CENTER FOR ENGAGED LEARNING & TEACHING

RESEARCH SHOWCASE BOOKLET

2015-2017

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2015-2017 *Research Showcase*

Welcome to the 2015-2017 CELT Research Showcase!

Over the past five years, the Center for Engaged Learning and Teaching has supported over 100 undergraduate faculty-mentored research projects in 30 different majors. This year, CELT is showcasing over 30 exceptional student recipients of the Faculty/Student Engagement Scholarly and Artistic Engagement award. We are proud to say that these students come from a myriad of majors like Biomedical Engineering, Neuroscience, Ecology & Evolutionary Biology, Psychology, History, Public Health, Political Economy, Engineering Physics, Economics and more.

Through our funding, students at Tulane are able to work alongside faculty mentors in their respective fields of interest. Most of our students have presented or published their research through scholarly outlets, such as, peer reviewed journals and presentations at national conferences. In partnership with the Howard Tilton Memorial Library, we are creating an online exhibition to host and archive the supplemental research materials of these exceptional CELT scholars.

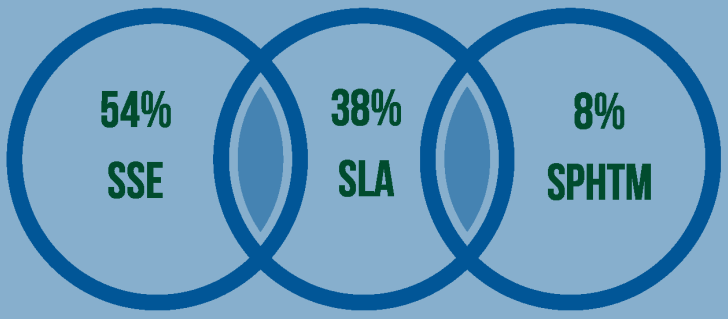
We enjoyed working with such capable and motivated students over the past few years. Our academically diverse students have worked closely with their faculty mentors on exciting, immersive projects, and we are proud to provide a platform to share their impressive experiences and work with the Greater Tulane community. We hope you enjoy.

Best wishes,
CELT Faculty & Staff
Susann Lusnia, Toni Weiss, Emily Gatehouse, Eric Roque, Antoinette Mills
Maeve Holler*, Emma O'Cinneide*, Joan Komolafe* & Monica Holler

The Center for Engaged Learning & Teaching
310 Richardson Building
Tulane University

**This booklet was compiled and edited by Senior Research Engagement Fellow, Maeve Holler ('17). The photos which appear in this booklet were taken by Marketing & Public Relations Fellow Joan Komolafe ('17). The informational graphic and its data analysis were done by Senior Research Engagement Fellow, Emma O'Cinneide ('17).*

Between 2015 - 2017 CELT funded students of various majors from:



- SCHOOL OF SCIENCE AND ENGINEERING
- SCHOOL OF LIBERAL ARTS
- SCHOOL OF PUBLIC HEALTH AND TROPICAL MEDICINE

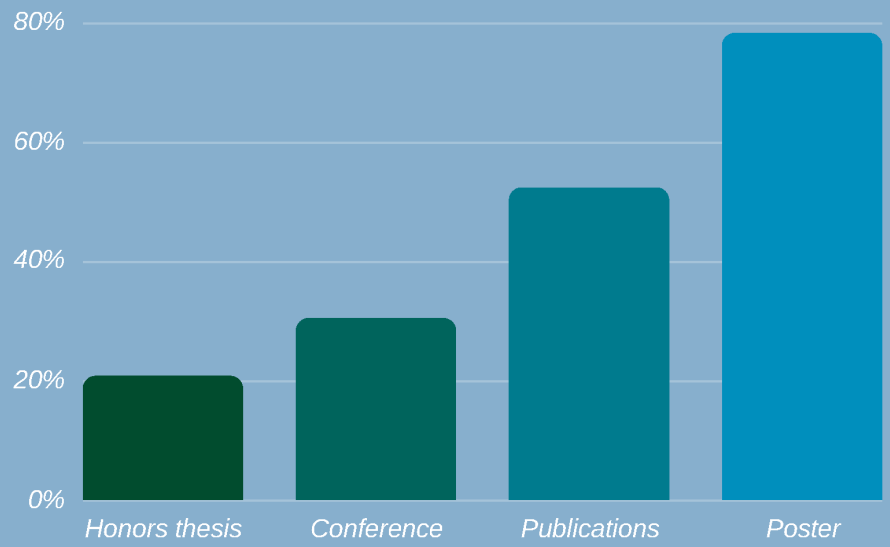
76% of students *reported tangible outcomes from their research*

Of these students:

78.2%
Created an academic poster

30.4%
Presented their research at conferences

20.7%
Wrote an honors thesis



52.3%
Had personal publications, co-authorship, or mention in academic papers

N=33 / 58

ANUSHA SIVAKUMAR ('17)

BIOMEDICAL ENGINEERING

Project

The Role of Central Transient Receptor Potential Vanilloid Type 1 Action on Whole Body Glucose Homeostasis Through Pre-Autonomic Hypothamalic Neurons

Faculty Mentor

Andrea Zsombok, Ph.D.

Paraventricular Nucleus (PVN) in the brain is an important integrative autonomic center that controls the glycemic balance and regulates glucose homeostasis by means of controlling the liver. The importance of studying the significance of PVN in the brain-liver neural pathway is key in coming up with therapeutic methods to treat type two diabetes mellitus in addition to already existing pharmacological interventions. In order to understand this brain-liver pathway fully, the PVN in the brain hypothalamus is analyzed using Biocytin staining, Texas-Red labeling and retrograde viral labeling to identify liver-related PVN neurons.

This information is then used to trace the neural pathway to the transient receptor potential (TRP) channels in order to determine if specific TRP (transient receptor potential) channels such as TRPV1 (Vanilloid Type 1) and TRPA1 (Ankyrin 1) have specific effects in the regulation of liver-related PVN neurons. This is done so by analyzing quantified excitation action potential values of the liver related PVN-neurons via electrophysiology. This study is focused on finding the distinct effects the TRPV1 and TRPA1 channels have with regards to liver-related PVN-neurons which in turn control glucose metabolism. The PVN-neuron and TRPA1 relationship in specific is understudied and further studies are required to establish a quantifiable relationship linking them, which can be applied to therapeutically approach glucose metabolism dysfunction. Further studies are needed to delineate these results and quantify how TRPV1 receptors affect whole body glucose metabolism. Further research can also be carried out using various other neuromarkers such as neuropeptide Y in place of TRPV1 receptors.

