pathways, thus making them interesting candidates for follow-up in functional validation studies. We will perform small interfering RNA (siRNA) knockdown experiments and use other suitable in vitro methods to validate the significant findings from our GWAS results. We will also analyze RNA-sequencing data to determine if differences in gene expression levels are associated with variation in drug response in individuals.

The completion of this study will elucidate the biological mechanisms of action by which the GWAS-identified SNPs and their associated genes influence anti-cancer drug response. Thus, we will be able to identify novel, causal genetic variants, that may have potential clinical relevance in cancer therapeutics.

Jennifer Baltzegar[1,2] and Fred Gould[2,3]
Graduate Programs: Genetics[1]; Genetic Engineering and Society Center[2]; Entomology and Plant Pathology[3]
Advisor: Fred Gould
Poster Number: 11

Evolution of Insecticide Resistance in Aedes aegypti in Iquitos, Peru

The mosquito, Aedes aegypti, transmits zika, dengue fever, chikungunya, and yellow fever, which affect hundreds of millions of people annually. One of the most prevalent methods to control the spread of arboviruses is by using insecticides. Pyrethroids, a common class of insecticides, has been implicated in the development of knockdown resistance (kdr) in multiple insect species. With frequent and recurrent applications of pyrethroids to control Ae. aegypti populations, increased levels of kdr are expected to occur. This is a major concern for the current and future efficacy of this control method. Many genetic loci associated with kdr resistance have been identified; however, two single nucleotide polymorphisms (SNPs), F1534C and V1016I, located in the voltage-gated sodium channel have been shown to be important in Central and South America. This study utilizes allele-specific PCR to genotype these two SNPs and analyze the evolution of insecticide resistance across an 18-year period in Iquitos, Peru. This time period encompasses all years of pyrethroid use in the city and includes samples collected prior to implementation of and after cessation of spraying. The results present an intriguing dynamic between resistant haplotypes that improve understanding of insecticide resistance evolution. Multiple resistant haplotypes exist and increase quickly under the selection pressure of pyrethroid exposure. Through further analysis, we found significant heterogeneity in fine-scale patterns of insecticide resistance, leading to a better understanding of Ae. aegypti population structure. Together these data provide crucial information to improve mosquito control programs for delaying widespread insecticide resistance and for developing the empirical evidence used to model emerging mosquito control techniques.

Patrick Barry[1], Nobuo Sato[2], Wally Melnitchouk[3], and Chueng-Ryong Ji[1]
Graduate Programs: Physics, North Carolina State University[1]; University of Connecticut[2]; Jefferson Lab[3]
Advisor: Chueng-Ryong Ji
Poster Number: 13

First Pion Parton Distribution Function at High- and Low-x

In addition to having a valence structure of two up quarks and one down quark, the proton holds an abundance of sea quarks and gluons, which comprises its internal structure and total mass. The pion is intimately related with the proton as analyses indicate an effective pion cloud exists around the core valence structure. The E866 experiment done at Fermilab was the first evidence of a light-sea-quark asymmetry in the proton, thought to be caused by the pion. We study the structure of the pion through its parton distribution function (PDF). The PDF is the probability of finding a parton (quark, antiquark, or gluon) at a momentum fraction, x, of the pion between 0 and 1. The sum of the momenta of each parton is 1, the total momentum of the pion. The valence quarks carry most of the momentum, followed by the sea quarks and gluons, so they occupy the high- and low-x regions, respectively. We obtain universal observables of valence quark, sea quark, and gluon PDFs of the pion through procedure of global fitting to Drell-Yan (DY) and Leading Neutron (LN) datasets. The DY datasets E615 from Fermilab and NA10 from CERN measure the differential cross-section of a pion beam incident on a Tungsten target. We also use data from H1 and ZEUS done at HERA at DESY for the LN process. Here, an electron barely strikes a target proton, which splits into a neutron and a pion. We investigate various models that describe this splitting. The DY and LN datasets constrain the high- and low-x regions of the PDF, respectively. We use Monte Carlo (MC) methods to fit the parameters of the PDFs. We achieve chi-squared values of 0.96-1.04 among different splitting models. This analysis provides the first pion PDFs constrained by both high- and low-x datasets.

Samuel D. Flynn, James P. Kneller, Warren Wright, Charles Stapleford, and Gail C. McLaughlin
Graduate Program: Physics
Advisor: Gail McLaughlin
Poster Number: 44

Ghosts from a Dying Star: Using Neutrinos to Probe Supernovae

In a final act of splendor, some dying stars explode in one of nature's most dramatic and terrific displays; a supernova. The sheer violence of the explosion creates an environment unlike anything available on Earth, giving us an important glimpse of physics we would otherwise be unable to study. Despite our fascination with these cosmic catastrophes, there are still many unanswered questions surrounding supernovae. During the explosion of a core collapse supernova, ghostlike subatomic particles called neutrinos are produced in unfathomably large numbers. Neutrinos are nearly-massless particles which come in 3 flavors and possess the eerie ability to oscillate between these flavor states. Due to their lack of mass and charge, neutrinos don't get stuck bouncing off the hot matter of the explosion like photons do. With 99% of the gravitational binding of the star creating 1058neutrinos these ghostly particles are a prime candidate for probing the inner workings of supernova, provided we can understand the neutrino oscillations that occur. With this poster I will introduce the basics of neutrino astronomy, and the importance of neutrino oscillations in interpreting detector signals. I will then outline my work in calculating the detector signals from neutrinos which undergo non-standard interactions with matter, how such interactions change the physics in the supernova explosion, and whether these signals are detectable on Earth.

Masoud Ghasemi, Long Ye, Huawei Hu, and Harald Ade
Graduate Program: Physics
Advisor: Harald Ade
Poster Number: 50

Mapping out the miscibility gap of binary blends: Quantitative relations between interaction parameter, miscibility, and function in organic solar cells

The rapid increase in the power conversion efficiency (PCE) of polymer solar cells (PSCs) is mainly attained through controlling the favorable morphology in organic blends. Despite the clear importance of the molecular interaction between the conjugated polymer and small-molecule acceptors, as main driving force controlling the formation and purity of the domains in PSCs, its quantitative relation to device performance has remained elusive. The limitations of the current methods for quantifying the temperature dependence amorphous-amorphous interaction parameter (χaa (T)) can be regarded as the bottleneck to establish a morphology-performance correlation. Here, we introduce a new method using the easily accessible time of flight secondary ion mass spectrometry (ToF-SIMS) measurement to map out the miscibility gap of binary blends directly[1]. We then establish a direct correlation between χaa (T) and device characteristics (i.e., fill factor) which has the potential to eliminate trial-and-error approaches in device fabrication. Most significantly, our framework will pave a way to predict the morphology and stability of OSCs at actual processing and operating temperatures.

[1] L. Ye, H. Hu, M. Ghasemi, T. Wang, B. A. Collins, J.-H. Kim, K. Jiang, J. Carpenter, H. Li, Z. Li, T. McAfee, J. Zhao, X. K. Chen, J. Y. L. Lai, T. Ma, J.-L. Bredas, H. Yan, H. Ade, Nat. Mater. 2018, DOI: 10.1038/s41563-017-0005-1.

Md Nazmul Islam[1], Jonathan Stallings[1], Ana-Maria Staicu[1], Dustin Crouch[2], Lizhi Pan[3], and He Huang[3]
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Advisors: Jonathan Stallings and Ana-Maria Staicu
Poster Number: 67

Functional Variable Selection for a Low-Dimensional Robotic Hand Prosthetic

State-of-the-art robotic hand prosthetics produce finger and wrist movement through trained pattern recognition algorithms on electromyography (EMG) signals resulting from forearm muscle contractions. Two major limitations of this data-driven approach are the need for extensive training as well as recalibration across different arm postures. We develop a novel EMG-based functional linear model that accounts for the underlying biomechanics of hand movement and so is capable of producing natural, continuous movement of a robotic hand prosthetic regardless of position. The model is made parsimonious and interpretable through a two-step variable selection procedure motivated by the relaxed LASSO technique. A final model is then fit on the selected subset to reduce shrinkage bias of the regression functions. Our variable selection method is shown to identify clinically important EMG signals with negligible false positive rates for an able-bodied subject and, unlike pattern recognition, holds across different postures. The proposed methodology is also applicable in a general functional linear model setting where the functional coefficients vary over multiple covariates. An extensive simulation study shows excellent variable selection and predictive performance.

Christopher Kolb, John Blondin, Stephen Reynolds, and Kazimierz Borkowski
Graduate Program: Physics
Advisor: John Blondin
Poster Number: 78

Modeling the binary circumstellar medium of Type IIb/L/n supernova progenitors

Before a massive star ends its life in a powerful supernova (SN) explosion, it fills its environment with a dense stellar wind. This environment, known as a circumstellar medium (CSM), becomes visible during a supernova explosion as SN radiation illuminates the dense wind and as the SN blastwave collides with the surrounding CSM. We aim to better understand the development of this environment, particularly for systems where the exploding star is orbiting a companion star, and to study the impact of the resulting asymmetric CSM on the supernova's appearance. To achieve this, we model the stellar wind and subsequent supernova explosion in full 3D hydrodynamical computer simulations and characterize our model by fitting a polar-to-equatorial density contrast function. We find a correlation between density contrast and properties such as the rate at which the progenitor of the exploding star loses mass, how far it is separated from its companion, and its companion's mass.

