CLEMSON® HONORS

EUREKA!

UNDERGRADUATE RESEARCH

ABSTRACT BOOK | 2021

FACULTY AND STUDENT EUREKA! EXPERIENCES

"Through the EUREKA program, incoming freshmen can have the opportunity to work on the same real-world research projects that M.S. and Ph.D. students are working on for their thesis. This means that the EUREKANs can be directly contributing to the frontiers of science, which is a pretty cool thing for someone so early in their academic career."

– EUREKA! faculty mentor Dr. Ethan Kung (not pictured)
Associate Professor, Department of Civil Engineering

"Joining EUREKA! was the best thing I could have done as an out-of-state student. I started the program without any connections to Clemson and finished with great friends, faculty relationships, and research experience. This program has made the transition to Clemson 10x easier, and I would do it all over again in a heartbeat!"

– Brianna Cherry (3rd from right), pictured with fellow EUREKANs (left to right) Elias McCall, Brandon Phillips, Tejasvi Joshi, Zakia Tasnim, and EUREKA! faculty mentor Dr. Qiushi Chen

WELCOME TO THE 2021 EUREKA! POSTER FORUM

EUREKA! (Experiences in Undergraduate Research, Exploration and Knowledge Advancement) is a unique endeavor to immerse incoming Clemson University Honors College students into the academic world.

In response to ongoing impacts associated with the global COVID-19 pandemic, from June 24th through July 31st, this year's EUREKA! program participants conducted their research in a creative, virtual format, with all facets of the program, including the research experience, being performed remotely from home through video conferencing and other online means.

Although a completely online program, participants were able to become acquainted with each other, campus resources, and some of the university's best faculty and administrators. Many of our students were also able to meet their EUREKA! mentors in person as they arrived on campus for the fall semester.

"Bringing together Clemson's brightest new students with the university's top research faculty sets the tone for the next four years. Honors students have unparalleled opportunities to conduct meaningful research that changes not only their own lives, but often the lives of many others. All of that starts here."

– Dr. Bill Lasser, Executive Director
Clemson University Honors College

Created in 2006, the new "Experiences in Undergraduate Research, Exploration and Knowledge Advancement!" (EUREKA!) program was based on an idea conceived by Stephen Wainscott, former Director of the Clemson University Honors College, and further developed by a committee of the following members:

- Dwight Camper, Professor of Entomology, Soil, and Plant Science;
- Dana Irvin, Assistant Director of the Clemson University Honors College;
- Pam Mack, Associate Professor of History;
- James McCubbin, Professor and Chair of Psychology;
- Mary Miller, Special Assistant to the Provost;
- Gary Powell, Professor Emeritus of Genetics and Biochemistry;
- Steve Wainscott, Director of the Clemson University Honors College;
- Sean Williams, Associate Chair and Professor of English; and
- Bill Pennington, Professor of Chemistry.

During the second summer session of 2021, the sixteenth group of EUREKAns – consisting of 36 incoming Honors freshmen and 3 rising sophomore counselors, together representing 13 different states and 20 academic majors – and three current Honors students serving as counselors, were joined together for a five-week period of research, scholarship, and discovery.

Students worked on individual projects under the direction of faculty mentors in fields ranging from religion and philosophy to physical sciences and engineering. In addition to their research activities, students attended web-based workshops and seminars on various topics designed to orient them to academic life on campus and provide them with the basic skills needed to perform research in a broad range of areas.

In addition to the educational rewards of active participation in undergraduate research, the EUREKAns got to know the campus resources and interacted with many faculty, staff, administrators, and other students. They developed networks of supportive mentors and colleagues that will serve them well in their academic careers.

Many of the participating students continue their projects throughout their undergraduate years. We hope that their enthusiasm for research will encourage their peers to follow their lead to build an exciting and productive environment for undergraduate research, scholarship, and discovery at Clemson University.

2021 EUREKA! STUDENTS

Participant	Hometown	Major	Faculty Mentor	Page
Lia Anderson	Louisville, KY	Engineering	Dr. Ethan Kung	6
Emily Bernabe	Furlong, PA	Biochemistry	Dr. Kerry Smith	7
Sophie Burhans	Homer, NY	Language & International Business	Dr. Eric Touya	8
Hayden Cagle	Holly Springs, SC	Engineering	Dr. Ge Lv	9
Dylan Carroll	Knoxville, TN	Biological Sciences	Dr. Kerry Smith	10
Bri Cherry	Reno, NV	Physics	Dr. Qiushi Chen	11
Elizabeth Cutler	West Columbia, SC	Animal and Veterinary Science	Dr. Sharon Bewick	12
Liz Dillard	Inman, SC	Marketing	Dr. Miren Ivankovic	13
Landon Ethredge	Mount Pleasant, SC	Engineering	Dr. Liangjiang (LI) Wang	14
Ashley Fister	Mount Pleasant, SC	Biological Sciences	Dr. Sharon Bewick	15
Kaitlyn Gazzara	Pearl River, NY	Biochemistry	Ms. Cary Kaye	16
Haleigh Hankins	Chapin, SC	Language & International Business	Dr. Job Chen	17
Annabelle Harris	Daniel Island, SC	Biochemistry	Dr. Cheryl Ingram-Smith	18
Lilli Hicks	Greensboro, NC	Chemistry	Dr. Dev Arya	19
Mariana Holladay	Arlington, VA	Environmental Engineering	Dr. Sruthi Narayanan	20
Sam Hurley	Scottsdale, AZ	Engineering	Dr. Bing Li	21
Teja Joshi	Simpsonville, SC	Engineering	Dr. Qiushi Chen	22
Abbegail King	Bryson City, NC	Anthropology	Dr. Liangjiang (LI) Wang	23
Faith Kosior	Southington, CT	Architecture	Dr. Winifred Newman	24
Charles Kowalski	Fort Mill, SC	Engineering	Dr. Yingjie Lao	25
Kaden Liles	Corpus Christi, TX	Engineering	Dr. Matthew Voigt	26
Sophia Manav	Aurora, OH	Business	Ms. Cary Kaye	27
Elias McCall	Charleston, SC	Engineering	Dr. Qiushi Chen	28
Aidan McPherson	Charleston, SC	Computer Science	Dr. Long Cheng	29
Hunter Meier	Chapin, SC	Engineering	Dr. Ge Lv	30
Ryan Meyer	Simpsonville, SC	Secondary Education - Mathematics	Dr. Hong Luo	31
Henry Miles	Spartanburg, SC	Computer Science	Dr. Eric Patterson	32
Shamitha Nandi	Sumter, SC	Biological Sciences	Dr. Ethan Kung	33
Andrew O'Rourke	Herndon, VA	Electrical Engineering	Dr. Ge Lv	34
Emily Peak	Aiken, SC	Health Sciences	Dr. Sharon Bewick	35
Brandon Phillips	Simpsonville, SC	Physics	Dr. Qiushi Chen	36
Matthew Ployhart	Chapin, SC	History	Dr. Job Chen	37
Deepthi Prabhakar	Greer, SC	Psychology	Dr. Dev Arya	38
Anvita Pudipeddi	Greer, SC	Biochemistry	Dr. Liangjiang (LI) Wang	39
Elsa Saine	Columbia, SC	Chemistry	Dr. Cheryl Ingram-Smith	40
Alanna Scoggins	Mauldin, SC	Microbiology (Biomedicine)	Dr. Kerry Smith	41
George Sprinkle	Homestead, FL	Engineering	Dr. Zhaoxu Meng	42
Abby Wildi	Knoxville, TN	Nursing	Mrs. Janice Lanham	43
Mark Zakrzwski	Piedmont, SC	Engineering	Dr. Ethan Kung	44