STEPHEN CORTESE ('18)

ECOLOGY & EVOLUTIONARY BIOLOGY AND NEUROSCIENCE

Project

Primate Health Responses to Extreme Drought in Northwestern Costa Rica

Faculty Mentor

Katherine Jack, Ph.D.

There has been increasing research using primates to measure the well-being of an environment. With climate change further disrupting ecosystems, effective analysis of health of wild primates for this purpose becomes imperative. However, invasive tactics, like blood sampling, typically only allow for a smaller sample size due to costliness. Noninvasive measures hold new promise of affordability and efficiency. We thus study an emerging noninvasive technique – urinary analysis and seek to determine the viability and validity of this analysis in the field. We used Chemstrip 10 MD by Roche Diagnostics to evaluate the levels of leukocytes, urobilinogen, ketones, proteins, and specific gravity in White-capped capuchin monkey (Cebus capucinus) urine in the dry tropical forest of the Santa Rosa reserve in Costa Rica. Urine samples were collected on the surface of leaves, branches and rocks immediately after micturition, following the methods of other studies. Through urinalysis, we found that none of our forty-nine samples contained ketones, which means that none of our subjects were using body fat as an energy source. This confirms our hypothesis as we conducted our experiment during the wet season in June when resources are plentiful. However, further urinalysis is needed to see if body fat usage increases during the dry season especially since the area has been under a consistent drought for the last five years. Furthermore, positive leukocyte samples were found primarily in individuals who come in close contact with humans or were pregnant or lactating. This suggests a direction of further research on the impact of anthropological effect on animal health. Our results have validity because we show that it's unlikely that urine concentrations had affected our results. Only high concentrations, e.g >1.030, can give false positives and our average for urine specific gravity was 1.0155. In conclusion, we have shown that noninvasive methods have the potential to produce informative and unbiased research.

LINA JANAH ('17)

NEUROSCIENCE

Project

Review of Patient Characteristics in Diagnosed vs. Non-Diagnosed Autism Spectrum Disorder: Tulane Center for Autism and Related Disorders Chart Review

Faculty Mentor

Lisa Settles, Psy.D.

Autism Spectrum Disorder (ASD) in recent years has become a topic of great discussion, as rates of diagnosed individuals have increased by enormous percentages. According to the CDC, in the 1980s, 1 in 2,000 children were diagnosed with ASD. Today, approximately 1 in 150 are diagnosed with ASD. The reason for said increase remains a mystery to be solved. Research about this topic has revolved around genetics, environment, and many other factors contributing to daily life. An important question remains: are more children really being born with ASD, or are we simply diagnosing it more due to increased awareness and a broader definition? Realistically, the answer is some combination of both.

At the Tulane Center for Autism and Related Disorders, we are able to observe and diagnose hundreds of cases of ASD every year, with access to in depth medical histories and genetic information. This project is a review of many of those cases, compiling data to observe correlations among factors such as premature birth, age of mother, father, and environmental factors. The main focus of this project is related to the premature birth and parental age during time of birth.

Methods of investigation for this study were predominantly used by reviewing case studies, studying literature related to the topics, and compiling data in a way to identify correlations.

The purpose of this project is to use the resources available on a large scale to better understand ASD and its increasing diagnostic frequency. Finding correlations as well as observing patterns will aid with further research and inquiry into causes and possibly, long term, helping to catch diagnoses in their earliest stages for maximal management of ASD.

Lina worked in conjunction as co-authors with Lindsey Berman.

AMY LEACH ('17)

NEUROSCIENCE

Project

Expression of Cation-Chloride Transporters in Vasopressin and Oxytocin Neurons in the Rodent Brain

Faculty Mentor

Jeffrey Tasker, Ph.D.

GABA, a typically inhibitory neurotransmitter, can act in an excitatory manner when the reversal potential (EGABA) becomes positive compared to the resting membrane potential. EGABA is determined by the electrochemical driving force on chloride, which is in turn generated by the actions of two counter-acting cation-chloride transporters, Potassium Chloride Cotransporter 2 (KCC2) and Sodium Potassium Chloride Cotransporter 1 (NKCC1). KCC2 is a chloride exporter while NKCC1 is a chloride importer. KCC2 has a low expression during embryonic development, but is expressed fairly ubiquitously throughout the nervous system in adulthood (Knoflach, Hernandez, & Bertrand, 2016). NKCC1 is found at low levels in adulthood (Kanaka et al, 2001). The developmental changes in expression of these two cation-chloride transporters result in a developmental switch in chloride gradients in neurons. Immature neurons typically display a high intracellular chloride concentration while mature neurons typically display a low intracellular chloride concentration (Watanabe and Fukuda, 2015). Immature neurons with a high expression of NKCC1 and high intracellular chloride generate an excitatory response to GABA. Mature neurons with high expression of KCC2 and low intracellular chloride generate the typical inhibitory GABA response (Knoflach, Hernandez & Bertrand, 2016).

The current project is an extension of a study from the Tasker lab that found GABA to be uniformly excitatory in adult vasopressin neurons in the rat hypothalamus under normal conditions, whereas oxytocin neurons in the hypothalamus were found to have the typical inhibitory response to GABA (Haam et al, 2012). The aim of the current project is to compare the expression of KCC2 and NKCC1 in oxytocin and vasopressin neurons in adult rat brains using immunohistochemistry and confocal microscopy to determine if the excitatory GABA seen in adult vasopressin neurons may be a result of differential expression of these cotransporters.

ASHTON FRIEND ('18)

PSYCHOLOGY & COGNITIVE STUDIES

Project

Development of Hand to Mouth Coordination in Infancy

Faculty Mentor

Jeffrey Lockman, Ph.D.

Hand to mouth motor movement is critical in the feeding and soothing of infants, but little is known about how this skill develops. Besides our knowledge that infants can perform smooth movement from hand to mouth by the age of 4-5 months (Lew & Butterworth 1997), we do not know how infants gain accuracy in this skill. On top of our little understanding of how babies master this task, another question arises. After looking solely at hand to mouth movement, it leads us to ask why placing an object in the hand adds another level of complexity to the task. For this question, we need to examine how the infant maneuvers and orients an object (a pacifier in this case), and seeing how the orientation of the object in hand would differ from that of a normal hand to mouth movement. Our goal is to understand the process by which hand to mouth skill with an object develops. This work can also be used to formulate norms to assess infants at risk or with motor disabilities.

In looking at the hand to mouth motor system, we investigated how objects work as extensions of the hand, being that this ability is foundational for later tool-use. Putting a pacifier in the hand of an infant affects the ability for the infant to coordinate the hand movement to its face. I contrasted how babies bring their empty hand to their face to when a baby has the object in hand. The project hypothesis was that the addition of an object in the hand will complicate smooth hand-to-mouth coordination. We thus predicted that young infants more successfully oriented their thumb, for example, to their mouth than a pacifier. We also examined the trajectories of hand to mouth transport in both conditions. Will the baby use an indirect or direct route based on whether an object is in hand? To address this question, we will look at the straightness of infants' hand-to mouth efforts.