Sanaz Koohfar and Divine Kumah
Graduate Program: Physics
Advisor: Divine Kumah
Poster Number: 79

Controlling the atomic and electronic reconstruction at manganite interface

Complex oxide heterostructures possess a wide range of functional electronic and magnetic properties including metal-insulator transitions, superconductivity, ferroelectricity and colossal magnetoresistance effects. At epitaxial interfaces formed between atomically thin complex oxide films, electronic, chemical and structural interactions can be used to effectively tune the physical properties of these materials. Using a combination of atomic-scale controlled thin film synthesis and high resolution synchrotron diffraction based imaging, we show that structural distortions at the interfaces between polar La1-xSrxMnO3 films and non-polar substrates can be effectively tuned by chemical modifications at these interfaces to control ferromagnetism in [001]-oriented La1-xSrxMnO3 films with thickness less than 1 nm. We show that atomic-scale chemical control at polar/non polar oxide interfaces provides a powerful route to engineer novel electronic and magnetic phenomena at complex oxide interfaces.

Alexandra Larsen[1], Brian J. Reich[1], Shu Yang[1], and Ana G. Rappold[2]
Graduate Programs: Statistics, North Carolina State University[1]; Office of Research and Development, Division of Environmental Public Health, National Health and Environmental Effects Research Laboratory, U.S. Environmental Protection Agency, NC[2]
Advisor: Brian J. Reich
Poster Number: 83

A Causal Spatial Analysis of Wildfire-Contributed PM2.5

Wildfire smoke contains hazardous levels of fine particulate matter (PM2.5), a pollutant studies have shown adversely effects the respiratory and cardiovascular health of exposed individuals. Accurate estimates of PM2.5 concentrations attributable to wildfires are key to understanding the extent to which wildfires contribute to poor air quality and to adverse health outcomes. We propose a method for separating estimates of wildfire-contributed PM2.5 from ambient PM2.5 concentrations using a novel causal inference framework and bias-adjusted computer simulations of PM2.5 under counterfactual scenarios. The numerical PM2.5 data for this analysis is from the Community Multi-Scale Air Quality (CMAQ) Modeling System, run with and without fire emissions across the contiguous U.S. for the 2008-2012 fire seasons. To account for biases, the CMAQ output is calibrated with observed data from the U.S. Environmental Protection Agency's Federal Reference Method (FRM) PM2.5 monitoring sites for the same spatial domain and time period. We use a spatial Bayesian model to estimate the effect of wildfires on PM2.5 and state assumptions under which the estimate has a valid causal interpretation. The analysis is run separately for nine regions that partition the contiguous U.S. based on similar climates. We find that the fire effect on PM2.5 is highest in areas of the U.S. where wildfires are most prevalent, including the West, Northwest and parts of the Southeast. Our results provide insight into using causal inference with numerical and spatial data, as well as a method that can be extended to investigate the causal effects of wildfire smoke on public health outcomes.

Mike Madden and Walter Robinson
Graduate Program: Marine, Earth, and Atmospheric Sciences
Advisor: Walter Robinson
Poster Number: 99

Can a suite of numerical model experiments capture key features of a flood-producing summer storm?

There is accruing evidence that climate change will amplify heavy, convective rainfall in future decades. After all, the Clausius-Clapeyron relationship suggests that a warming environment could increase the vapor pressure of water, should the relative humidity be held constant, and near-surface convergence processes could push the additional moisture above the lifting condensation level, where the extra condensation and latent heat processes could boost rainfall rates and updraft speeds. Several studies have attempted to obtain a more complete picture of how the storms of today could evolve under future climatological environments, but those studies sometimes lack robust conclusions because their regional/global climate models do not resolve convection and the underlying topography at appropriate scales. Studies that use highly-resolved, "convection-permitting" model configurations show promise, but are computationally demanding if lengthy periods are simulated.

To circumvent these difficulties, one can apply the pseudo-global warming (PGW) approach toward a singular event. An extreme phenomenon is simulated under a thermodynamic environment that is representative of a future climate (i.e., higher temperatures, sea-surface temperatures, water vapor concentrations) while the large-scale, synoptic weather patterns remain intact. We will eventually apply this technique to a loosely-organized, flood-producing mesoscale convective system (MCS) that occurred on July 16, 2016 over the U.S. Southeast, and test our previous assumptions regarding its potential increase in intensity with future warming. Our first step is to demonstrate our models' capabilities of reproducing the essential characteristics of the MCS within the current climate. Therefore, we will present a comprehensive evaluation of our control suite, which is comprised of Weather Research and Forecasting (WRF) model runs that were driven by 12-km North American Mesoscale reanalysis data and nested to convection-permitting domains of 4-km and 1.33-km over Raleigh, NC.

Rachael McCaully and Carli Arendt
Graduate Program: Marine, Earth, and Atmospheric Sciences
Advisor: Carli Arendt
Poster Number: 102

Influences of Moisture Regimes and Functional Plant Type on Nutrient Cycling in Permafrost Systems

In the permafrost-dominated Arctic, climatic feedbacks exist between permafrost degradation, soil moisture, plant functional type, and nutrient availability. Discontinuous permafrost regions contain both 1) regions with an absence of permafrost, resulting in increased drainage pathways and well-drained soils, suitable to shrub patches (including alders) and 2) areas with a presence of permafrost, limiting vertical drainage of soil-pore water creating elevated soil moisture content suitable to wet gramminoids. Previous investigations in degraded permafrost systems in AK show an elevated presence of nitrate (an important limiting nutrient within the Arctic) within and downslope of alder patches, and have established a negative correlation between soil moisture content and nitrate production. Further observations within these degraded permafrost systems are crucial to assess whether alders are drivers of, or merely respond to, nitrate fluxes. We investigate these feedbacks in the Seward Peninsula, AK, through research supported by the United States Department of Energy Next Generation Ecosystem Experiment (NGEE) - Arctic. We hypothesize that nitrate is likely accumulating within alder patches, through N2 fixation via a symbiotic relationship between alder roots and microbes, and subsequently migrating downslope. Soil pore-water chemistry and soil moisture content are analyzed from samples collected over various temporal and spatial scales within degraded permafrost to highlight the complex relationships existing between alders, soil moisture regimes, thaw depth, and available nitrate supply. From data collected previously for this project, we have discovered that nitrate concentrations vary substantially on short timescales and between adjacent patches. It is clear that alders exert controls on nutrient availability at our study location, although the magnitude and feedbacks of this control remain unclear. Understanding the role of nitrate in degrading permafrost systems, in the context of both vegetation present and soil moisture, is crucial to understand the impacts of a warming climate on biogeochemical cycling in degrading permafrost regions.

Stephanie McKnight
Graduate Program: Toxicology
Advisor: Gerald LeBlanc
Poster Number: 105

Disruption of Infradian Rhythms by Exogenous Chemicals

Biologic rhythms are used throughout nature to properly time important events. Infradian rhythms, a type of chronobiologic cycle that is longer than 24 hours, have rarely been the focus of chronobiologic research despite their abundance and little literature exists on their regulatory mechanisms. We used the model infradian rhythm that drives the linked processes of molting and reproduction in the crustacean Daphnia magna to investigate the regulation of these cyclical events and their disruption by chemical exposure. The molting and reproduction cycle in D. magna is an ~82-hour rhythm, carefully regulated by a gene expression cascade that has some orthologs to human circadian rhythm regulatory genes. GSK4112 is a small molecule inhibitor of human REV-ERB, a protein involved in regulating human circadian rhythm, that was developed to treat metabolic and sleep disorders. We hypothesized that GSK4112 would inhibit E75, the ortholog of REV-ERB in D. magna, and disrupt the infradian rhythms of molting and reproduction. Animals were continuously exposed to 1.0 uM, 3.0 uM, or 10 uM GSK4112 for a minimum of three days to a maximum of 21 days. Molting and reproduction were observed and the length of time between molting events was determined. The length of the intermolt duration increased following initial exposure to all concentration of GSK4112 for both adult and neonates. Daphnids exposed as neonates exhibited a significantly reduced growth rate and required significantly more time to attain reproductive maturation. These results indicate that infradian rhythms are susceptible to exogenous chemical exposures and could result in population level effects.

Carl J. Meunier, James G. Roberts, Gregory S. McCarty, and Leslie A. Sombers
Graduate Program: Chemistry
Advisor: Leslie A. Sombers
Poster Number: 91

Characterizing the Impedance of Carbon-Fiber Ultramicroelectrodes and Microenvironments: Impact on Fast Scan Cyclic Voltammetry Measurements

Background-subtracted fast-scan cyclic voltammetry (FSCV) employing carbon-fiber ultramicroelectrode (CFME) sensors has emerged as a powerful analytical technique for real-time monitoring of sub-second neurochemical fluctuations in a wide-range of biological preparations ranging from single-cells to behaving animals. Electrical properties and performance of CFME are altered by various surface chemistry, such as oxidation state and application of coatings, as well as by use in biological environments. Although noted, these effects are not well characterized and have largely been ignored, leading to misrepresentation of data and hindering advances in quantification and sensor design. Herein, we employ model circuits to alter the electrochemical system's impedance to investigate resulting changes to FSCV measurements. The data show that uncompensated impedance systematically decreases the magnitude of the potential applied to the CFME surface, impacting sensitivity and voltammogram shape which are used to construct models for multivariate analysis. These data were used to develop and validate an in situ model to determine the oxidation potential of dopamine in live tissue. Furthermore, we utilize electrochemical impedance spectroscopy to monitor CFME impedance changes resulting from various surface conditions and demonstrate their impact on FSCV recordings. It is shown that implantation in tissue increases impedance over time, which directly impacts resulting FSCV signals, and that these effects can be partially mitigated by extended electrochemical conditioning of the sensor surface. These findings are vital for improving data interpretation, sensor development, and will serve as a foundation for the development of new in situ calibration paradigms that will help to remove user bias from analysis and improve throughput.

This work was supported by the NIH (R01-NS076772). C.J.M. is supported by an NSF Graduate Research Fellowship (DGE-1252376).