COMPUTATIONAL CARDIOVASCULAR RESEARCH ON CAROTID STENOSIS

LIA ANDERSON, Mark Zakrzwski, Shamitha Nandi, and Dr. Ethan Kung
Department of Mechanical Engineering

Carotid stenosis is the narrowing of the carotid artery. This can cause a blood clot and a potential stroke.

The purpose of this project was to determine factors that may help in predicting the likelihood of patients with carotid stenosis experiencing a stroke. This was done by creating patient models of stroke and non-stroke patients and determining factors that are different between them.

Through an image-based simulation software, Simvascular, fourteen models were created by building a path, segmenting arterial walls and meshing them for an accurate representation of the artery. Simulations were created and uploaded to a supercomputer to be run. The simulation files were transferred to Paraview software for data analysis. Clips of various regions of the artery and its factors such as velocity and shear stress were collected for analysis. After obtaining data in each of these regions, a two-sided t-test was used to see if the differences were statistically significant.

The analysis indicated that stroke patients have a higher mean velocity in the external carotid artery than non-stroke patients. This data can be further analyzed and used as a diagnostic factor for stroke in patients with carotid stenosis.

IDENTIFICATION OF VIRULENCE GENES IN THE FUNGAL PATHOGEN CRYPTOCOCCUS NEOFORMANS

EMILY BERNABE and Dr. Kerry Smith
Department of Genetics and Biochemistry

Cryptococcus neoformans is an invasive fungal pathogen that is inhaled through the lungs and often results in fungal meningitis when it spreads. The CDC estimates the yearly burden of cryptococcal meningitis to be nearly one million cases with greater than 190,000 deaths.

C. neoformans can be known as an opportunistic pathogen because it takes advantage of individuals with compromised immune systems, specifically ones with HIV. The lungs provide a low-glucose environment for C. neoformans, so it is likely that it must use alternative carbon sources to survive. It is hypothesized that acetate is utilized when glucose is not readily available.

The goal of this research is to identify specific genes that are necessary for acetate utilization as they might be expected to play a role in pathogenesis.

This project investigated the gene CNAG_00613 (cytosine deaminase) which was one of fifteen genes identified in a genetic screen as being necessary for growth on acetate. Cytosine deaminase catalyzes the reaction that turns cytosine into uracil. This deamination reaction often results in mutations in microorganisms and inherited human diseases. The observation of expression data and analysis of function prediction was used to identify the role cytosine deaminase may play in C. neoformans infection.

SOCIO-POLITICAL AND CULTURAL CONTENTIOUS ISSUES IN EUROPE AND AMERICA: MAKING SENSE OF FRANCE, THE UNITED STATES, AND HUNGARY TODAY

SOPHIE BURHANS and Dr. Eric Touya
Department of Languages

The French political landscape is ever changing and this paper seeks to analyze the various contributing factors to this change. In order to do so, this research focuses on France's growing political and ideological divide, the rise of populism in France, France's political interaction with the rest of Europe, the impacts and opinions of globalization, and women's role in French politics. Then these issues will be examined in the context of Hungary and the United States. The aim will be to compare how issues pertaining to cultural and political divides, the rise of populism, sovereignty, globalization, identity, and feminism are at the center of political debates in the three countries. The purpose of this project is to analyze the various social, political, and cultural factors influencing the changing political landscape and to gain a global perspective on current issues.

SMART SHOE INSOLE FOR DETECTING GAIT PHASES WITH POWERED LOWER-LIMB EXOSKELETONS

HAYDEN CAGLE, Hunter Meier, Andrew O'Rourke, and Dr. Ge Lv
Department of Mechanical Engineering

For those with lower-limb disabilities, lower-limb exoskeletons provide benefits during rehabilitation and daily locomotive assistance by providing mechanical support and reducing the load on their legs. Passive systems use counterweights and springs to redistribute weight while active systems utilize robotic actuators to assist in automated locomotion. Active exoskeletons often divide the entire gait cycle into discrete phases for control system design, therefore accurate gait phase detection is necessary. Current methods of gait phase detection are costly and available only in specific laboratories. Shoe insoles with embedded force sensors provide a solution to this issue by enabling gait phase detection at a lower cost and within a compact system.

The purpose of this project is to develop a smart shoe insole insert utilizing force sensing resistors to detect and communicate the gait phases in real-time for active lower-limb exoskeletons. Using FSRs embedded in the user's insoles and wireless-enabled microcontrollers, the force distribution under each foot during locomotion is determined and communicated to a personal computer. The center of pressure of each foot is calculated and mapped along the shoe insole, based on which the gait phases will be determined.

IDENTIFICATION OF VIRULENCE GENES IN THE FUNGAL PATHOGEN CRYPTOCOCCUS

DYLAN CARROLL and Dr. Kerry Smith
Department of Genetics and Biochemistry

Fungal infections cause over one and a half million deaths annually, while the most common invasive species Cryptococcus neoformans kills more people each year than tuberculosis. In immunocompromised individuals, namely HIV/AIDS patients, Cryptococcus is extremely virulent and can spread to the brain causing meningitis. Furthermore, the cellular composition of bacterial cells is so similar to human cells that the production of antifungal drugs is very challenging. Due to increases in immunosuppressive drugs and a large population of humans living with some form of autoimmune disorders, cryptococcal meningitis cases have become prevalent and require innovative research.

The Smith lab hypothesizes that acetate utilization directly links to virulence since the site of infection, the lungs, is low in glucose content. One of fifteen initial genes screened by the Smith laboratory deemed crucial for acetate utilization was CNAG_00403, a mitochondrial protein that functions in the production of L-carnitine. This amino acid helps transport Acyl-Coa into the mitochondria to be broken down as part of the Krebs Cycle to produce energy for the fungi as a part of fatty acid metabolization. Further research is required to understand the carnitine biosynthesis pathway to see if it could be manipulated to prevent virulence of Cryptococcus.