Based on the findings, I was going to develop an abstract to be submitted as a poster presentation in the SRCD meetings in Austin, Texas, 2017. The SRCD is the Society for Research in Child Development, an important organization where scientific findings on child development are presented. Unfortunately, upon analyzing data I found that a good portion of data (coded by a few colleagues) were miscoded and thus prohibited me from concluding the study due to lack of time remaining.

RACHEL OBSTFELD ('17)

PSYCHOLOGY & COGNITIVE STUDIES

Project

Workplace Correlates of Teacher Misperceptions: Understanding Discrepancies in Teacher Predictions of Low-Income Preschoolers' Pre-Academic Skills

Faculty Mentor

Courtney Baker, Ph.D.

Preschool teachers are susceptible to developing inaccurate impressions about their preschoolers' pre-academic skills (Mashburn & Henry, 2004) which could lead to ineffective instructional scaffolding, result in limited student learning during a critical developmental period, and, for children from disadvantaged backgrounds, contribute to the achievement gap (Baker et al., 2015; Duncan et al., 2007). Workplace factors, such as teachers' perception of their job and leadership, also appear to contribute to variability in these misperceptions (Baker et al., 2015). The current study aims to understand the link between workplace factors and teachers' harmful underestimation of preschoolers' pre-academic abilities. The current study utilizes data from the Building Bridges project, which evaluated a kindergarten readiness program in Head Start and community child care programs (Baker et al., 2010). Our sample includes 760 ethnically diverse preschoolers (Mage = 4.6) and 123 teachers (98% female). Teachers provided demographic information and ratings for preschoolers and preschoolers were directly assessed. Discrepancy scores were computed by subtracting a standardized score representing a preschooler's objective pre-academic ability from a standardized score representing teacher perceptions of that same preschooler's ability. Multi-level modeling was used to test the hypothesis that healthier work environments would be associated with more accurate or overestimated teacher perceptions of preschooler ability. All analyses controlled for relevant child, teacher, and center characteristics. In line with hypotheses, teachers who reported of positive and healthy work environments were more likely to overestimate their preschoolers' pre-academic language, $B = .57$, $p = .01$, and math abilities, $B = .87$, $p = .002$.

These findings suggest that workplace factors such as workplace health and job satisfaction impact teachers' accuracy when evaluating their preschoolers' pre-academic skills. Consequences of too-low expectations are clearly negative, and oftentimes long-lasting (Baker et al., 2015; Rubie-Davies et al., 2006). Attending to the ecological context of the preschool may help researchers understand patterns of underachievement that could contribute to the achievement gap. These findings also suggest avenues for intervention targeting the preschool workplace, rather than the individual preschooler, in order to address disparities.

Rachel worked in conjunction with Treshena L. Hill and Janis Kupersmidt.

DAVID GAIDAMAK ('18)

HISTORY

Project

"The Nobles are Finished": Gender, Race, and Citizenship in Postcolonial Nicaragua through the Eyes of Aristocratic Women 1807-1847

Faculty Mentor

Justin Wolfe, Ph.D.

Personal artifacts are hard to come by in Central American archives; their society is generally not as liberal in divulging their personal lives. The Cesar family was high-ranking before the Latin American independence movement and kept in contact with Spanish elites on the Iberian Peninsula. When the Central American states gained independence, elites had to make a choice that could cost their lives – stay with old elites or lead a new generation. We tend to overlook the women's perspective in this context; we often teach narratives that we know, and in Nicaragua, this is the men's story. Professor Wolfe's project, "The Nobles are Finished: Gender, Race, and Citizenship in Postcolonial Nicaragua through the Eyes of Aristocratic Women, 1807-1847," serves to educate and give resources to not only the academic community but to a broader range of public interested in the changing lives of elite women during a massive civil change.

My part in this project was transcription. Not Spanish to English, but Spanish to Spanish. The letters, written in an older style, are all in cursive with altered grammar and spelling than I am used to in class. We used Google Drive and Zotero to collaborate and share the documents. The process of transcription was hard for me at first. One letter, only three or four pages, would take an hour for me to go through and convert to a word document. After I slowly learned the personal styling for each person, the process became easier. Over the course of a semester and a half my transcription is not yet complete, though I hope to have this done by the end of the academic year. The collective letters may be published as a standalone piece for future researchers and academics, but they can also be used to add to a neglected part of Central American history.

ANNA SANFORD ('18)

PUBLIC HEALTH

Project

Chagas Disease in New Orleans: An Opportunity for Student and Community Training

Faculty Mentor

Claudia Herrera, Ph.D.

Trypanosoma cruzi is a pathogenic microorganism that cause Chagas disease, an anthropozoonosis that represents a major public health problem in Latin America. T. cruzi is widely distributed throughout the American continent, from the southern regions of the United States (U.S.) to Argentina, and infects at least 6 million people in Latin America. Although the U.S. was initially defined as non-endemic for Chagas disease due to the rare occurrence of human cases, the presence of T. cruzi has now been amply demonstrated as enzootic in different regions of the southern half of the country. Much remains unknown about the dynamics of the parasite's transmission among mammals and triatomine vectors in different eco-epidemiological cycles. In southeastern Louisiana, a T. cruzi infection rate of 60.4% has been demonstrated in the local vector Triatoma sanguisuga, also called the "kissing bug".

Through CELT funding, we have developed and performed a survey in the West Bank area to determine the community's knowledge, attitudes and practices towards the vector and disease. Resulting from our work in the West Bank, we established a good relationship with the community by collecting data on their perception of Chagas disease and kissing bugs, as well as collecting triatomine samples from their properties. We have collected 71 local kissing bugs that we are analyzing in the lab to determine the genetic diversity of T. cruzi in these vectors and to identify their habitats.

The outcomes are expected to be a clear delineation of the complex elements of the relevant natural history and risk of T. cruzi transmission to humans in this area. The results from our CELT projects will be utilized to spread awareness on preventing Chagas disease in southeastern Louisiana and as basis for future funding to study the disease and its vector in other areas in Louisiana.

Anna worked in conjunction with Eli Bierman and Sarah Hill.

LIPAZ AVIGAL ('19)

POLITICAL ECONOMY (INTERNATIONAL PERSPECTIVE)

Project

Liberalism in Illiberal States, Trends on Political and Electoral Support for Anti-Systemic Parties in France, Germany, and Britain

Faculty Mentor

Mark Vail, Ph.D.