Nathalia Ortiz, Brandon Zoellner, Tara Janelli, Shuli Tang, Paul A. Maggard, and Gufeng Wang
Graduate Program: Chemistry
Advisor: Gufeng Wang
Poster Number: 131

Developing Composite Plasmonic-Ferroelectric Nanocatalysts for Hydrogen Gas Evolution

Gold nanorods show great potential in harvesting natural sun light and generating hot charge carriers that can be employed to produce electrical or chemical energies. We show that photochemical reduction of Pt(IV) to Pt metal mainly takes place at the ends of gold nanorods (AuNRs), suggesting that photon-induced hot electrons are localized in a time-averaged manner at AuNR ends. To use these hot electrons efficiently, a novel synthetic method to selectively overgrow Pt at the ends of AuNRs has been developed. These Pt-end-capped AuNRs show relatively high activity for the production of hydrogen gas using artificial white light, natural sun light, and more importantly, near IR light at 976 nm. Tuning of the surface plasmon resonance (SPR) wavelength of AuNRs changes the hydrogen gas production rate, indicating that SPR is involved in hot electron generation and photo-reduction of hydrogen ions. In addition, these Pt-end-capped AuNRs are used in combination with a ferroelectric material. Our data shows that this composite particle catalyst can effectively extend the lifetime of the charge carriers generated on Pt-end-capped-AuNRs in the presence of the ferroelectric materials, leading to a greater production efficiency of hydrogen gas. This study shows that gold nanorods are excellent photocatalysts for converting low energy photons in to high energy hot electrons.

Milo Page[1], Chris Gotwalt[2], and Alyson Wilson[1]
Graduate Programs: Statistics, North Carolina State University[1]; SAS Institute[2]
Advisor: Alyson Wilson
Poster Number: 133

Automated Data Imputation: Extending Low-Rank Approximation Techniques For General Purpose Handling of Missing Data

Missing data is ubiquitous and causes problems for data analyses because either the missing values are of interest (e.g. the so-called Netflix problem) or the analyst wants to fit predictive models that require complete data. One commonly used strategy to address this is to perform data imputation, where the missing values are replaced by an (or multiple) estimate(s). While there is no single best way to perform imputation, our research goal is to develop an automated, robust method, meaning one with mild assumptions that works well for a variety of data sets. For that purpose, we chose to use a low-rank matrix approximation, also referred to as matrix completion. We address several limitations including automating the selection of the number of dimensions and adding streaming capabilities. The result is an imputation method that fits a variety of data, is appealingly simple to use, and seamlessly integrates with crossvalidation techniques for tuning predictive models based on the imputed data. We call our method Automated Data Imputation (ADI) and implemented it in JMP Pro 14, a product of SAS.

Patrick D. Parker
Graduate Program: Chemistry
Advisor: Joshua G. Pierce
Poster Number: 137

Total Synthesis of Crinane and Related Amaryllidaceae Alkaloids

Crinane is a member of approximately fifty related natural product alkaloids isolated from the Amaryllidaceae family of terrestrial plants. These compounds show a range of biological activities such as antiviral (including anti-HIV) and antitumor. They are also affective inhibitors of acetylcholinesterase an anticholinergic property and one of the leading options for therapy against Alzheimer's disease. Owing to their wide array of biological relevance, crinane-derived natural product alkaloids have attracted the attention of biologists and synthetic chemists with several efforts towards their total synthesis some of which being asymmetric. We aim to develop an efficient, short, and industry-attractive synthesis of crinane-derived amaryllidaceae alkaloids by utilizing an effective multi-component process previously developed in our group for the synthesis of 3-hydroxy-1,5-dihydro-pyrrol-2-ones. A reductive Heck reaction and ring closing metathesis (RCM) should provide the natural product scaffold, and subsequent functional group transformations should afford access to many of the crinane-derived alkaloids. The multi-component reaction has proven to be an efficient process providing the desired 3-hydroxy-1,5-dihydro-pyrrol-2-one substrate in excellent yield without the need for column purification. Studies on the subsequent transformations to the natural product scaffold are currently underway.

Stephanie B. Proano, Hannah Morris, David Dorris, and John E. Meitzen
Graduate Program: Biology
Advisor: John E. Meitzen
Poster Number: 142

Hormone Cycle Differences in Excitatory Synaptic Input onto Neurons in Adult Female Nucleus Accumbens Core

Natural cycles of steroid sex hormones change overall brain function, behavior, and disorders in adult female animals. In human females, this natural cyclical hormone pattern is called the menstrual cycle. In rat females, this pattern is called the estrous cycle. The mechanisms by which these hormone patterns regulate individual neuron electrical function is poorly understood. This includes neurons in the nucleus accumbens core (AcbC), a brain region that regulates motivated behavior and reward, and neurological disorders such as depression, addiction, and Huntington's disease, all of which exhibit hormone effects in phenotype and incidence. Therefore, this study's goal is to test whether cyclical hormone patterns affect the excitatory synaptic input and intrinsic electrophysiological properties of medium spiny neurons (MSNs) in the adult female AcbC. These electrical properties determine how neurons respond to stimuli and ultimately produce behavior. To accomplish this, we performed whole-cell patch clamp recordings of MSNs in acute brain slices of adult female AcbC with known estrous cycles. Excitatory synaptic input robustly varies across estrous cycle, as analyzed with miniature excitatory post-synaptic current (mEPSC) experiments, including mEPSC frequency. Intrinsic electrophysiological properties also varied across the estrous cycle, including resting membrane potential and input resistance. Thus, for the first time, we found that neuron electrical properties in this critical brain region are changing with natural hormone cycles. Broadly, this information is important because it indicates that fundamental neuron properties in brain regions not directly associated with reproduction and other sex-specific behaviors are sensitive to the natural hormone cycles in females.

Jacob C. Rudolph[1], Christopher L. Osburn[1], Hans W. Paerl[2], and Alexandria Hounshell[2]
Graduate Programs: Marine, Earth and Atmospheric Sciences, North Carolina State University[1]; Institute of Marine Sciences, University of North Carolina at Chapel Hill[2]
Advisor: Christopher L. Osburn
Poster Number: 148

Hurricane Matthew's Effects on Wetland Sources of Organic Matter to North Carolina Coastal Waters

Increased frequency and intensity of storm events such as tropical cyclones will have a major impact on estuarine and coastal biogeochemical cycling. Here, we determined the sources of dissolved and particulate organic matter (DOM and POM) as part of a larger study to quantify the short-term (several months) response of carbon and nitrogen cycling in the Neuse River Estuary-Pamlico Sound (NRE-PS) ecosystem to floodwaters associated with Hurricane Matthew. Sampling was conducted weekly in both the NRE-PS (October 2016 to January 2017), the Neuse River (NR) (October to December 2016) and in freshwater wetlands of the Neuse River above head of tide in March 2017. Specific ultraviolet (UV) absorbance at 254 nm (SUVA254) and stable carbon isotope ratios (δ13C-DOC) were used to determine the sources of DOM and POM transported to the NRE-PS in post-hurricane floodwaters. For DOM, SUVA254 values increased from 3.50 ±0.02 mg C L-1 m-1 in the NR to 4.14±0.007 mg C L-1 m-1 in the NRE and then declined to 3.62±0.006 mg C L-1 m-1 in PS. Combined with depleted δ13C-DOC values (-26 to -32‰) and elevated C:N values in the estuary and sound, these results confirm continued loading of fresh terrestrial organic matter into NRE-PS weeks after the storm. For POM, δ13C-POC and C:N ratio results likewise indicated a terrestrial source in floodwaters. SUVA254 values >3.5 mg C L-1 m-1 coupled with the depleted δ13C values and large C:N values were consistent with DOM primarily sourced from wetlands. We hypothesize that floodwaters connected riverine wetlands to the main channel of the NR, exporting DOM and POM into the NRE-PS. Our results indicate that upstream wetlands play a central and potentially significant role in organic matter enrichment and metabolism of estuarine and coastal waters, in light of increasing frequencies and intensities of tropical cyclones impacting coastal watersheds.

Chengchun Shi
Graduate Program: Statistics
Advisor: Wenbin Lu and Rui Song
Poster Number: 157

Maximin-Projection Learning for Optimal Treatment Decision with Heterogeneous Individualized Treatment Effects

A saline feature of data from clinical trials and medical studies is inhomogeneity. Patients not only differ in baseline characteristics, but also the way they respond to treatment. Optimal individualized treatment regimes (OTRs) are developed to select effective treatments based on patient's heterogeneity. However, the OTR might also vary for patients across different subgroups. This is typically the case in meta analysis, where we combine the results of multiple studies conducted at different locations or times. Random effects meta-analysis (DerSimonian and Laird, 1986) is commonly used to combine subject-specific studies. Using its multivariate extensions (Jackson et al., 2010; Chen et al., 2012), we can aggregate the groupwise OTRs based on random effects models. The resulting OTR maybe reasonable choice when the OTRs for different groups do not vary much. However, when there is certain degree of heterogeneity in OTRs across different groups, it may perform uniformly worse than the proposed OTR for any of the groups. In this paper, we propose a new maximin-projection learning for estimating a single treatment decision rule that works reliably for a group of future patients from a possibly new subpopulation. Based on estimated optimal treatment regimes for all subgroups, the proposed maximin treatment regime is obtained by solving a quadratically constrained linear programming (QCLP) problem, which can be efficiently computed by interior-point methods. We show under certain model assumptions, the proposed OTR maximizes the minimum percentage of making the correct decision and value function of different groups. In addition, consistency and asymptotic normality of the estimator is established. Numerical examples show that the proposed OTR achieves better performance than the OTR obtained based on random effects meta-analysis.