UNDERSTANDING LUNAR REGOLITH-TOOL INTERACTION FOR IN-SITU CHARACTERIZATION OF LUNAR REGOLITH

BRIANNA CHERRY, Brandon Phillips, Tejasvi Joshi, Elias McCall, Zakia Tasnim, and Dr. Qiushi Chen
Department of Civil Engineering

In 2017, NASA launched the Artemis Program to establish a more sustainable, permanent human and robotic presence on the Moon. Someday, this might involve construction on the Moon's surface or the utilization of the Lunar soil as a resource.

Understanding lunar regolith, the soil on the Moon's surface, is essential for the success of these missions. Therefore, the development of efficient tools for automated drilling, sampling, and in-situ resource utilization and characterization is a key component of NASA's Artemis Program. In this study, data on lunar regolith simulants, shear strength parameters, and existing drilling tools was compiled and processed. A database of Lunar Simulants was verified and updated.

This research will contribute to NASA's ongoing effort to develop efficient, automated drilling and characterization systems on the Moon.

EXAMINING THE PRESENCE OF INVASIVE ANTS IN SOUTH CAROLINA REGIONS UTILIZING VARIOUS TRAPPING METHODS

ELIZABETH CUTLER, Ashley Fister, Emily Peak, Daniel Malagon,
and Dr. Sharon Bewick
Department of Biological Sciences

Ant species (Formicidae) that are not indigenous to a particular area can be detrimental to both native ant species and other organisms in the surrounding environment. In South Carolina, red imported fire ants (Solenopsis invicta), Argentine ants (Linepithema humile), crazy ants (Nylanderia flavipes), and Asian needle ants (Brachyponera chinensis) are invasives that pose a serious threat to the environmental health of the region.

The purpose of this study is to discover the presence of ant species in the tested locations, as well as examine the impact of alternate trapping methods on species richness. Pitfall and baiting traps were employed throughout the course of four weeks in urban areas of Aiken, Columbia, and Charleston, SC. Ant specimens were collected from propylene glycol samples and identified to the level of genera using a dichotomous key. Asian needle ants and red imported fire ants were present in sampling clusters in Columbia, however invasives were absent from the samples derived from Aiken and Charleston. Richness was shown to increase steadily in Aiken and Columbia after the making of a species accumulation graph, while it eventually leveled out in Charleston with the addition of more pitfall traps. Baiting proved to accumulate additional invasive ant genera.

STATISTICAL ANALYSIS OF TECHNOLOGY USE IN THE CLASSROOM

LIZ DILLARD and Dr. Miren Ivankovic
Economics Department

Each year, technology becomes increasingly integrated into the classroom. In the present day, students use a plethora of electronic devices to assist them in their studies. However, there is a popular and ongoing debate whether technology improves student performance or if it is a detriment to them instead.

For this particular study, two sections of economics classes at Anderson University were analyzed. Section two was allowed unlimited access to technology in the classroom, while section three was not allowed to use technology in any capacity. Data such as student SAT score, GPA, attendance, student job or lack thereof, student extracurricular sports or lack thereof, household income, student religion, and professor and class evaluations were collected from both sections. This data was then entered into Microsoft Excel, where numerous statistical tests were performed to determine if the differences in performance between the two sections were statistically significant in relation to the use of technology. The data below represents the statistical findings.

PREDICTION OF NOVEL AUTISM RISK GENES BY GENOMIC DATA MINING

LANDON ETHREDGE, Abbegail King, Anvita Pudipeddi, Snehal Shah, Anqi Wei, and Dr. Liangjiang Wang
Department of Genetics and Biochemistry

Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder which affects social development and general behavior. ASD varies in its symptoms and severity but is often characterized by rigid, repetitive behavior patterns, sensory issues, intense interests, and communication delays. While the majority of currently discovered ASD genes are protein-coding, great promise exists in finding novel autism risk genes among non-coding RNA genes since they make up the bulk of the human genome. Specifically, this study focused on long non-coding RNAs (lncRNAs), which are classified as transcripts longer than 200 nucleotides.

This study aimed to identify potential ASD risk genes by means of machine learning, a subset of artificial intelligence. We have trained three machine learning models, Random Forest, Support Vector Machine, and Artificial Neural Network, to mine for relevant features within genomic data of previously discovered ASD risk genes to predict novel risk genes using those features. The Artificial Neural Network Model showed the highest performance of the three. 624 lncRNAs were identified as high confidence candidate lncRNAs by all three models and 1,174 were identified in total. Upon further analysis of the results, many candidate lncRNAs were located in close proximity to known ASD risk genes on their respective chromosomes.

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VACCINE MANDATES AND THE COMMERCE CLAUSE

KAITLYN GAZZARA and Ms. Cary Berkeley Kaye
Department of Philosophy and Religion

In a hypothetical scenario, petitioner William DeNolf challenges a federal statute mandating a vaccine for polio, saying that compulsory vaccination is not authorized by the Commerce Clause. After a fictional outbreak of five cases of polio, William DeNolf resists statutory vaccination.

The precedent of the United States Supreme Court and the circumstances of this particular case indicate that the statute is not supported by the Commerce Clause. Five cases nationally in a country with 90% of the population immunized is not severe enough for DeNolf's actions to risk a pandemic and its adverse effects on interstate commerce. Additionally, in the Obamacare case, the Supreme Court narrowed the Commerce Clause to mainly regulate existing commercial activity and the materials associated with it. Contrary to that case, the vaccination statute would authorize Congress to order individuals to make a health decision that they never previously engaged in.

A ruling against DeNolf in this case would rid Congress of any bounds to their Commerce Clause power by going beyond the practice of controlling goods circulating in an industry.

PERCEPTIONS OF LAW ENFORCEMENT AND THEIR INFLUENCE ON TRUST IN AUTHORITY

HALEIGH HANKINS, Matthew Ployhart, Randle Aaron Villanueva, and Dr. Job Chen
Department of Religious Studies

In the modern era, the police and law enforcement are a controversial presence in the media. Bad impressions linger more than good ones, so perceptions of police brutality in the media can result in a general distrust of the police. Granted, in many of these instances, the police have abused power. However, in other instances, when the actions of police are justified, it is important to maintain a trusting law enforcement-citizen relationship for a functioning society.

The intended purpose of this study was to determine different factors that may influence societal perceptions of law enforcement. This is to be executed through an informational video that demonstrates a neutral and positive view of law enforcement. The apparent wealth of the suspect in the video will also be manipulated to be a further independent variable. The results of this study, while simulated, are predicted to have significant results in favor of societal perceptions being more positive when presented with a positive informational video.