I have been assisting Mark Vail in two separate projects. The first involves assisting Dr. Vail with the completion of his most recent book manuscript, currently under review at Oxford University Press with a tentative publication date of late 2017. The book, entitled Liberalism in Illiberal States: Ideas and Economic Adjustment in Contemporary Europe, traces patterns of policy making in France, Germany, and Italy in the areas of fiscal policy, labor-market policy and financial regulation since the early 1990s.

The second project involves an analysis of recent increases in economic inequality and insecurity in Continental Europe and the effects of these trends on political and electoral support for anti-systemic parties of the far Left and far Right in France, Germany, and Britain. Many scholars and journalists alike have observed the increased salience of questions of economic distribution and equity in contemporary Europe and the concomitant rise of anti-systemic, ideologically extreme parties, such as the French National Front, the United Kingdom Independence Party, and the Alternative for Germany, which are using these issues in their increasingly successful appeal to voters.

However, there has been comparatively little analysis of why certain kinds of appeals gain political traction in particular countries or the extent to which voters tend to support either the far Left or far Right in such contexts. I am assisting him in developing a tight, workable research question and research methodology, beginning a survey of the relevant scholarly literatures, and beginning to collect primary data and evidence in English-language periodicals.

Lipaz worked in conjunction with Jake Ward.

GRAY HALLIBURTON ('17)

BIOMEDICAL ENGINEERING ('16), MASTERS

Project

In Vivo Alabation of Liver Cancer by High-Intensity Focused Ultrasound and Ethanol

Faculty Mentor

Damir B. Khismatullin, Ph.D.

The aim of this experiment was to grow tumor xenograft models in vivo and measure the effectiveness of treatment with High Intensity Focused Ultrasound (HIFU) alone and in combination with Ethanol. Liver cancer cells were of the HEP3B cancer cell line and cultured in T-175 flasks with DMEM until confluent (~10 million cells/flask). Once cells were confluent they were mixed with High Concentration Matrigel in a 1:1 ratio so they could be seeded in vivo for tumor growth. Matrigel and Cancer cells were removed from the aliquot with an 18 gage syringe and injected into the each flank of 20 male athymic nude mice using a 25 gage syringe (Theoretically yielding 40 total tumors).

After a few weeks of monitoring and measuring tumor sizes they reached the 8*8 threshold and were selected to 1 of 4 different treatment groups: Control (PBS Injection), Ethanol Only, HIFU only, HIFU + Ethanol. The tumors were treated with 1.1 MHz Sonic Concepts HIFU Transducer locked in a system where the focus was directly established at a certain point where the mouse could be treated using ultrasound gel to aid in passing the signal to the tumor. Directly after treatment tumor ablation regions were measured using ultrasound. Tumors were then continuously monitored and measured to observe tumor progression post treatment. After 5 days and 14 days select groups of euthanized and tumors were dissected and prepared to be pathologically analyzed.

Results from ultrasound images showed tumor ablation in HIFU and HIFU + Ethanol groups. Regression of tumor size post treatment was observed in only in the HIFU + Ethanol group. Pathology report also indicated that the HIFU + Ethanol group had a significantly higher cancer cell necrosis percentage.

AMELIA BERGESON ('18)

CHEMICAL ENGINEERING

Project

Synthesis and Thin Film Morphology of Linear and Cyclic Poly(ε-Caprolactone)

Faculty Mentor

Scott M. Grayson, Ph.D.

Linear poly(ε-caprolactone) (PCL) is a biodegradable polymer. This polymer as well as its degradation products are biocompatible within the human body and because of this property the FDA has approved its use in drug delivery devices. However only limited research has investigated the properties of cyclic PCL, which is expected to have unique and complementary properties relative to the well-studied linear PCL. This lack of research is due to the fact that cyclic PCL has been previously difficult to synthesize. The initial portion of the research was to create linear and cyclic samples of PCL at various molecular weights.

The synthesis was completed over the summer of 2016 in the Grayson lab, as the Grayson lab has developed an efficient process to synthesis cyclic PCL across a wide range of molecular weights. The second portion of the research project is being conducted in Dr. Albert's lab to create and study the linear and cyclic PCL samples in thin films. Before the films can be studied their film thickness must be verified by analyzing their reflectance spectra. The films are then studied using optical microscopy and atomic force microscopy to observe the morphology and architecture of the thin films. Preliminary results show differences in the crystalline domain size and shape between linear and cyclic samples of the same molecular weight. Current research is looking at differences between low molecular weight PCL and high molecular weight PCL linear and cyclic pairs. The overarching goal of the project is to synthesize with high yields cyclic PCL and to examine its properties.

Amelia worked in conjunction with Fariah M. Haque, Giovanni Kelly, and Julie N.L. Albert.

HAKM MURAD ('17)

BIOMEDICAL ENGINEERING ('16), MASTERS

Project

Development of Adjuvant HIFU Therapy for Prostate Cancer

Faculty Mentor

Damir B. Khismatullin, Ph.D.

High-intensity focused ultrasound (HIFU) emerges as a powerful technology for noninvasive or minimally invasive non-ionizing treatment of cancer, with recent FDA approval. HIFU deposits a large amount of acoustic energy at the focal region within the target tissue (i.e., tumor), causing tissue heating and necrosis. Our laboratory explores synergistic combination of HIFU with other therapeutic modalities to achieve the complete destruction of large and multifocal tumors. In this study we test the hypothesis that HIFU and percutaneous ethanol injection (PEI), a leading method for chemical ablation, have a synergistic effect on ablation of aggressive prostate cancers in vivo.

This in vivo study was performed using the xenograft mouse models of human prostate cancers. DU145 human prostate cancer cells (2.0 x ⟦10⟧^6) were injected on flanks of athymic nude mice. Tumors were allowed to grow to 8-10 mm size and then separated into the following treatment groups: HIFU alone, PEI (50% Etoh, 50 µl) alone, PEI+HIFU (50%Etoh, 50 µl), and sham. Tumor sizes were measured by caliper every day and a veterinary diagnostic ultrasound system was used pre-treatment, 5 days, and 12 days post-treatment. Tumors were surgically removed and fixed using 10% formaldehyde solution. Samples were sent for H&E staining with a single blinded pathologist, and live/dead percentages of tumor cross sections were determined at 5 and 12 days post treatment.

Tumor growth is significantly reduced or completely eliminated in tumors treated with HIFU in combination with PEI. Tumors treated with HIFU alone or PEI alone show a decrease in tumor size at 5 days, then rebounding to similar sizes as the sham. Histology shows largest necrotic tissue area in tumors treated with PEI and HIFU at 5 and 12 days post treatment.