Ryan J. Smith
Graduate Program: Chemistry
Advisors: Christopher Gorman and Stefano Menegatti
Poster Number: 150

Transforming charge distribution and therapeutic payload in next-generation dendrimers for drug delivery to the central nervous system

The delivery of therapeutics to the central nervous system (CNS) remains an open issue in modern medicine. In this context, a major challenge is posed by the blood brain barrier (BBB), which restricts the uptake of many neuro-therapeutics. Hyperbranched macromolecules, and PAMAM dendrimers in particular, have the ability to permeate the BBB, and have been considered as vehicles to shuttle drugs to the CNS. In their current design, however, Drug-PAMAM conjugates show insufficient BBB permeation and pose safety concerns. To address these issues, we propose a new class of PAMAM-like dendrimers (PLD), whose function can fully express the potential of dendrimers as drug delivery vectors. Unlike traditional Drug-PAMAM conjugates, PLDs are constructed with non-canonical building blocks that afford an optimal distribution of electrostatic charge and drug conjugation onto the PLD scaffold, which results in improved BBB permeation and scheduled drug release. In our work, we have explored various synthetic routes to construct internally functionalized dendrimers, and have successfully demonstrated synthesis of an ensemble of PLDs. Building on these results, we will study the correlation between structural parameters and their bioactivity. To this end, we will employ a microfluidic BBB model to evaluate in vitro therapeutic efficacy and safety, and select optimal PLD-drug conjugates to be tested in vivo to treat brain tumor.

Samantha K. Smith[1], Saahj P. Gosrani[2], Matthew E. Dausch[3], Christie A. Lee[1], Gregory S. McCarty[1], and Leslie A. Sombers[1]
Graduate Program: Chemistry[1]; Biochemistry[2]; Biomedical Engineering[3]
Advisor: Leslie Sombers
Poster Number: 160

Novel Lactate Oxidase-Modified Carbon-Fiber Microbiosensor for Monitoring Rapid Lactate Fluctuations in the Rat Striatum Using Fast-Scan Cyclic Voltammetry

Traditionally, it has been thought that glucose is the principal energy source of the brain. Recently, this widely accepted concept has been challenged by several studies demonstrating lactate as an important molecule with an essential role in energy metabolism and memory formation. As such, real-time molecular detection of lactate dynamics is imperative to understanding brain energy availability, and its involvement in neuropathological disorders such as Alzheimer's disease. However, to date, existing methods for detecting brain lactate concentrations are limited in terms of temporal and spatial resolution. We have addressed this need by developing and characterizing a novel lactate oxidase-modified carbon-fiber microbiosensor and coupling it with fast-scan cyclic voltammetry. This approach enables detection of rapid lactate fluctuations with unprecedented spatiotemporal resolution as well as excellent stability, selectivity, and sensitivity at discrete recording sites in the rat striatum. It can be coupled with our previously developed glucose-oxidase microbiosensor to enable simultaneous detection of both essential non-electroactive molecules. Combined, these new tools enable quantitative investigation of limitations to brain metabolism in disease states.

D. Parker Sprinkle II
Graduate Program: Marine, Earth, and Atmospheric Sciences
Advisor: Del Bohnenstiehl
Poster Number: 164

Analysis of Frequency-Magnitude Distributions and Tidal Triggering for Microearthquakes at Axial Seamount

To better understand the eruptive dynamics of Axial Seamount, a volcano in the Juan de Fuca Ridge, a long-term and continuous set of microearthquakes has been recorded from January 2015 to present near the summit caldera. Variations in earthquake and hydrothermal statistical patterns are used to infer changes in stress through space and time. This study represents the first 4-D investigation of microearthquake frequency-magnitude distributions (FMDs) and their relationship with tidal triggering and hydrothermal pumping for a caldera in a mid-ocean ridge setting. Processed data from 7 ocean-bottom seismometers (OBS) have detected and located approximately 90,000 seismic events over the 3-year period. The scaling exponents from the FMDs, known as b-values, for these data are used as a proxy to map spatial and temporal changes in stress for the caldera complex. Semi-diurnal ocean tides in the region are large in amplitude and stress change with values of 3-4 meters and ~20 kPa respectively. Seismicity exhibits a statistically significant relationship with percent excess numbers of microearthquakes during maximum crustal extension at low tide. The b-values exhibit spatial and temporal variability throughout the eruption cycle. Spatially, b-values are consistent with the established inverse relationship between b-value and local stress field. Values exceed 2.0 at shallow depths and fall to ~1.0 at depths below 1.5 km. Temporally, b-values steadily increase during the months leading up to the seismic crisis suggesting increasing heterogeneity in the stress field. Curiously, the week prior to the eruption, a decrease in b-value is recorded, a result also observed in laboratory fracture mechanics experiments, that would indicate an increase in the local stress regime. The modulation of microearthquake timing via relatively small periodic stresses is consistent with fracture initiation occurring in a system that is maintained at a critical failure state due to hydrothermal and magmatic processes.

Pornpan Uttamang[1], Viney Aneja[1], and Adel Hanna[2]
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Advisor: Viney Aneja
Poster Number: 178

Assessment of Air Pollution in Bangkok Metropolitan Region, Thailand

Bangkok Metropolitan Region (BMR) refers to Bangkok (BKK), the capital city of Thailand, and five adjacent provinces. These provinces are linked closely to BKK in terms of traffic and industrial development. Since 1995, BKK has experienced exceedances in Thailand National Ambient Air Quality Standard (NAAQs) for particulate matters and ozone (O^3). The transportation and industrial sectors are considered to be the major sources of air pollutants in this area. Furthermore, the ambient air quality of BMR is considered as one of the worst air quality in Thailand. The adverse effects of air pollution on human health, economics, ecology and vegetation have been reported in many studies. Exposure to exceeded air pollution leads to health problems, such as cardiovascular, respiratory diseases, morbidity and mortality. Air pollutants reduce photosynthesis, resulting in slower growth and lower yield in many plants. In this study, the ambient air quality over BMR is evaluated. Observation of meteorology and gaseous criteria pollutant concentrations are analyzed and compared with the Thailand NAAQs. Observed data from monitoring stations in BMR, reveals that the hourly concentrations of O^3 ($[O^3]$) exceeded the NAAQs, especially during the summer and winter. Air Quality Index (AQI) for O^3, a tool to assess the effects of O^3 on human health, reveals that, in general, the air quality over BMR was predominantly between good to moderate; however, unhealthy O^3 categories were observed during episode conditions. Interconversion between O^3, and its precursors (NO^x) shows that the relationship among species is a non-linear relationship. When $[NO^x] < 60$ ppb, $[O^3]$ increase with $[NO^x]$; however, when $[NO^x] > 60$ ppb, $[O^3]$ decrease with $[NO^x]$. During O^3 episodes, the analysis of local and regional contributions of O^x (O^3+NO^2) show that both the local and regional O^x contributions enhance the concentration of O^x; which associate with high $[O^3]$ in this area.

Andrew Wade
Graduate Program: Marine, Earth, and Atmospheric Sciences
Advisor: Matthew Parker
Poster Number: 181

Simulated Supercells in High-Shear Low-CAPE Environments

Two key ingredients for severe convective storms are buoyancy/instability and the change in wind with height. The former is quantified by convective available potential energy (CAPE) and the latter by bulk wind shear. Skill in forecasts, watches, and warnings is greatly diminished in high-shear, low-CAPE (HSLC) events. The radar signatures of tornadic and nontornadic HSLC storms have been shown to be indistinguishable except at close range. Since almost half of U.S. tornadoes occur with low CAPE, a more thorough understanding of these types of storms is needed. Furthermore, HSLC events are particularly common in the southeastern U.S., which has unique geographic and socioeconomic vulnerabilities. Numerous recent studies have illuminated in-storm processes leading to tornadogenesis or its failure, but these have focused almost exclusively on high-CAPE storms.

This research explores the internal dynamics of HSLC supercell thunderstorms. We hope to identify in-storm processes leading to production of low-level vortices and compare these processes to those found in higher-CAPE storms. Any detectable precursor to vortexgenesis might be useful for warning forecasters or point to some important characteristic of the near-storm environment. Idealized high-resolution simulations are initialized with observed HSLC environments and perturbed to produce thunderstorms. This technique is common in severe storms research but not yet widely applied to HSLC storms. In this way, supercells have so far been successfully simulated in several different HSLC environments. The size of storms and the transient nature of vortices are, subjectively, similar to observed behavior in many HSLC events. Some produce low-level vortices; some do not. In at least one vortex-producing case, a feature of simulated high-CAPE tornadic storms (the “vorticity river”) appears suppressed.

Samuel J. Widmayer and David L. Aylor
Graduate Program: Genetics
Advisor: David L. Aylor
Poster Number: 188

Genetic Architecture of Hybrid Male Sterility in the Mouse

The formation of reproductive barriers between diverging groups is a key component of species formation. Hybrid male sterility (HMS) is a reproductive barrier that restricts gene flow between two subspecies of mice, Mus musculus musculus and M. m. domesticus. Crosses between inbred strains derived from these subspecies recapitulate HMS in the lab. Two major loci have been previously linked to HMS, but we observed wide variation in fertility and reproductive traits among hybrids with identical genotypes at those loci. We characterized this variation in a panel of hybrid males bred by crossing musculus-dervied PWK/PhJ strain females to males from four inbred mouse strains of primarily domesticus origin. These PWK-derived hybrids ranged from complete sterility to complete fertility. In addition, some hybrids exhibited age-dependent fertility that is characterized by delayed-onset of fertility and premature sterility. Taken together, our results support the hypothesis that HMS in the mouse is a polygenic trait and undiscovered modifiers drive key differences in sterile hybrids. We have begun to employ a novel QTL mapping design to identify the modifier alleles driving these differences in sterility phenotypes between hybrids.