BIOINFORMATICS INVESTIGATION OF EXCYSTATION IN THE INTESTINAL PARASITE ENTAMOEBA HISTOLYTICA

ANNABELLE HARRIS, Elsa Saine, and Dr. Cheryl Ingram-Smith
Department of Genetics and Biochemistry

Entamoeba histolytica is a human pathogenic amoeba that causes amoebic dysentery in 90 million people and kills up to 100,000 people each year. *Entamoeba* has two forms: the trophozoite that causes symptoms and the dormant cyst. Infection occurs by ingesting food or water contaminated with cysts. Once ingested by the host, cysts excyst to the trophozoite form in the small intestine. The trophozoites colonize the large intestine and can encyst and pass out of the body to continue the disease cycle. Most studies on these processes have used the related species *Entamoeba invadens*, a reptile pathogen, because *E. histolytica* does not encyst well in culture. The purpose of this research was to identify genes in *E. invadens* involved in excystation that have orthologs in *E. histolytica* using a bioinformatics approach using AmoebaDB, a bioinformatics database for pathogenic amoebas. AmoebaDB allows one to search for transcriptome data for *E. invadens* that are upregulated five-fold or more during the beginning stages of excystation, suggesting a possible role in the conversion from cyst to trophozoite. These genes encode proteins involved in energy production, motility, and pathogenesis, all of which are essential to the survival and purpose of *Entamoeba* in its trophozoite form.

HOW LINKER LENGTHS AFFECT HOECHST DERIVATIVES BINDING TO B-DNA

LILLI HICKS, Deepthi Prabhaker, Andrea Conner, Adam Gaynor, and Dr. Dev Arya
Department of Chemistry, College of Science

Hoechst 33258 is a well-known nucleic acid dye which is noted for its affinity to B-DNA. Prior drug discovery research has investigated two fragments that attach at a target site and are connected via combinations of linkers to observe activity between the two. Yet, the effects of linkers on an individual fragment itself has not been fully understood. The objective of this study was to observe the impact of linker length and composition with Hoechst 33258 binding to B-DNA. After using multiple experimentation methods such as UV thermal denaturation and fluorescence microscopy studies, the results showed that shorter linkers localized in the DNA nucleus while longer linkers interacted with extranuclear organelles. The composition of the linker also played a role in its stabilization to the binding site, particularly when referring to the number of oxygen atoms increasing the compound's stability. Using these results, we are better able to see the applications of Hoechst 33258 and future linker research in drug developments.

THE IMPACT OF ROOT MORPHOLOGY ON GERMINATION OF SOYBEANS UNDER DROUGHT STRESS

MARIANA HOLLADAY, Jyoti Kakati, and Dr. Sruthi Narayanan
Department of Plant and Environmental Sciences

Soybean is the most important oilseed and one of the most important and affordable protein sources worldwide. Water stress is a major limitation for soybean production worldwide. When water stress occurs during the soybean sowing period, germination will most likely be affected. Root morphology influences the amount of water and nutrient absorption and is important for maintaining crop performance under water stress conditions. The purpose of this study was to determine whether root traits influence germination of soybean under optimal and water stress conditions and identify genotypes that possess beneficial root traits. Soybean seeds were grown hydroponically using polythene glycol to mimic different levels of water stress. Fourteen days after sowing, roots were harvested and scanned, and the images were processed using the WinRHIZO software. The results showed that root length, surface area, volume, diameter, and weight could have a significant impact on germination under water stress. These traits had a larger effect under severe stress in comparison to moderate, low, and no- stress. Genotypes 6 and 13 performed well under stress conditions based on germination and root traits. Genotype 6 also performed well under optimal conditions. This information can be used to develop soybean varieties with better tolerance to water stress.

SOCIAL FORCE PEDESTRIAN TRAJECTORY PREDICTION

SAM HURLEY, Ziyue Feng, and Dr. Bing Li
Department of Automotive Engineering

Human behavior can never fully be predicted, posing a challenge for autonomous vehicles which rely on their prediction ability to ensure the safety of the passengers, other drivers, and, most vulnerable to injury, pedestrians. The purpose of this research is to explore and strive to improve upon traditional methods for pedestrian trajectory prediction. The social force model attempts to define human behavior by properties which are influenced by specific stimuli. This model accurately predicts trajectory in this way without neural networks, artificial intelligence, or deep learning. It describes forces from pedestrians upon one another and from obstacles onto pedestrians, but it is otherwise very limited in its programmed forces. To improve this model, a hazard force which is representative of smoke has been implemented and actualized through the simulator. Although the social force model may not be the most efficient or effective method compared to deep learning models, this description of human behavior is crucial for trajectory prediction, and it may be very useful in conjunction with artificial intelligence.

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TEJASVI JOSHI, Brianna Cherry, Elias McCall, Brandon Phillips, Zakia Tasnim, and Dr. Qiushi Chen
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MAPPING VISUAL STIMULUS COMPLEXITY AND SPATIAL NAVIGATION: FACTORS THAT CHANGE WITH AGE

FAITH KOSIOR, Tong Liu, and Dr. Winifred Newman
Department of Architecture, Art, and Humanities

Changes in mobility are important factors that impact the longevity and quality of life in older adults. Mobility is related to cognitive changes and the environment. A decline in sensory perception is part of the changes in age that leads to issues with mobility. The purpose of this project is to predict a "mobility" age and address what possible affordances need to be changed to accommodate a decline in mobility. In order to gather research for this potential "mobility" age, we will use wearable devices to monitor physiological markers of stress.

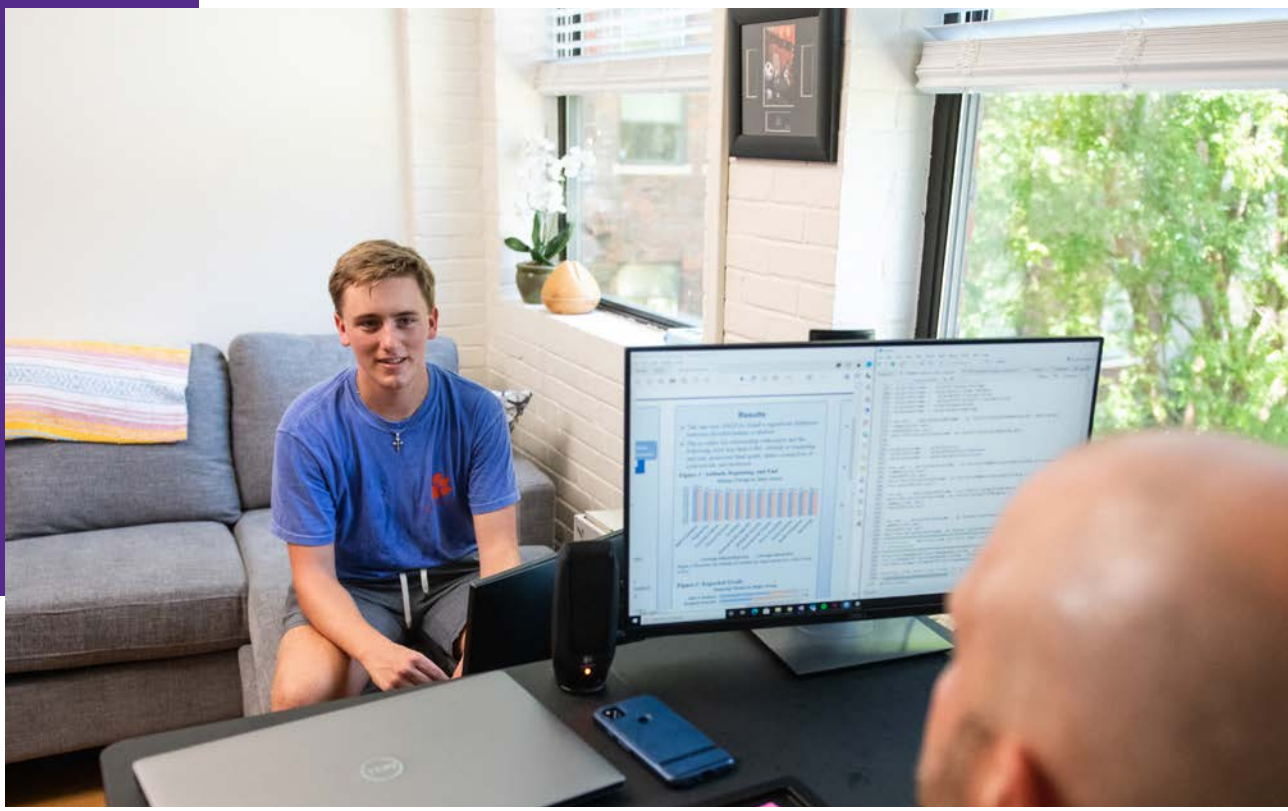
The work in this phase tested the performance of various 'smartwatches' over short- and long-duration use. The study aims to find a way to map changes in sensory approaches using visual stimuli in accordance with affordances to determine how that impacts spatial navigation.