EMMA BORTZ ('18)
BIOMEDICAL ENGINEERING

Project

Molecular Mechanisms of the Synergistic Ablation of Prostate Cancer by Ethanol and HIFU

Faculty Mentor

Damir B. Khismatullin, Ph.D.

Prostate cancer is the most incident cancer in men. Since elderly men, often not suitable for invasive procedures, compose the majority of prostate cancer patients, there is a need for minimally invasive therapies such as focused ultrasound. We tested the hypothesis that ethanol-treated prostate cancer cells exposed to high intensity focused ultrasound (HIFU) have a reduced metastatic potential and proliferation rate due to inhibition of NF-kB through increased expression of ROS.

Suspensions of cultured DU145 prostate cancer cells were placed in 0.2ml tubes. The cells were left untreated or exposed to HIFU alone, 4% ethanol, or HIFU+4% ethanol. The HIFU signal was generated by a 1.1 MHz transducer, with acoustic power ranging from 4.1 to 20 W. Reactive oxidative species (ROS) expression was measured by flow cytometry, and NF-kB protein levels were determined by Western blot analysis at 2, 24, and 72 hours post-treatment. To confirm that cancer cells lose aggressiveness, we measured the number of cancer cells adhered to TNF-a-activated endothelium as well as tested the ability of cells to form multi-cellular spheroids.

Prostate cancer cells significantly increased their expression of ROS immediately after being exposed to HIFU+4% ethanol and continued to produce these molecules at a significantly higher amount than untreated, ethanol, or HIFU alone treated cells. Static adhesion assay showed that cells in the combined treatment were less likely to attach to endothelium. Cells exposed to both ethanol and HIFU were unable to form three-dimensional tumor spheroids. We showed that HIFU reduces NF- kB production in prostate cancer cells, and the levels remain low for at least 72 hours post treatment in the HIFU+4% ethanol treatment group. These factors lead to phenotypic changes in cancer cells that reduce their aggressiveness

ETHAN GASTA ('18)

ENGINEERING PHYSICS

Project

Magneto-optical Kerr effect magnetometry of 2D atomically-thin magnetic materials

Faculty Mentor

Diyar Talbayev, Ph.D.

The Magneto-optic Kerr Effect (MOKE) is the altering of polarization of light when reflected off a material within a magnetic field. MOKE is typically used to discover magnetic and optical properties of materials, which are important to know for applications of spin electronic devices. Measuring MOKE is a very sensitive process since the strong magnetic field in the system can create unwanted artifacts in our results. We have constructed a modified MOKE microscope to measure the change in polarization of the light reflected by the material. Our modification allows for the incoming light to be perpendicular to the sample, and then collects the reflected light back up through the microscope. The primary testing materials are MnPS3, an antiferromagnetic semiconductor, and FeTeSe, a metal that becomes a superconductor at the low temperature of 14 K.

We have started measuring the MOKE of these materials and hope to soon continue to on a 2D MnPS3 sample. MnPS3 was chosen as our focus due to the little known magnetic properties of these 2D crystals. A cryostat station holds the samples at a low temperature, where the materials become superconducting and antiferromagnetic. For the antiferromagnetic MnPS¬3, our goal is to measure its magnetization using light. For the superconducting FeTeSe, our goal is to image magnetic flux penetration into the inhomogeneous superconducting state.

ADRIAN JONES ('18)
BIOMEDICAL ENGINEERING

Project
Ultrasound-Enhanced Molecular Therapy for Neurogenesis

Faculty Mentor
Damir B. Khismatullin, Ph.D.

Spinal cord injury (SCI) impacts 200,000 Americans annually. Many of those afflicted with a SCI experience loss of sensation or motor function below the site of spinal cord injury or severed nerve. Because there is currently no effective for nerve regeneration in the central nervous system (CNS), the damage of an SCI is chronic. Low intensity ultrasound (LIU) has been used to show accelerated growth and increased neurotrophic levels of peripheral nerves.

The goal of this project is to develop a non-invasive method to stimulate neurogenesis through low-intensity focused or unfocused ultrasound through varying certain acoustic parameters such as center frequency, acoustic power/intensity, duration, and duty cycle. In combination with ultrasound applications, molecular therapy will be applied to test the synergistic effects on neurogenesis. Current results of testing the ultrasound application without molecular therapy show that there is an increased neuron density from treated neurons in comparison to the control. In the future, we plan on combining synergistic effects to see if there is increased neurogenesis.

MICHAEL MAHONEY ('17)

ECOLOGY & EVOLUTIONARY BIOLOGY

Project

Preferential selection of fruiting trees based on habitat structure by diurnal avian frugivores across successional forests in the Chocó Rainforest, Esmeraldas Province, Ecuador

Faculty Mentor

Jordan Karubian, Ph.D.

Animal-mediated seed dispersal in tropical rainforests shapes varying ecological processes including seedling recruitment and demography. In our study we explore which diurnal avian frugivores act as primary seed dispersal agents for the long lived, hyper abundant canopy palm tree, *Oenocarpus batuau*, and if these birds select foraging sites based on surrounding forest structure.

Our study took place in the Chocó Rainforests of Northwest Ecuador, Esmeraldas province at Bilsa Biological Station in the Mache-Chindul Reserve. Observations were conducted across our 130 ha parcel in primary old growth, selectively logged, and >20 year old secondary forest. We found that only one principal primary frugivore, the long wattled-umbrella bird (*Cephalopterus peduliger*) consumed more fruits at trees surrounded by denser canopies, indicative of primary old growth and selectively logged forests. Two toucan species (*Ramphastos brevis and R. swainsonii*) were observed eating large proportions of fruit from *O. bataua* showed no preference in their foraging patterns.

With this study we hope to inform our continuing investigation of the role these birds play in shaping their environment and make speculations about the impact these patterns may have for tropical forest regeneration following forest clearing.

MIRANDA HENDRIX ('17)

PHILOSOPHY

Project

Influence of flooding on baldcypress endophyte community composition and its effects on plant responses to inundation stress

Faculty Mentor

Sunshine Van Bael, Ph.D.

Coastal wetlands provide substantial ecosystem services. Baldcypress trees (Taxodium distichum) dominate coastal flooded forests (swamps) and are crucially important to the Gulf Coast region as the major buffers against storm damage. The productivity of these trees is tied closely to hydrological processes. A myriad of studies have examined the effects of flooding and differential flooding regimes on baldcypress seedling growth, morphology, germination, establishment, and physiology. To date, however, no study has examined the effects of differential flooding regimes on the microbial symbionts of baldcypress trees. Our goal is to evaluate how flooding influences shifts between root communities being dominated by bacterial versus fungi. We will pursue the following questions:

1) Does flooding change the bacterial to fungal ratio of the endophyte community in baldcypress trees?