Jaime A. Willett[1,2,3], Ashlyn Johnson[1], Opal Patel[1], Jinyan Cao[1,2], David M. Dorris[1], and John E. Meitzen[1,2,4]
Graduate Programs: Biological Sciences, North Carolina State University[1]; W.M. Keck Center for Behavioral Biology, North Carolina State University[2]; Graduate Program in Physiology, North Carolina State University[3]; Center for Human Health and the Environment, Center for Comparative Medicine and Translational Research, North Carolina State University[4]
Advisor: John E. Meitzen
Poster Number: 190

Estrous Cycle-Dependent Sex Differences in Rat Dorsal Striatal MSN Excitability

The neuroendocrine environment in which the brain operates is both dynamic and differs by sex. How this unstable neuroendocrine state affects neuron properties has been significantly neglected in neuroscience research. Behavioral data across humans and rodents indicate that natural changes in steroid sex hormone exposure affect sensorimotor and cognitive function in both normal and pathological contexts. These behaviors are critically mediated by the dorsal striatum: a well-conserved constituent of the basal ganglia that is instrumental for forebrain function, various forms of learning, and sensorimotor performance. In the dorsal striatum, medium spiny neurons (MSNs) are the predominant and primary output neurons. As such, MSNs are fundamental components of the circuits which underlie striatal-mediated behaviors. Importantly, MSNs express membrane-associated estrogen receptors and demonstrate estrogen sensitivity. However, the effects of cyclical hormone changes across the estrous cycle on the basic electrophysiological properties of MSNs have not been investigated. Here, I test the hypothesis that dorsal striatal MSN intrinsic excitability is a dynamic property that is modulated in adult females across the estrous cycle via the associated changes in steroid sex hormone levels. I performed whole-cell patch clamp recordings on male, diestrus female, proestrus female, and estrus female MSNs in acute brain slices obtained from adult rat dorsal striatum. Assessment and analysis of the electrophysiological properties is ongoing, with a particular emphasis on intrinsic excitability and miniature excitatory synaptic currents (mEPSC). Preliminary results indicate that the properties that govern cellular excitability differ over the course of the estrous cycle for female MSNs. Additional analysis is needed to further inform these results. Overall, given the estrous-dependent sex differences in the normal and pathological behavioral output of circuits involving the dorsal striatum, understanding the nature of neuroendocrine modulation of MSN function is an important research goal.

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Graduate Programs: Physics, North Carolina State University[1]; CNMS, Oak Ridge National Laboratory[2]
Advisor: Jerry Bernholc
Poster Number: 195

Graphene nanoribbons for future nanoelectronics: synthesis, applications and stability

Graphene nanoribbon (GNRs) is a narrow strip of mono-layer graphite (called graphene). It is a qusai-1D material with very high electron mobility and great potential for future nanodevices. We investigated atomically precise bottom-up synthesis of graphene nanoribbons (GNRs), determined the mechanism of its growth from molecular precursors and showed how to facilitate the growth of GNRs through injection of positive charges (holes). Our work (Nature Comm. 8, 14815, 2017) provides a new route towards controllable synthesis of freestanding GNRs. We have also investigated (ACS Nano Lett. 17, 6241, 2017) seamless, all-carbon staircase contacts to ultra-narrow nanoribbons that contain no dangling bonds and are quasi-metallic, as confirmed by scanning tunneling spectroscopy. Our findings can enable all-carbon nanoelectronics with breakthrough properties. As an example of a novel nanoscale device, we devised a nanoscale resonant tunneling diode (RTD) based on GNR/hybrid structures. We show that the classical RTD concept, which is based on a single quantum dot surrounded by electron barriers, needs significant modification when applied at nanoscale, and we devise a five-part ballistic device that exhibits substantial negative differential resistance. Key parts of this device structure have already been fabricated at ORNL. For future applications, the stability of nanoribbons against oxidation is of critical concern. We determined the oxidation sites and their structures (Phys. Rev. Mat. 2, 014006, 2018) and showed that armchair nanoribbon edges are significantly more stable than zigzag edges. The armchair edges do not react with oxygen up to very high temperatures, demonstrating that devices based on semiconducting armchair nanoribbons are practical and will not deteriorate during normal use.

College of Textiles

Ruksana Baby
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Advisor: Stephen Michielsen
Poster Number: 9

Wicking of small drops into knit fabrics

Analysis of wicking of blood into textiles can provide information about how a stain develops and understand the nature of the crime; greatly contribute to the reconstruction of the crime scene in forensic disciplines through the blood stain pattern analysis (BPA) and help investigators distinguish between an assailant's garments and those of innocent bystanders. In forensic disciplines, extensive researches on BPA has been conducted on hard surface but only very few studies on textiles have been reported. Wicking of blood through textiles is much more complicated than most other materials because of the complex textiles structures and yarn properties. With the objective to see how yarn size relative to drop size affects bloodstains, this research investigated the wicking behavior of blood into knitted fabrics to understand the capillary flow through the fabrics and the factors influencing stain patterns. Porcine blood (2 µL, 10 µL, 30 µL and 60 µL) to mimic the human blood behavior and three knitted single jersey fabrics made of 100% cotton ring-spun single-ply 12 Ne, 20 Ne and 30 Ne yarns respectively were used for the experiments. Blood viscosity, surface tension and hematocrit value were measured to properly characterize the blood. Wicking rate was initially found nearly linear but then became slower depending on the capillaries. Wicking was similar on both fabric sides and fabrics made from finer yarns (such as 30 Ne yarns) with lower weight per unit area and thickness resulted in larger bloodstain areas than the other fabrics. Also with the increased drop sizes, stain areas were found to increase linearly. All these findings document the need to consider the effects of yarn linear density and other fabric parameters while examining the bloodstains at the crime scenes for better analysis and explicit interpretation.

Raj Bhakta
Graduate Program: Fiber and Polymer Science
Advisor: Jesse Jur
Poster Number: 15

Wearable Electronics on Textiles: Smart Fabrics of the Future

We have smart cars on the road, smart TVs in our homes, and smartphones in our pockets but why don't we have smart fabrics on our bodies? After interviewing over 100 stakeholders in the smart fabrics space, we found production cost and scale to be the most fundamental problem. To solve this, we combined 3D printing, printed electronics, and textile science to create an automation solution that's 36x faster and 5x cheaper than current methods. Our technology directly prints sensors and circuitry onto textiles for smart garments.The versatility of this process allows for conductive ink penetration into the textile's fiber bulk and fiber bundles allowing for percolation of silver micro-flake particles (PU-Ag conductive ink) and thereby conductive composite formation. Within a fiber system this results in enhanced stretchabiity up to 180% strain with a normalized resistance change of up to 20x (comparable to state of the art in literature). This unique structure improves the reliability of end-use products such as smart garments that can sense one's electrocardiogram, for example. Furthermore, we integrated an in-situ infrared curing system that can cure dielectric and conductive based materials, decreasing curing time by 3x compard to state of the art. The process knowledge created herein will ultimately be used to fabricate a smart garment in 5 minutes or less as compared to state of the art fabrication techniques which take around 3 hours. To justify our choice of this process technology, we will discuss the techno-economics for manufacturing and the underlying science behind our process, materials characterization, and the end-use application for a smart garment for electrocardiogram sensing within healthcare for uses in consumer telemedicine and the internet-of-things. Finally, we will conclude by discussing how this research is being commercialized directly from lab to market by our start-up company, Funxion Wear.

Charles E. Blackwell
Graduate Program: Fiber and Polymer Science
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Poster Number:16

Lignin Plasticization of Gel-Spun Polyacrylonitrile Fibers

High-performance carbon fiber is spun from polyacrylonitrile (PAN) precursor fibers. PAN is an expensive polymer, due to its high demand and low supply within the global market. This research considers alternative biomaterials to reduce raw material costs, reduce global reliance on PAN demand, and improve the environmental sustainability of carbon fiber precursors, while maintaining the mechanical strength and integrity of the desired fiber. Lignin–a waste by-product of pulp and paper manufacturing–carbonizes at high yield while catalyzing carbonization reactions at lower temperatures because of its aromatic structure. However, lignin's amorphous structure has led to low performance among melt-spun carbon fiber precursors. This research explores solutions to gel fiber spinning techniques to enhance the processibility and mechanical performance of lignin-based PAN fibers. As a result, fiber draw ratios of 100× and greater were achieved, and the fiber microstructures were highly crystalline. Interestingly, gel-spun lignin/PAN fibers contained up to 50% lignin while yielding higher modulus and tougher fibers.

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Poster Number: 38

Poly(ε-caprolactone) Resorbable Knitted Scaffold for Craniofacial Skeletal Muscle Regeneration

Craniofacial microsomia is a congenital deformity caused by asymmetric development of the skull (cranium) and face before birth. Current treatments include corrective surgery and replacement of the deformed structure using autograft tissue, which results in donor site morbidity. An alternative therapy could be achieved by developing a resorbable scaffold for skeletal muscle regeneration which will help restore the symmetry and function of the facial muscles and reduced donor site morbidity. We have fabricated a knitted scaffold with a unique, auxetic structure, having a negative Poisson's ratio, which means that there is no lateral narrowing when stretched longitudinally. Auxetic structures are currently being incorporated into a range of textile applications, such as architectural textiles, ballistic protection and sport textiles. This study will evaluate their advantages and limitations in this particular tissue engineering application. In order to operate in a dynamic bioreactor, the scaffold needs to incorporate an elastic and resorbable yarn with a minimum of 20 percent stretch and 100 percent recovery when pulsed so as to mimic the function of smooth muscle tissue. Preliminary samples of the auxetic fabric have been knitted from poly-L-lactic acid and polyurethane yarns plated together. A number of their basic physical and mechanical properties have been measured, including thickness, total porosity, tensile strength, elastic recovery, the tendency to ravel and changes in the crosswise dimension when stressed. The next generation of prototype samples with similar auxetic properties will then be knitted from elastomeric poly(ε-caprolactone) multifilament yarns and tested for the same physical and mechanical properties before being evaluated for their rate of resorption. These prototype fabrics will then be seeded with a satellite mixed cell population so as to determine their biocompatibility in terms of their initial cell viability and cell migration behavior.