THE EFFECTIVENESS OF MEMBERSHIP INFERENCE ATTACKS ON QUANTIZED MACHINE LEARNING MODELS

CHARLES KOWALSKI, Azadeh Famili, and Dr. Yingjie Lao
Department of Computer Engineering

Advances in artificial intelligence have propelled machine learning models into widespread use. Their ability to process information through neuron-like interactions and provide generally accurate conclusions has made them invaluable in many industries, especially the sales and medical fields. The implementation of machine learning requires intense computational infrastructure, limiting its expansion to enterprise users. Neural network compression is one of the proposed methods which allows for edge device deployment. This would allow portable devices and consumer electronics to tap into the possibilities of machine learning.

However useful, the adoption of machine learning methods presently comes with associated risks. Machine learning models can inadvertently reveal information on the data that they were trained on. This danger is especially potent in applications of networks that involve private, personal data, such as the healthcare industry. If machine learning is to be further utilized in technology, the methods by which they are made accessible must be evaluated and revised to defend against such data leaks. This research focuses on a membership inference attack on a full precision network and compressed network.



THE RELATIONSHIP BETWEEN DECLARED UNDERGRADUATE MAJOR AND EXPERIENCES IN MATHEMATICS COURSES

KADEN LILES, Tyler Sullivan, and Dr. Matthew Voigt
Department of Engineering and Science Education

Student Engagement in Mathematics through an Institutional Network for Active Learning (SEMINAL) is a nationally funded program working to better understand the utilization of active learning techniques in introductory undergraduate mathematics courses. This research done this summer investigated how different groups of majors experienced their mathematics courses from Precalculus to Calculus 2 at nine universities across the United States.

This was done by analyzing the survey responses (n=16,523) from the X-PIPS-M Survey Suite within Microsoft Excel in pivot tables and graphs to illustrate relationships. A text entry question about declared/intended major was recoded, matching the responses by the students with shortened major groups for easier analysis. One-way ANOVAs were run to assess the significance of the relationships, with p-values of less than 0.05 indicating significant results. Math and statistic majors had the most positive math identity, while psychology majors had the least positive math identity. Undeclared students felt the least included in their math courses showing the potential significance of declaring a major in your perception of belonging within your classes. Results of this study have implications of how calculus courses can be taught to better include students of all majors.

IN THE FEDERAL CONSTITUTION, IS THERE A PRIVACY AND LIBERTY RIGHT TO RESIST MANDATORY VACCINATIONS?

SOPHIA MANAV and Ms. Cary Berkeley Kaye
Department of Philosophy and Religion

In a hypothetical case, a citizen challenges the President's order requiring polio vaccinations for all citizens, for violating his rights to liberty and privacy protected by the Due Process Clause of the Fifth Amendment. The fictional petitioner has little human contact but swims in a river that passes through his land, which puts everyone else who uses the river downstream at risk for polio. He asks the Court to overturn Jacobson v. Massachusetts (1905) which permitted the states to mandate vaccinations.

His argument fails for four reasons. Jacobson v. Massachusetts (1905) is longstanding; polio is a major health risk and threat to the public; protecting public health and safety is within the state's policing power; and mandatory vaccination is deeply rooted in the nation's history and traditions, but a substantive due process right against it would also have to be so rooted. Moreover, remaining unvaccinated is morally wrong and unethical. The federal Constitution does not require the government to permit one citizen to put others at risk. For all these reasons, there is no federal constitutional liberty or privacy right to refuse mandatory vaccination.

UNDERSTANDING LUNAR REGOLITH-TOOL INTERACTION FOR IN-SITU CHARACTERIZATION OF LUNAR REGOLITH

ELIAS MCCALL, Brandon Phillips, Brianna Cherry, Tejasvi Joshi, Zakia Tasnim, and Dr. Qiushi Chen
Department of Civil Engineering

In 2017, NASA launched the Artemis Program to establish a more sustainable, permanent human and robotic presence on the Moon. Someday, this might involve construction on the Moon's surface or the utilization of the Lunar soil as a resource.

Understanding lunar regolith, the soil on the Moon's surface, is essential for the success of these missions. Therefore, the development of efficient tools for automated drilling, sampling, and in-situ resource utilization and characterization is a key component of NASA's Artemis Program. In this study, data on lunar regolith simulants, shear strength parameters, and existing drilling tools was compiled and processed. A database of Lunar Simulants was verified and updated.