2) Does the prevailing endophyte community under flooding conditions promote the plant survival under these stressful conditions?

We will use a growing room study to ask these questions. We will have flooded and non-flooded baldcypress seedlings, and we will extract DNA to compare the ratio of bacteria and fungi in the roots of the seedlings. We expect that pursuing these questions will help us evaluate the role of endophytes in stress resilience for flooded baldcypress. Since we are working with seedlings in our proposed experiment, our data may be relevant to restoration projects seeking the best outcomes for planted trees.

Miranda worked in conjunction with Emma Darr.

GRIFFIN SANDLER ('18)

MATH AND ECONOMICS

Project

Fighting against Crime: How Citizen Participation and Collective Action Deter Crime in New Orleans

Faculty Mentor

Wei Long, Ph.D.

Police departments across the country are extremely motivated to find procedures that can deter and reduce crime at a low cost. Previous studies in economics and criminology have concluded that significant police visibility and proactive patrolling strategies in crime "hot spots" can effectively deter crime. This paper investigates the impact of citizen participation and collective action has to further reduce crime in "hot spots" in New Orleans, specifically the French Quarter. In March 2015, a privatized police force, the French Quarter Task Force (FQTF), made up of off-duty New Orleans Police Department (NOPD) officers, was formed to prevent crime in the French Quarter. Citizens could report crimes in the area via an app downloaded onto their phones, and the FQTF would respond in real time.

Using NOPD crime data from 2012 to 2015, we combine and analyze data on robbery, assault, burglary, and theft into one variable, street crime, for each of the 72 neighborhoods in New Orleans. After accounting for seasonality, we use a finite distributed lag (FDL) model of order 1 to demonstrate that crime was significantly reduced in the French Quarter by the FQTF. We then use the difference-in-difference model to prove that the introduction of the FQTF significantly reduced crime in the French Quarter when compared to the other 71 neighborhoods in New Orleans. This affirms the importance of citizen participation and collective action in crime prevention whether the police service is provided by the public or private sector.

WEIYAO WANG ('18)

CHEMICAL ENGINEERING

Project

Bacterial Swimming and Biofilms Porous Media Affected with Entrapped by Oil Spills

Faculty Mentor

Kyriakos Papadopoulous, Ph.D.

Studies have shown that many bacteria isolated from crude oil contaminated sites can use crude oil as their carbon source, making these microbes favorable crude oil degraders. Due to the wide range of isolated strains, there are a variety of strains to choose from to create an effective bacteria consortium. In order to produce the most effective consortium, various consortia's oil degrading abilities must be compared to one another. Common experimental methods that have been devised to make these comparisons require a large capital investment for supplies as well as demand a substantial amount of space and time.

Our lab created a microscopic approach, which can speed up the screening process and decrease the amount of required material. This approach utilizes inexpensive, compact materials such as 35mm petri dishes and requires less oil and bacteria, ultimately needing fewer materials to grow and incubate the bacteria. This method offers a promising alternative to monitoring bacteria consortia in batch reactors. This can also enable us to visualize the entire progression of bacteria degrading a crude oil droplet.

TONI BROWN ('17)

ECOLOGY & EVOLUTIONARY BIOLGOY

Project

Behavioral barriers in the speciation process: color variation in a hybrid zone of role-reversed species

Faculty Mentor

Elizabeth Derryberry, Ph.D.

Species-specific vocalizations can be reproductive isolating mechanisms among closely related populations. We analyze vocal divergence between two hybridizing species of shorebirds, the Northern Jacana (Jacana spinosa) and Wattled Jacana (Jacana jacana). As these species are both sexually dimorphic, we also compare calls between males and females.

We found that species are significantly different in their vocalizations, but males and females are not. Specifically, Wattled Jacana vocalizations have longer notes and higher mean frequency bandwidth, whereas Northern Jacana vocalizations have higher fundamental and peak frequencies.

Our results suggests that vocal divergence could act as a behavioral barrier to limit hybridization between the species, and future studies using playback experiments should test this hypothesis.

RYAN FISHEL ('17)

BIOMEDICAL ENGINEERING, CHINESE MINOR

Project

Quantification of Stem Cell Fate in Microvascular Networks

Faculty Mentor

Walter Murfee, Ph.D.

Understanding the cues that regulate stem cell fate during microvascular growth will improve our ability to design cell-based angiogenic therapies for vascular diseases. Stem cells are an appealing option in part due to their ability to differentiate to pericytes, which regulate vascular remodeling. Preliminary data from our lab suggests that our rat mesentery tissue culture model is suitable for studying differentiation of exogenously delivered stem cells to vascular pericytes. The objective of this study is to determine the effect of pretreatment of transforming growth factor-beta (TGF-β) on inducing pericyte differentiation and microvascular incorporation of adipose-derived stem cells (ASCs) in an intact microvascular network ex vivo. In vitro ASCs were pretreated with 10 ng/mL rhTGF-β and cultured with rat mesentery tissues for 5 days in MEM alpha + 10% fetal bovine serum. Mesenteric windows were harvested from adult male Wistar rats and labeled with FITC conjugated BSI-Lectin to visualize the microvascular network. Our results show that in vitro ASCs exhibit elongated morphologies in both the treated and untreated groups. Post-injection, TGF-β pretreated cells exhibited a higher percentage of ASCs with an elongated morphology, as well as a higher percentage of cells in a pericyte location. These results establish that ASCs can be induced to differentiate to pericytes, and that our model can be used as a tool for evaluating how this pretreatment directly affects pericyte fate.

This project was an extension of a study by Sadegh Azimi examining variations by stem cell donor of pericyte incorporation of adipose-derived and bone marrow-derived stem cells, and was the subject of Ryan's Honors thesis. He would like to thank Dr. Murfee, Sadegh Azimi, and the entire Microvascular Dynamics laboratory for their guidance and support throughout this study.

LINDSEY BERMAN ('17)

PSYCHOLOGY

Project

Behavioral barriers in the speciation process: color variation in a hybrid zone of role-reversed species

Faculty Mentor

Lisa Settles, Psy.D.

Autism Spectrum Disorder (ASD) in recent years has become a topic of great discussion, as rates of diagnosed individuals have increased by enormous percentages. According to the CDC, in the 1980s, 1 in 2,000 children were diagnosed with ASD. Today, approximately 1 in 150 are diagnosed with ASD. The reason for said increase remains a mystery to be solved.

Research about this topic has revolved around genetics, environment, and many other factors contributing to daily life. An important question remains: are more children really being born with ASD, or are we simply diagnosing it more due to increased awareness and a broader definition? Realistically, the answer is some combination of both.