Anuradha Gupta and Elizabeth Claunch
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Poster Number: 32

Innovation in 3D Woven Composites

A unique advantage of fiber reinforced composites is that their properties can be tailored to fit different applications. Unlike traditional 3D structures from 2D woven preforms that are prone to delamination, 3D orthogonal woven (3DOW) preforms are often used to add reinforcement in the thickness direction and to prevent delamination. Despite the potential benefits of 3D woven composites, their commercial use has been limited to a number of niche applications. This research explores additional novel applications in the areas of natural fiber reinforced composites and smart composites.

Natural fiber reinforcements are a prevalent option for use in composite manufacturing, aiming to reduce the overall carbon footprint. Hemp yarns can be constituted in the 3DOW structure by altering preform thickness, weave, and the amount of through the thickness yarn. Thus, providing application specific and tailorable properties to meet performance requirements. Hemp fibers have been used as reinforcement in composites due to high specific strength and modulus. They possess a high vibration dampening, high fiber yields, and pest and drought resistance. These properties make hemp an excellent candidate for composite reinforcement and possibly a more sustainable replacement of glass fiber composites in areas like automobiles, consumer goods, construction, etc.

Optic fibers are well suited to be incorporated in textile structures. During composite fabrication, a polymeric optic fiber can be woven directly alongside the yarns in the 3DOW preform, creating a smart composite. This allows access to interior structural locations, where other sensing methods may not reach. Signal loss in the optic fibers is compared to composite structural damage and serves as a basis to interpret the sensor's ability to identify the structure's current health. Structural health monitoring systems, such as this, are predominately being used in bridges and building, but also have a promising future for wind turbines and the aerospace industry.

Daniel Hines
Graduate Program: Textile Chemistry
Advisor: Renzo Shamey
Poster Number: 61

Veiling Glare and Its Influence on Measurements with Optical Instruments

DSLR cameras have become attractive options in fields where light measurement of a scene are of interest. Whether for determining luminance (perceived light intensity) or color measurement, DSLR cameras provide a more affordable option over traditional instruments such as radiometers or spectrophotometers. However, DSLR cameras are designed to capture an attractive image, rather than generate scientific data. Veiling glare decreases the contrast in an image by introducing stray light onto the image sensor and thus affects the accuracy of measurements. Glare is present in virtually all systems that employ a lens, including the human eye. The extent of glare however, is different depending on the complexity of the lens fixture. This work investigates the impact of veiling glare on measurements using DSLR cameras compared to a radiometer. Multiple experimental setups were used to quantify the amount of glare present at a given position in the image. The first part of the study compared a DSLR camera and lenses with a radiometer by using a mask around the target that would produce either high or low amounts of glare. The second half of the study examined how a gradual change in the surround reflectance would influence the response intensity from a target. Results confirm that both cameras and radiometers are influenced by veiling glare due to changes in the surround of the target. The second part of the study allowed us to define a functional relationship for the glare in each instrument. A target's measured luminance would change by as much as 20% for a DSLR camera depending on the color of the surround. For a radiometer the change was less severe but still apparent.

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Poster Number: 63

Comparison of Polyvinylidene Fluoride and Polypropylene Barbed Sutures in Patellar Tendon Repair

The barbed suture, as an innovative type of suture, has been developed over the last 20 years and was approved by US FDA in 2004 for clinical use in the USA. With its projected barbs, this type of suture is able to penetrate and anchor the surrounding tissues, which means there is no need to tie a knot. A tendon connects muscle to bone, regulating the forces applied by the muscles during movement. Once ruptured, the patient needs surgical repair, or the injury may result in a systemic disease. Current tendon repair uses traditional non-absorbable sutures which require surgeons to tie knots to secure the tissues. However, the part of the suture at the knot is potentially the weakest point of the repair. The knot will also affect the flexibility. Polypropylene (PP) sutures have been widely used in tendon repair, but there is an increasing number of reports indicating dissatisfaction with PP monofilament sutures because of their thrombogenicity and incidence of long-term mechanical failure. On the other hand, polyvinylidene fluoride (PVDF) has been identified as an alternative monofilament suture material for PP because of its superior handling properties and long term durability. Since barbed sutures do not need knots to anchor them into the surrounding tissue, a modified cross-locked cruciate suturing pattern was created and used in place of the traditional Kessler technique. The anchoring performance of barbed PVDF and PP sutures was measured using a suture/tendon tissue pullout test, in terms of the maximum pullout force and the 2-mm-gap formation force. This study demonstrated for the first time that PVDF sutures can be barbed, and used successfully for effective tendon repair. The PVDF barbed sutures showed superior mechanical properties compared with the PP conventional sutures by achieving both a greater maximum pullout force and a 2-mm-gap formation force.

Hanna Lee
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Advisor: Karen K. Leonas
Poster Number: 95

Utilizing Self-Checkout Technology in the Fashion Industry

With the growing popularity of automation because of its ability to increase effectiveness and decrease cost, self-checkout technology has been widely adopted in many sectors of the retail industry. However, it has been largely ignored in the fashion industry because of the service-oriented characteristics of the fashion industry. However, self-checkout technology has the potential to enhance business profits by increasing checkout process efficiency in high traffic areas and by separating repetitive checkout process from personalized service. To have technologies that support corporate strategy and to fully satisfy diverse and continually changing consumer demands, it is imperative to examine the fit between self-checkout technology and the characteristics of fashion firms to achieve successful integration of technology and business strategy which is required to have significant business returns. In this review, capabilities of self-checkout technology will be first evaluated based on its advantages and disadvantages to check if this technology has potential to give competitive power for firms in the fashion industry. Then, applicability of self-checkout technology to fashion industry will be examined from strategic perspective. Also, new types of self-checkout technologies, including mobile self-checkout technology and mobile payment technology embedded in the self-checkout process, will be considered to reflect changes in technology. Through the review and analysis of potential opportunities and challenges, this paper provides managerial implications for practitioners to adopt self-checkout technology by addressing key considerations and strategic issues to fully evaluate self-checkout technology.

Lu Lin
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Advisor: Yingjiao Xu
Poster Number: 90

Chinese Consumers' Brand Avoidance: A Study of the Sportswear Market

With growing consumer demands and increasingly intensified competition, the Chinese sportswear market is facing great opportunities and challenges at the same time. While the Chinese domestic brands seemed bearing a relatively heavier burden than their global counterparts, challenges exist for the whole market. It is of strategic importance for sportswear brands to gain an insight of consumers' brand behavior in the Chinese market. Researchers suggested that in addition to exploring the reasons behind why consumers select brands and how firms can increase brand loyalty, the idea that some people avoid certain products and brands because of negative associations or meanings has the equally valid. Therefore, the purpose of this study was to investigate Chinese consumers' negative brand behaviors in the context of sportswear market--brand avoidance. Based on existing literature and an exploratory focus group study, a conceptual model was proposed to determine the sources for consumers' brand avoidance toward sportswear brands. Specifically, the following sources were proposed: experiential avoidance, identity avoidance, moral avoidance, deficit-value avoidance, and advertising avoidance. A web-based survey was administered to 355 Chinese consumers to collect data for this study. Factor analyses and regression analyses were conducted to test the proposed conceptual model regarding Chinese consumers' avoidance behaviors toward sportswear brands. The results were very promising and can lend strong implications to the practitioners in the Chinese sportswear market.

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Advisor: Philip Bradford
Poster Number: 84

Polymer Reinforced Multifunctional Ultralight Carbon Nanotube Foams with Tunable Properties for Real-world Applications

The unique combination of superior mechanical, electrical, and thermal properties of carbon nanotubes (CNT) has established them as a state-of-the-art engineering material. Recently, foam like materials have been produced from CNTs, however the foams are fragile or have low durability for practical applications. In this work, a simple processing technique was developed to reinforce an aligned CNT foam structure (~99% porosity) with nanoscale coatings of polydimethyl siloxane (PDMS). The CNT-PDMS foams were prepared by PDMS solution infiltration into pyrolytic carbon (PyC) coated aligned CNT foams. By changing the PyC time and the PDMS solution concentration, the foam's porosity, elasticity, and electrical conductivity can be tuned over a wide range. The microstructure, cyclic compression behavior, piezoresistive response of the 3-D porous foam for both the parallel and perpendicular directions to the CNT alignment were assessed. In addition, the electromagnetic interference shielding effectiveness (EMI SE) and selective organic liquid/oil absorption capability were studied in detail. When the foams were exposed to compressive strains the electrical resistance of the porous CNT/PDMS structure decreased linearly in both the longitudinal and transverse directions, but the structure returned to its original shape even after 90% of compression. This was attributed to the stable and reversible re-arrangement of the electrical conductive CNT network. Additionally, foam with a thickness of only 1 mm showed an EMI SE of around 64.78 dB, for X-band frequency (8.25-12.4 GHz). Oils & organic solvents were selectively absorbed and separated from water. The original foam structure can also be recovered through burning the foam after oil absorption. The structure showed stability even after 100 burn off cycles. The excellent combination of ultralight-weight, high porosity, high compressive stability, selective liquid absorption capacity, stable piezoresistive response, durability and reusability of the 3-D porous CNT foam structure demonstrated promising application for textile-based strain sensors, environmental clean-up of oil spills and lightweight EMI shielding.