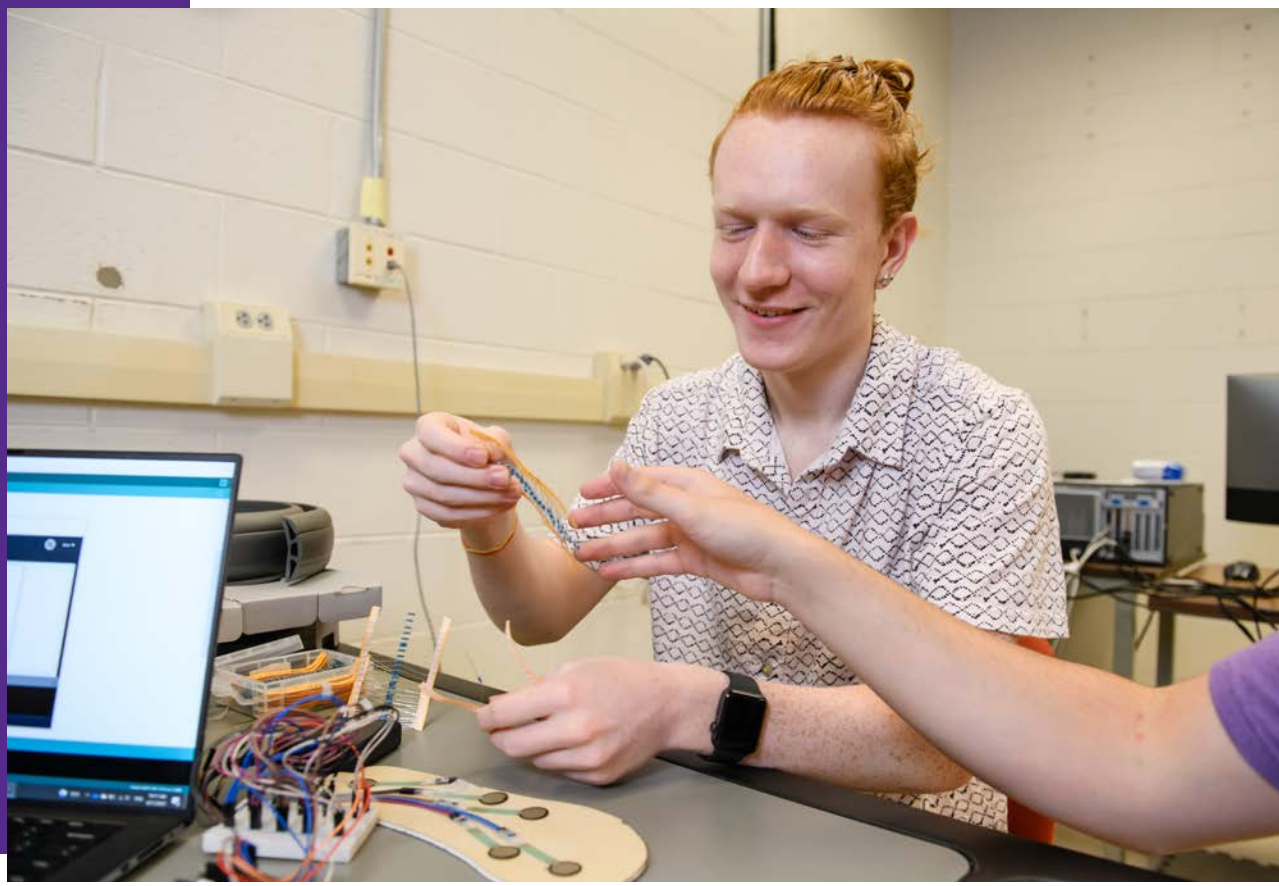
This research will contribute to NASA's ongoing effort to develop efficient, automated drilling and characterization systems on the Moon.

DATA-DRIVEN PRIVACY PROTECTION IN VOICE PERSONAL ASSISTANTS

AIDAN McPHERSON, Song Liao, and Dr. Long Cheng
School of Computing

Voice assistants, such as Google Home and Alexa, have become extremely popular in recent years. The convenience they grant for many people is part of that reason. Voice assistants have many programs that allow them to be as useful and all-encompassing as possible to consumers. A major factor of this is the ability for third parties to create their own programs that one can install on their voice assistant. This, however, has become a cause of alarm for many as to whether data is being taken from these voice assistants by third parties.

That is why privacy policies are required for many programs, and this is because privacy policies help address user's concerns over data protection and can hold a developer or company liable for misuse of that data. However, it is unknown how developed these privacy policies are. This research has led us to investigate the data practices of 15635 privacy policies to analyze their effectiveness in protecting consumer data through analysis of many privacy policies. The results have shown that 6676 privacy policies have no data practices, and this is a major vulnerability for consumers.



SMART SHOE INSOLE FOR DETECTING GAIT PHASES WITH POWERED LOWER-LIMB EXOSKELETONS

HUNTER MEIER, Hayden Cagle, Andrew O'Rourke, and Dr. Ge Lv
Department of Mechanical Engineering

For those with lower-limb disabilities, lower-limb exoskeletons provide benefits during rehabilitation and daily locomotive assistance by providing mechanical support and reducing the load on their legs. Passive systems use counterweights and springs to redistribute weight while active systems utilize robotic actuators to assist in automated locomotion. Active exoskeletons often divide the entire gait cycle into discrete phases for control system design, therefore accurate gait phase detection is necessary. Current methods of gait phase detection are costly and available only in specific laboratories. Shoe insoles with embedded force sensors provide a solution to this issue by enabling gait phase detection at a lower cost and within a compact system.

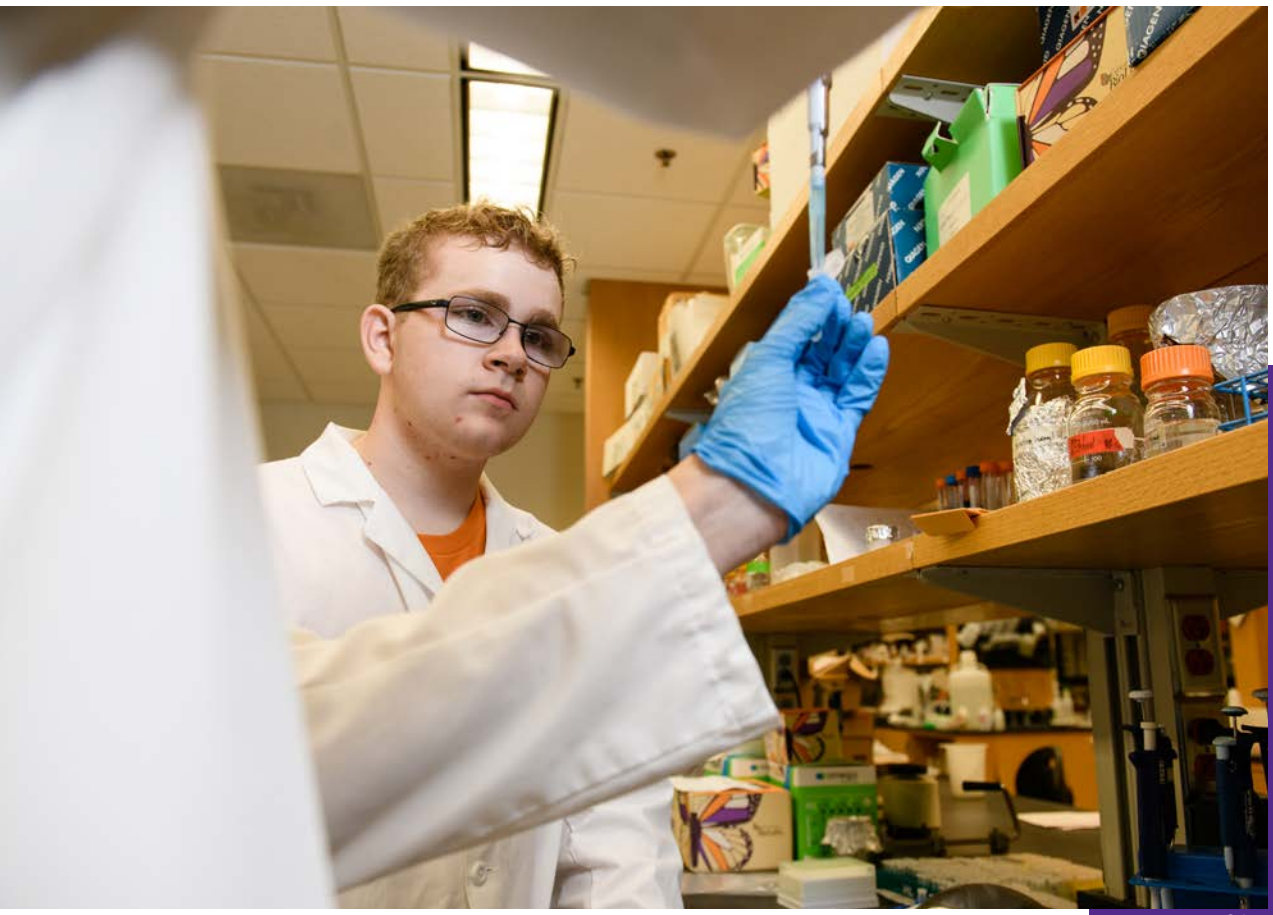
The purpose of this project is to develop a smart shoe insole insert utilizing force sensing resistors (FSR) to detect and communicate the gait phases in real-time for active lower-limb exoskeletons. Using FSRs embedded in the user's insoles and wireless-enabled microcontrollers, the force distribution under each foot during locomotion is determined and communicated to a personal computer. The center of pressure of each foot is calculated and mapped along the shoe insole, based on which the gait phases will be determined.