At the Tulane Center for Autism and Related Disorders, we are able to observe and diagnose hundreds of cases of ASD every year, with access to in depth medical histories and genetic information. This project is a review of many of those cases, compiling data to observe correlations among factors such as premature birth, age of mother, father, and environmental factors. The main focus of this project is related to a pattern of environmental factors that may have affected the ASD diagnosis. Methods of investigation for this study were predominantly used by reviewing case studies, studying literature related to the topics, and compiling data in a way to identify correlations.

The purpose of this project is to use the resources available on a large scale to better understand ASD and its increasing diagnostic frequency. Finding correlations as well as observing patterns will aid with further research and inquiry into causes and possibly, long term, helping to catch diagnoses in their earliest stages for maximal management of ASD.

Lindsey worked in conjunction as co-authors with Lina Janah.

WAN WEI ZHOU ('17)

PUBLIC HEALTH ('16), MASTERS

Project

Topoisomerase II Inhibition by Crude Plant Extracts From Traditionally Important Species in Suriname, South Africa

Faculty Mentor

Jeffrey Wickliffe, Ph.D.

Topoisomerase II plays an important role in DNA replication, transcription, and recombination. It is highly expressed in many cancers in highly proliferating cells. Many local Surinamese plants have been speculated for their medicinal properties. The plant extracts (aqueous fraction) were shipped from Anton de Kom University of Suriname. Plant extracts from local species here in the southeastern United States were also analyzed for Topoisomerase II inhibition. Plant species were selected based on their uses in traditional medicine and as nutriceuticals. We analyzed the enzyme inhibiting properties using a TopoGEN Topoisomerase II assay kit followed by 1% agarose gel electrophoresis. Etoposide, a well-studied Topoisomerase II inhibitor, was used as the positive control. Kinetoplast DNA is used as the DNA source for Topoisomerase II activity and function. After adding the enzyme to the plant extracts, the solution was incubated at 37°C. A 5x concentration stop buffer and Syber Green is added to each sample to stop the reaction and stain the DNA. We have observed that extracts from Luffa acutangula, Lantana camara, and a species endemic to the southern US, Nyssa aquatica (water tupelo) appear to inhibit Topoisomerase II activity. The results of these initial experiments provide insight into the biomedical properties of select extracts. These studies will be used to guide future research into the specific chemical and medicinal components of such bioactive plant extracts.

This project was completed with the help of Wilson MJ and Mans DRA, who are Faculty of Medical Sciences at the Antom de Kom University of Suriname in Paramaribo, Suriname.

JUDY CHEN ('18)

CELL & MOLECULAR BIOLOGY AND CHEMISTRY

Project

Biochemical Mechanism of TU-1, a New Antibiotic Drug

Faculty Mentor

David Mullin, Ph.D.

The advent of modern medicine in the 19th and 20th centuries drastically improved the knowledge, detection, and treatment of infectious diseases caused by bacteria. Unfortunately, the wide spread overuse and misuse of antibiotics has selected for a growing number of bacterial strains that have developed resistance to a wide range of therapeutic drugs. My research project seeks to investigate TU-1, a member of a new class of antibacterial drugs under development in the Mulllin lab. So far I have determined the minimum inhibitory concentration (MIC) of TU-1 for a variety of gram positive and gram negative bacterial pathogens, and have investigated the kinetics of growth inhibition of cultures of Staphylococcus aureus strain MLS1 at various fold concentrations of the MIC.

From the killing kinetic experiment, I have found that strain TU-1 is bactericidal because at each of the concentrations tested, viability of the Staphylococcus aureus cells dropped by more than 1000-fold. Using the same approach, I found that the viability of stationary phase cultures of strain MLS1 was unaffected by TU-1. The results from these initial tests suggest that TU-1 is a potent antibacterial agent that might hold promise for development into a therapeutic antibacterial agent. Future studies aim to identify the molecular target of TU-1 and its biochemical mechanism of action.

This research was completed with partial funding from the Georges Lurcy Grant Program.

ALEX BEHN ('17)
ENVIRONMENTAL STUDIES

Project

Economic and Environmental Impacts of Globalization on Women in the Developing World

Faculty Mentor

Laura McKinney, Ph.D.

The "race-to-the-bottom" theory of globalization argues that the highly-mobile nature of capital in the modern global political-economy incentivizes corporations moving their operations to those nations with the least environmental regulations (Wheeler 2001). This suggests a positive correlation between foreign direct investment (FDI) and environmental degradation, a hypothesis which has been widely studied and supported by quantitative analyses (McKinney 2014). Research has also examined which socioeconomic factors tend to exacerbate environmental degradation associated with FDI, which include home countries subsidizing FDI and "[FDI fueling] economic development at a scale and pace that overwhelms host country regulatory capacity" (Mabey and McNally 1999:92). Additionally, research on the topic of ecofeminism has suggested that "women and the environment are interconnected dimensions of exploitation, as ecological losses weaken women's status in nations" (McKinney 2015:1). This research focuses largely on women's traditional roles as caregivers and resource collectors which often put them into close contact with the natural environment. This framework offers convincing evidence that women are disproportionately affected by—and have unique potential to improve—ecological conditions. This research does not, however, examine possible cross-national patterns of vulnerability by integrating external debt and FDI into its analysis. My project will synthesize these well-established but as yet distinct bodies of research by analyzing the ways in which women are uniquely susceptible to the deleterious economic and environmental effects of globalization.

LYDIA CURDTS ('16)

PSYCHOLOGY AND LINGUISTICS

Project

The Development of Face Maps during the First Year

Faculty Mentor

Jeffrey Lockman, Ph.D.

Individuals possess functional maps of the body that enable them to use their hands to localize targets positioned on the skin. These functional maps have great adaptive value. They enable individuals to engage in self-feeding and remove stimuli from the body, and they may also contribute to a sense of self (Amsterdam, 1972). Little is known, however, about the origins of such body maps. Here we investigate the early development of face maps in infants.

In a longitudinal design, small vibrating discs were adhered to eight facial locations. Each session consisted of the discs presented individually in random order. Locations included the chin, left and right sides of mouth, under the left and right ears, and the center, left and right temple. Infants (N=16, 8 males) participated in approximately biweekly sessions from two months until successful manual localization of the discs. Data collection is ongoing with additional infants enrolled.

Trials were coded for whether or not infants manually contacted the vibrating disc (inter-rater reliability, $\hat{k}$=0.994, $p<.001$). For trials in which infants manually contacted the buzzer, hand posture was coded as involving the front/back of the hand only or extension of the fingers (inter-rater reliability, $\hat{k}$=0.660, $p<.001$). Using the palm, back of the hand or fist to contact the buzzer was coded as 0, while a one- or multiple-finger touch, or a pincer- or four-finger grip was coded as 1.