Qiong (Sarah) Tao and Yingjiao Xu
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Advisor: Yingjiao Xu
Poster Number: 171

Fashion Subscription Retailing: An Exploratory Study of Consumer Perceptions

The purpose of this study is to explore how consumers perceive the subscription service in the fashion industry. This research is qualitative in nature, utilizing focus group study approach. Content analysis was applied to analyze the data. Findings indicate participants possessed varying degrees of knowledge about the service. Participants identified quite some relative advantages of using fashion subscription services, including convenience, personalization, consumer excitement, opportunities to try new styles, and opportunity to better apparel budget management. Concerns mainly focus on missing social shopping and hassle in the cancellation process. The overall intended adoption was high. Future marketing could focus more on educating consumers about the attributes of the services they provide. Retailers can strategically leverage the positively perceived advantages in their marketing communications to enhance consumers' adoption intention of their services. The paper fills a gap in the literature on consumer behavior toward fashion subscription retailing and sheds light for companies in their endeavors to excel in this new retailing venue.

Jiaying Wu
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Advisor: Stephen Michielsen
Poster Number: 145

Impact Spatter Bloodstain Patterns on Textiles

Impact bloodstain patterns are important evidence that contributes to the reconstruction of crime scenes and solving puzzles related to violent crimes. Many researchers have done great jobs in unraveling the relationships between bloodstain patterns and how it relates to criminal actions. However, most of the studies were conducted on hard surface materials, such as white cardboard and tile. BPA studies conducted on textiles are not developed to the same level as on the hard surfaces. It is really important that investigators understand the difference between hard surfaces and fabric materials because the appearance of the bloodstain patterns may not be the same. BPA study based on textiles is more complex since there are many different textile materials and the appearance of the patterns are strongly influenced by fabric properties. This research investigated the appearances of impact bloodstain patterns on different knit fabrics and papers. The differences caused by different substrates' nature were analyzed. A modified rattrap device was used to produce the spatter. The updated rattrap was redesigned to improve the stability, repeatability, and operation safety. Analysis of the impact bloodstain patterns shows that the appearance of the pattern is various on different substrates. The patterns on filter paper are mainly circular while the patterns on knit fabrics are with a variety of shapes and is highly dependent on the local fiber orientation. There are more bloodstain patterns visible on filter paper compared to the patterns on knit fabrics. In addition, as the yarn size becomes smaller, the fabric becomes smoother with a texture approaching that of filter paper, hence the patterns are not hidden inside the loop structure and it's harder for a blood droplet to go through a loop hole. The number and area of bloodstain patterns increase with the decreasing yarn diameter.

Cody Zane
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Poster Number: 198

Flame Retardants: New Approaches to Reduce Exposure

In 2013 the National Fire Protection Agency reported 1.24 million fires, which attributed to 3,200 deaths, 15,925 injuries and $12 billion in property damage. Flame retardants (FRs) play a significant role in fire protection by delaying the ignition or spread of a fire. These chemicals tend to be either organohalogenated or organophosphorous based compounds, which some studies have indicated can cause adverse health effects, such as osteoporosis, cancer, and obesity. A main challenge with conventional FR compounds is that they are added mechanically and thus are not permanently bonded to the material. One thought is that FR compounds can be encapsulated, which may enable the FRs (1) to be chemically bound to natural materials or melt extruded with synthetic materials; (2) to have enhanced long-term stability within the substrate; (3) to still remain effective as a FR; and (4) to be safer since they will not be released from the substrate with time. It was recently demonstrated that a common FR, triphenyl phosphate (TPP), can form an inclusion complex (IC) with β-cyclodextrin (BCD). The goal of our work is to use a combination of experiments and molecular modeling to characterize these ICs, such as the binding affinity between the FR and BCD, the solubility in a series of solvent systems, the crystalline form(s) of the ICs, the ratio of FR to BCD, and the impact on the flame retardancy of the substrate. We are currently focusing on developing approaches using high resolution mass spectrometry and collision-activated dissociation (CAD), for quantifying the formation and overall stability of ICs. The results so far correlate well with what is known from other experimental approaches as well as from molecular modeling. In addition, we are working to identify other potential FRs that can form ICs with BCD and other CDs.

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Poster Number: 176

A Bilayer Small Diameter Vascular Graft from Collagen Yarns and Electrospun Collagen Fibers

Vascular disease is among the leading causes of death worldwide. Synthetic arterial prostheses were developed 60 years ago and function well as large diameter (> 5 mm) vascular grafts. However, for the replacement or bypass of small diameter arteries (< 5 mm), synthetic prostheses tend to fail due to thrombosis, stenosis, occlusion or intimal hyperplasia. Yet bioresorbable materials have been shown to provide improved patency for small caliber vessels. In this study, a bilayer vascular graft fabricated from collagen yarns and electrospun collagen fibers has been designed and evaluated in terms of its structural, mechanical and biological performance. Recently developed electrochemically aligned collagen yarns (ELACs) have been knitted into tubular vascular grafts to mimic the native component of the blood vessel wall and to improve the mechanical support of purely electrospun collagen grafts. A bilayer graft with a combined ELAC-knitted layer and an electrospun luminal layer, together with a single layer ELACs weft knitted graft control, have been fabricated and are now being characterized mechanically and biologically. The ELACs were plied and cross-linked before knitting into a 4 mm diameter tube on a circular weft knitting machine. It is designed to simulate the elastic layer in the media and provide sufficient strength and maintain the structural integrity of the graft. The role of the inner electrospun collagen layer is to encourage the adhesion and proliferation of endothelial cells on the luminal surface. To characterize the collagen graft, mechanical tests are being conducted according to ISO 7198 to measure the scaffold's mechanical and physical properties, such as the total porosity, bursting strength, radial compliance and suture retention strength. The attachment and proliferation of human umbilical vein endothelial cells on the inner lumen surface during a 7-day in vitro cell culture trail are being evaluated by SEM and an MTT assay.

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Poster Number: 158

Fatigue Study of a Chimney Stent Graft Deployed in an Aortic Aneurysmal Model

Abdominal aortic aneurysms (AAA) and thoracic aortic aneurysms (TAA) are a leading cause of preventable death among the elderly. Endovascular aneurysm repair (EVAR) provides treatment for AAA and TAA with several advantages compared to traditional open surgery. The chimney approach of EVAR is a procedure to ensure blood flow to adjoining arteries using covered stents as parallel "chimney" conduits in the same aorta. However, this approach has concerns over surface abrasion and graft migration. The objective of this study was to evaluate the positional stability and physical properties of stent grafts and covered stents that are used in a chimney EVAR. To reach this objective, an accelerated mechanical fatigue test of 120 million cycles (equal to 3 life-years) was applied to chimney EVAR devices that were deployed inside a customized polyurethane phantom and mounted on an Electroforce Stent Graft Fatigue Tester. The fabrication of two polyurethane phantoms was based on a specific patient who was treated with chimney EVAR repair. The fatigued phantom with endovascular devices inside, was removed from the mechanical fatigue system at a series of different time intervals so as to take computed tomography (CT) scans and endoscopy views to monitor the devices size, shape and positional stability. After 120 million cycles, post-fatigue tests including scanning electron microscopy (SEM), bursting strength and fabric total porosity were performed to determine any changes in the physical properties of the stent graft fabric during fatiguing. The results confirmed that the shape and position of the proximal end of the chimney covered stent did not move significantly during fatiguing, while the total length and distal position did experience some displacement. While there was no apparent surface abrasion observed by SEM, and no significant changes in bursting strength during fatiguing, the total fabric porosity was observed to change depending on its location.

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Poster Number: 205

A novel bi-functional double-layer rGO–PVDF/PVDF composite nanofiber membrane separator with enhanced thermal stability and effective polysulfide inhibition for high performance lithium–sulfur batteries

Lithium sulfur (Li-S) batteries is considered as a promising next-generation energy storage system because S has a high theoretical capacity of 1675 mAh g-1. But the practical application of Li-S batteries is hindered by the continuous capacity fading (caused by the “shuttle effect” of discharge intermediate polysulfides) and low stability of commercial polypropylene (PP) separator in high-temperature atmosphere. Here, we report a novel bi-functional double-layer rGO-PVDF/PVDF nanofiber membrane separator which was fabricated by a simple electrospinning technique and could potentially solve the continuous capacity fading problem while enabling high temperature safe operation. This novel double-layer structure design of porous rGO-PVDF/PVDF nanofiber composite membrane separator has two different advantages: i) the PVDF nanofiber framework in both rGO-PVDF and PVDF layers has good thermal stability and can help maintain the structure integrity of the separator; and ii) the conductive rGO-PVDF layer serves as a polysulfide inhibitor and ensures the fast transfer of lithium ions. Compared to conventional polypropylene membrane separators, this new separator design can significantly enhance the cycling stability and rate capability of the incorporated lithium-sulfur batteries. Overall, it is demonstrated that this new double-layer rGO-PVDF/PVDF composite membrane separator opens an alternate avenue in the structural design of high-performance lithium-sulfur batteries in dealing with multiple challenges.

College of Veterinary Medicine

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Advisor: Paula Fedorka-Cray
Poster Number: 10

Molecular Characterization of Extended-Spectrum β-Lactamase Escherichia coli from Cattle and Poultry Farms in the Wakiso District of Uganda

Introduction: Extended-Spectrum β-Lactamase (ESBL) are enzymes that confer resistance to β-lactam antibiotics. Many gram-negative organisms producing these enzymes cause serious infections and prolong illness. This study collected the prevalence of ESBL E.coli and data will be used as a source of information for the World Health Organization (WHO) ESBL global surveillance system.