CROP GENETIC ENGINEERING FOR ENHANCED BROAD ABIOTIC STRESS TOLERANCE IN TRANSGENIC CREEPING BENTGRASS

RYAN MEYER and Dr. Hong Luo
Department of Genetics and Biochemistry

Plants encounter a variety of environmental stresses, biotic and abiotic, which hinder plant growth and development. Genetic engineering can improve plant performance to reduce or eliminate these effects of environmental stresses by taking a beneficial gene from one species and inserting it into another, especially with recent technological developments in the field of genetics and biochemistry.

The purpose of this study was to determine if the overexpression of OsSIZ1, a rice SUMO E3 ligase gene, would enhance abiotic stress tolerance in creeping bentgrass. OsSIZ1 plays an important role in sumoylation, a post-translational regulatory process that can control plant development and responses to abiotic stresses. OsSIZ1 was inserted into the creeping bentgrass genome by Agrobacterium-mediated plant transformation, creating transgenic lines for evaluation. Compared with the wild type controls, transgenic lines of creeping bentgrass were found to show an enhanced resistance to drought conditions, heat shock, and phosphate starvation.



AUTOMATING CAMERA CONTROL FOR STUDYING MATERIAL LIGHT-SCATTERING PROPERTIES WITHIN A VARIABLE ILLUMINATION SPHERE

HENRY MILES, Xiang Li, and Dr. Eric Patterson
School of Computing

How materials reflect and transmit light is an important area of study for computer graphics, optics, material science, and other industries, but it is difficult to study due to the four-dimensional nature of the elevation and azimuth of incoming light and elevation and azimuth of viewing position.

The purpose of this project is to develop an automated camera system to work in conjunction with a variable illumination sphere in order to photograph various materials being studied from any viewing angle and illuminated from any angle. This will allow researchers to create accurate, physically-based shading models for real-world objects. The camera-control system will also be used for multi-view stereo to capture face models for digital humans as well as real-world objects for computer graphics and animation.

COMPUTATIONAL CARDIOVASCULAR RESEARCH ON CAROTID STENOSIS

SHAMITHA NANDI, Mark Zakrzwski, Lia Anderson, and Dr. Ethan Kung
Department of Mechanical Engineering

Carotid stenosis is the narrowing of the carotid artery. This can cause a blood clot and a potential stroke.

The purpose of this project was to determine factors that may help in predicting the likelihood of patients with carotid stenosis experiencing a stroke. This was done by creating patient models of stroke and non-stroke patients and determining factors that are different between them. Through an image-based simulation software, Simvascular, fourteen models were created by building a path, segmenting arterial walls and meshing them for an accurate representation of the artery. Simulations were created and uploaded to a supercomputer to be run. The simulation files were transferred to Paraview software for data analysis. Clips of various regions of the artery and its factors such as velocity and shear stress were collected for analysis. After obtaining data in each of these regions, a two-sided t-test was used to see if the differences were statistically significant. The analysis indicated that stroke patients have a higher mean velocity in the external carotid artery than non-stroke patients. This data can be further analyzed and used as a diagnostic factor for stroke in patients with carotid stenosis.