This project was submitted for presentation at the 2017 Conference for the Society of Research in Child Development.

QUENTIN BOOSE ('18)
CHEMICAL ENGINEERING

Project

3D Printing of Patterned Surfaces Using Functionalized Silicon Nanoparticles

Faculty Mentor

Brian Mitchell, Ph.D.

1-7 Octadiene and 1-Hexyne functionalized Silicon Nanoparticles synthesized via Reactive High Energy Ball Milling (RHEBM) were printed on glass and plastic substrates using material inkjet printing to determine optimal parameters. Material inkjet printing is important for industrial scale roll to roll processing of flexible circuits for electronic devices. The aforementioned nanoparticles were dispersed in ethanol and terpineol to create an ink which allows for accurate patterned prints. These prints produce high resolution, long term blue luminescence when subjected to UV light, which means they could be used as phosphors for flexible solid state lighting.

MATTHEW GORBAN ('19)

ENGINEERING PHYSICS

Project

Laser Assisted Control of the Metal-Insulator Transition in Hydrogenated Vanadium Dioxide Nanobeams

Faculty Mentor

Jiang Wei, Ph.D.

Vanadium dioxide (VO¬2) is an incredibly promising material with many unique characteristics for electronic and optical applications. One of the defining traits exhibited by VO¬2 is the reversible metal-insulator transition (MIT). When heated up to 68°C, VO2 switches from insulating to metallic phase by showing 3 orders of magnitude increase in electrical conductance, accompanied with a crystal structural change from monoclinic to rutile in a time scale of femtoseconds. Along with the pursuit of understanding of the fundamental mechanism, the expectation of its applications in computation, memory storage, and sensors is high.

However, to effectively control the phase transition has been a grand challenge in VO2 research. In the past a few years, we have demonstrated a fully reversible process where hydrogen intercalates into the lattice of single-crystal VO2 nanobeam can adjust the phase transition temperature and even lock VO2 into the metallic rutile phase.

Therefore, the idea of controlling phase transition of VO2 can be realized utilizing hydrogenation. Controlling the concentration of hydrogen (i.e. protons) that is intercalated into VO2 lattice should be able to reshape the transition profile spatially and enable the functionality from nanoscale VO2 devices. In this project, we explore the fundamental mechanism of hydrogenation effect on VO2 and seek to demonstrate functional nanoscale electronic devices utilizing such hydrogen modulated MIT.

NATHAN SANDERS ('17)

BIOLOGICAL CHEMISTRY AND NEUROSCIENCE

Project

Interleukin (IL)-18 in the Differentiation and Maturation of Mast Cells and Its Implication in Mast-Cell Mediated Pathology

Faculty Mentors

Anil Mishra, Ph.D
David Mullin, Ph.D.

Recent studies have demonstrated a variety of roles for interleukin (IL)-18 in cytokine regulation and lymphocyte development, with results indicating roles in the development of both Th1 and Th2 responses depending on the other cytokines present. There is significant correlational evidence linking increased levels of IL-18 with allergic diseases in both human and animal models. Mast cells are major mediators of allergies; the cytokines, enzymes, and other molecules stored in mast cells effect an array of allergic and inflammatory processes when released. Therefore, the correlation between IL-18 and allergy suggests a possible role for the cytokine in mast cell pathology. Additionally, recent research has found IL-18 to induce the release of a variety of molecules from mast cells, such as Th2 cytokines, and found that IL-18 works in synergy with IL-3 to increase this release.

However, there is little evidence on the direct effects of IL-18 on mast cell differentiation and maturation, and the role of IL-18 on the in vivo accumulation of mast cells has shown conflicting results to date. This led us to investigate the effects of IL-18 on differentiation of mast cells from bone marrow precursors, maturation in vitro, and the synergy of IL-18 and IL-3. This also led us to investigate the role of IL-18 on in vivo accumulation of mast cells in the intestinal tract. Preliminary results indicate that IL-18 promotes differentiation and maturation, but not survival, of mast cells, and that overexpression of IL-18 results in a proliferation of mast cells in the intestinal tract. Ongoing projects are aimed at clarifying the interactions of IL-3 and IL-18 by using anti-IL-3 neutralizing antibodies and IL-18 knockout and transgenic IL-18 overexpressed mice for both in vivo and in vitro studies. This research will help guide future therapies to treat and prevent allergic diseases.

ADAM MAJEWSKI ('17)

ECONOMICS

Project

Employment Discrimination against Indigenous People and the Labor Market Impact of Indian Reservations: Evidence from a Field Experiment

Faculty Mentor

Patrick Button, Ph.D.

The history of Indigenous Peoples in the United States is marred by forced removal, racism, illness, and ultimately genocide. Today, indigenous peoples continue to face challenges, specifically in terms of economics as American Indian and Alaskan Native (AIAN) peoples face high levels of unemployment at 9.9% and Native Hawaiians and Other Pacific Islander (NHPI) peoples experience an unemployment rate of 5.7% in comparison to white people's unemployment rate of 4.6%. AIAN also earn strikingly lower incomes with a median income of $35,060 in 2010, compared to $50,046 for the entire nation.

These statistics demonstrate a clear racial gap in the economics for Indigenous Peoples in the United States, which may be attributed to discrimination. This experiment is a resume correspondence study designed to test for discrimination in the labor market towards Indigenous Peoples applying for jobs. We designed pairs of realistic resumes for men and women applying for entry-level positions (retail sales, cook, wait-staff, janitor, security) with one resume containing a racial signal indicating that the applicant is Indigenous.

Aside from the signal, the resumes are similar in other aspects, such as age, skills, and experience. In addition, some Native American applicants' resumes will signal that they grew up on an Indian reservation to determine how much employers discriminate Native Americans of a reservation background.

OLIVER S ANDERSON ('19)
ENGLISH AND DIGITAL MEDIA PRODUCTION

Project
Composition for Surround Sound

Faculty Mentor
Rick Snow, Ph.D.

Though creating an array of speakers, the ability to generate and manipulate spatialized sound becomes possible. Surround sound enables more tools for expression and emphasis than just pitches and dynamics by giving it a perceivable location. Traditionally, music is listened to with two channels at most (e.g. with headphones) and as a result, is not as agile as an arrangement using surround sound – as movement there can only be achieved through panning. However, with the speakers set up in a circular array, the sound has a much greater range of movement which enables great creative possibilities with sound localization and immersion.

Oliver worked in conjunction with Aidan Tuttle.

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