Objectives: To genotypically characterize ESBL-producing E. coli isolated on cattle and poultry farms in the Wakiso District of Uganda.

Methods: Forty poultry and cattle farms were visited during the dry and rainy seasons. Susceptibility testing was done using broth dilution. Four E. coli isolates each from cattle (4/385; 1%) and poultry (4/334; 1.2%) farms presenting resistance to Ceftriaxone and/or Ceftiofur were screened by polymerase chain reaction (PCR) for five ESBL genes: blaCTX-M, blaSHV, blaCMY, blaOXA, and blaTEM. The isolates were subjected to whole genome sequencing (WGS) to identify antimicrobial determinates, PCR to determing replicon type plasmids and Class I integrons, and pulse-field gel electrophoresis (PFGE) to determine relatedness.

Findings: The isolates displayed multiple drug resistance (MDR) to a panel of 14 antimicrobials. Collectively, six replicon plasmids were identified among cattle (HI1 1/4, HI2 2/4, FIB 1/4, P 1/4, X3 1/4, and FII 1/4) and poultry (FIB 2/4 and FII 2/4) ESBL E.coli isolates. The Class I Int1 was positive among cattle (1/4) and poultry (4/4). PFGE cluster analysis showed 7 distinctive cluster types. ESBL genes were identified by PCR as follows: cattle (blaCTX-M 3/4, blaTEM-12 2/4, and blaSHV 1/4) and poultry (blaCTX-M 3/4, blaTEM-12 3/4, and blaOXA-1 2/4). Using WGS, concordance with PCR was observed.

Conclusions: We conclude ESBL-producing E.coli may harbor plasmids that carry MDR genes for most of the antimicrobials tested. WGS provides a more extensive analysis of AMR genes.

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Advisor: B. Duncan X. Lascelles
Poster Number: 125

Reverse Translation to Discover Relevant Targets for Chronic Pain: GFRA3/Artemin

Introduction: Chronic pain is a major health problem posing an enormous economic burden to our society. The lack of therapeutic options is driving the current opioid epidemic in humans. One of the limitations in developing potential therapeutics is a lack of understanding of the precise mechanisms in the target disease condition. To overcome this problem, we use naturally occurring osteoarthritis in pet dogs that are highly phenotyped using validated measures of pain. Analyzing tissues from these subjects, we identify novel targets, then utilize mouse models to further understand the mechanisms involved – a forward and reverse approach from mice to dogs to mice.

Objectives: To identify novel targets for pain treatment using samples from pet dogs with naturally occurring osteoarthritis.

Methods: From mouse RNA-sequencing data we determined the GDNF family receptor alpha 3 (GFRA3) is highly colocalized with the TRPV1-ion channel and thus possibly connected with pain hypersensitivity. Canine samples collected from highly phenotyped dogs (subjective assessment; ground reaction forces; quantitative sensory testing) were subjected to qRT-PCR (dorsal root ganglia [DRG]) and ELISA (serum).

Results: We found expression of GFRA3-receptor significantly increased in dorsal root ganglia (DRG) serving osteoarthritic (OA) joints (n=12) compared to normal ($p<0.01$) (n=12). Additionally, using samples from highly phenotyped normal (n=22) and OA dogs (n=54) serum artemin (GFRA3 ligand) was significantly elevated in OA dogs ($p<0.05$). Our results strongly implicate a role for GFRA3 and its ligand artemin in OA pain. Additional work in a mouse model supports this finding. These results show that samples from well-characterized (phenotyped) canine patients can be used to uncover potential novel mechanisms involved in pain states.

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Poster Number: 144

Inhibition of Clostridium difficile by commensal Clostridia

Clostridium difficile is a spore forming obligate anaerobe that is one of the leading causes of antibiotic-associated diarrhea (AAD). Complications of C. difficile infection (CDI) include pseudomembranous colitis, toxic megacolon, and death. The microbiota of the gastrointestinal tract provides colonization resistance against C. difficile, and antibiotics lead to alterations in the gut microbiota, decreasing colonization resistance. Gut microbiota derived secondary bile acids and commensal Clostridia are associated with protection from CDI in mice and humans. However, the mechanism has yet to be elucidated. Thus, we hypothesize that commensal Clostridia associated with CDI colonization resistance alters the C. difficile lifecycle and ultimately pathogenesis. We tested this hypothesis by defining the growth of a clinically relevant strain C. difficile R20291 and a commensal non-pathogenic strain Clostridium scindens in the presence of secondary bile acids that have been shown to inhibit C. difficile, as well as primary bile acids that C. scindens is able to use as substrates for secondary bile acid production. We also evaluated whether C. scindens was able to outcompete C. difficile for similar nutrients in a complex media as well as a defined medium that will be used for future targeted competition studies. Preliminary results show that C. scindens has lower MICs in the presence of bile acids compared to C. difficile. We also show that C. scindens is able to compete with C. difficile in a complex media and that the two strains are able to grow in the same defined medium. Elucidating the mechanisms behind how the gut microbiota provides colonization resistance against C. difficile is vital for designing targeted bacterial therapeutics to combat CDI.

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Poster Number: 146

Investigation of Sensory Thresholds in Cavalier King Charles Spaniels with and without Chiari-like Malformations and Syringomyelia

Ninety-two percent of Cavalier King Charles Spaniels (CKCS) have a skull malformation called Chiari-like Malformation (CM). CM is frequently associated with syringomyelia (SM), an accumulation of fluid within the spinal cord that has been linked to a neuropathic pain syndrome. The purpose of this study was to obtain quantitative data on sensory thresholds in CKCS with and without SM. We hypothesized that CKCS affected with SM will have lower sensory thresholds when compared to unaffected dogs. Fifty-four dogs were classified as symptomatic or not by their owners, presence of pain was noted on neurological examination, sensory threshold testing was performed, and SM was identified on magnetic resonance imaging. Owners reported 24/54 dogs as painful, 33/54 had scratching signs, 40/54 were painful on examination and 34/54 had SM. There was no significant difference in sensory thresholds between dogs with and without SM ($P > 0.5$). Owner-reported symptomatic dogs had lower mechanical latencies on the paw (median: 0.367kgs) and neck (2.075kgs) compared to asymptomatic dogs (0.6275kg and 2.545kgs, respectively) ($P = 0.009$ and 0.007, respectively). Dogs that exhibited pain on neurological examination had decreased latencies to heat at the thorax (median = 17.55 seconds) compared to dogs that were not painful (median = 22.16 seconds) ($P = 0.03$). Mechanical latencies were lower on the side of the neck that corresponded to lateralization of SM in dogs with asymmetrical syrinxes ($P = 0.03$). This information can be leveraged to optimize treatment protocols and objectively study efficacy of future therapeutics in CKCS.

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Defining the role of specificity proteins in embryonic neurodevelopment

Neurogenesis is a fundamental and precisely regulated process in which neural stem cells (NSCs) give rise to progenitors and neurons, which will ultimately form neocortical layers in the embryonic brain. Aberrations in cortical development underlie the etiology of myriad neurological disorders, notably heterotopias, microcephaly, and various forms of perinatal epilepsies. However, our current understanding of the molecular and cellular processes underlying cortical development remains largely incomplete. Thus, elucidating the cellular and molecular mechanisms playing key roles in neurogenesis is of fundamental and clinical significance. A critical component of neurogenesis is the precisely balanced division of neural stem cells (NSC), to first expand their population and later give rise to neurons. Sp transcription factors likely play a crucial role in regulating these highly coordinated events. Future experiments including high-throughput sequencing and genetic manipulation in mice will aim to address a significant gap in our understanding of the cellular and molecular mechanisms which orchestrate normal brain development, and elucidate novel genetic etiologies contributing to neurological diseases.

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Poster Number: 206

Age-dependent Defect in Subacute Intestinal Restitution Associated with Underdeveloped Glial Network is Rescued by Juvenile Mucosal Homogenate in a Neonatal Pig Model of Intestinal Ischemia

Necrotizing enterocolitis (NEC) is the leading cause of death in neonatal intensive care units. In NEC, ischemia damages the epithelial barrier leading to sepsis and death unless the mucosal barrier is rapidly restored, or injured intestine is resected. In our translational pig model, we previously characterized rapid epithelial restitution and tight junction re-assembly in juvenile (6-8-week-old) pigs. However, we have recently noted a deficiency in repair in a neonatal (2-week-old) model. Emerging studies highlight important barrier-regulating paracrine signals from the enteric glial cell (EGC) network within the lamina propria, which develops postnatally in rodents. We hypothesized that the lamina propria EGC network and thus and the pro-reparative EGC-secretome is reduced in neonates as compared to juveniles, and that exogenous application of injured juvenile mucosal homogenate, which includes EGC components, will rescue repair in injured neonatal tissue. We induced 30-minutes jejunal ischemia in neonatal and juvenile pigs and recovered injured mucosa in Ussing chambers with or without the addition of injured juvenile or neonatal mucosal homogenate while monitoring transepithelial electrical resistance (TER) and mannitol flux. Recovered tissues were collected for further analysis. While juvenile tissues fully repaired, TER and flux failed to recover in neonates corresponding to a defect in epithelial restitution. This defect was associated with reduced EGC markers s100β and GFAP in the lamina propria of neonates as compared to juveniles by western blot, histology and volume imaging. Scanning electron microscopy revealed neonatal wound-adjacent enterocytes lacked the migratory phenotype seen in juveniles. Injured juvenile mucosal homogenate (but not neonatal) rescued the TER of injured neonatal mucosa. Histology to confirm rescue of restitution are pending. Ongoing experiments will assess differential transcriptome expression between ischemia-injured mucosal homogenates of neonates and juveniles. Identifying rescuable defects in infant intestinal repair mechanisms will foster development novel clinical interventions to reduce NEC mortality.

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