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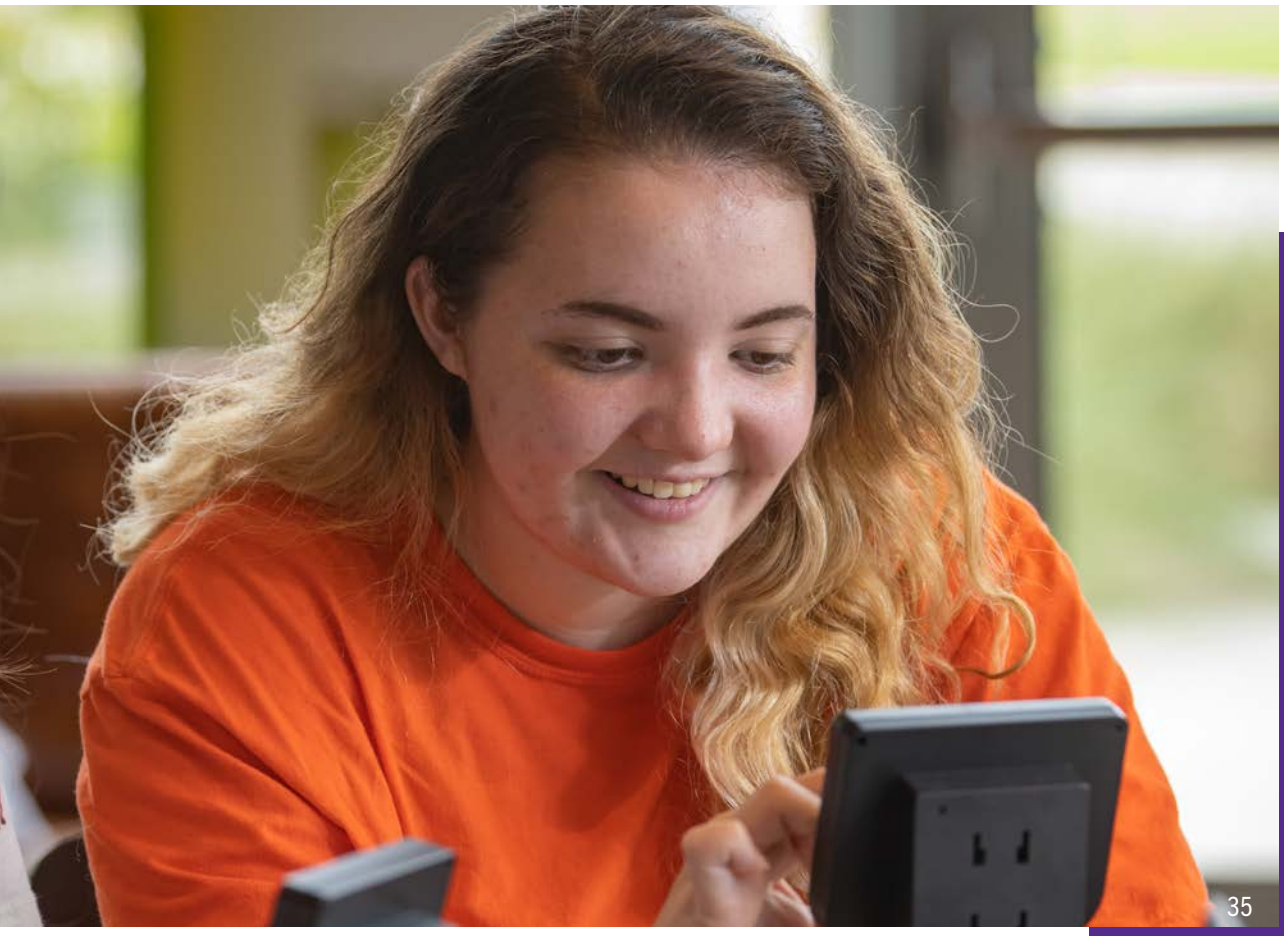
EXAMINING THE PRESENCE OF INVASIVE ANTS IN SOUTH CAROLINA REGIONS UTILIZING VARIOUS TRAPPING METHODS

EMILY PEAK, Ashley Fister, Elizabeth Cutler, Daniel Malagon, and Dr. Sharon Bewick
Department of Biological Sciences

Ant species (Formicidae) that are not indigenous to a particular area can be detrimental to both native ant species and other organisms in the surrounding environment. In South Carolina, red imported fire ants (Solenopsis invicta), Argentine ants (Linepithema humile), crazy ants (Nylanderia flavipes), and Asian needle ants (Brachyponera chinensis) are invasives that pose a serious threat to the environmental health of the region.

The purpose of this study is to discover the presence of ant species in the tested locations, as well as examine the impact of alternate trapping methods on species richness. Pitfall and baiting traps were employed throughout the course of four weeks in urban areas of Aiken, Columbia, and Charleston, SC. Ant specimens were collected from propylene glycol samples and identified to the level of genera using a dichotomous key. Asian needle ants and red imported fire ants were present in sampling clusters in Columbia, however, invasives were absent from the samples derived from Aiken and Charleston. Richness was shown to increase steadily in Aiken and Columbia after the making of a species accumulation graph, while it eventually leveled out in Charleston with the addition of more pitfall traps. Baiting proved to accumulate additional invasive ant genera.



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PERCEPTIONS OF LAW ENFORCEMENT AND THEIR INFLUENCE ON TRUST IN AUTHORITY

MATTHEW PLOYHART, Haleigh Hankins, Randle Aaron Villanueva, and Dr. Job Chen
Department of Religious Studies

In the modern era, the police and law enforcement are a controversial presence in the media. Bad impressions linger more than good ones, so perceptions of police brutality in the media can result in a general distrust of the police. Granted, in many of these instances, the police have abused power. However, in other instances, when the actions of police are justified, it is important to maintain a trusting law enforcement-citizen relationship for a functioning society.

The intended purpose of this study was to determine different factors that may influence societal perceptions of law enforcement. This is to be executed through an informational video that demonstrates a neutral and positive view of law enforcement. The apparent wealth of the suspect in the video will also be manipulated to be a further independent variable. The results of this study, while simulated, are predicted to have significant results in favor of societal perceptions being more positive when presented with a positive informational video.

HOW LINKER LENGTHS AFFECT HOECHST DERIVATIVES BINDING TO B-DNA

DEEPTHI PRABHAKAR, Lilli Hicks, Andrea Conner, Adam Gaynor, and Dr. Dev Arya
Department of Chemistry

Hoechst 33258 is a well-known nucleic acid dye which is noted for its affinity to B-DNA. Prior drug discovery research has investigated two fragments that attach at a target site and are connected via combinations of linkers to observe activity between the two. Yet, the effects of linkers on an individual fragment itself has not been fully understood. The objective of this study was to observe the impact of linker length and composition with Hoechst 33258 binding to B-DNA.

After using multiple experimentation methods such as UV thermal denaturation and fluorescence microscopy studies, the results showed that shorter linkers localized in the DNA nucleus while longer linkers interacted with extranuclear organelles. The composition of the linker also played a role in its stabilization to the binding site, particularly when referring to the number of oxygen atoms increasing the compound's stability. Using these results, we are better able to see the applications of Hoechst 33258 and future linker research in drug developments.

PREDICTION OF NOVEL AUTISM RISK GENES BY GENOMIC DATA MINING

ANVITA PUDIPEDDI, Abbegail King, Landon Ethredge, Snehal Shah, Anqi Wei, and Dr. Liangjiang Wang
Department of Genetics and Biochemistry

Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder which affects social development and general behavior. ASD varies in its symptoms and severity but is often characterized by rigid, repetitive behavior patterns, sensory issues, intense interests, and communication delays. While the majority of currently discovered ASD genes are protein-coding, great promise exists in finding novel autism risk genes among non-coding RNA genes since they make up the bulk of the human genome. Specifically, this study focused on long non-coding RNAs (lncRNAs), which are classified as transcripts longer than 200 nucleotides. This study aimed to identify potential ASD risk genes by means of machine learning, a subset of artificial intelligence. Researchers trained three machine learning models, Random Forest, Support Vector Machine, and Artificial Neural Network, to mine for relevant features within genomic data of previously discovered ASD risk genes to predict novel risk genes using those features. The Artificial Neural Network Model showed the highest performance of the three. 624 lncRNAs were identified as high confidence candidate lncRNAs by all three models and 1,174 were identified in total. Upon further analysis of the results, many candidate lncRNAs were in close proximity to known ASD risk genes on their respective chromosomes.

BIOINFORMATICS INVESTIGATION OF EXCYSTATION IN THE INTESTINAL PARASITE ENTAMOEBA HISTOLYTICA

ELSA SAINE, Annabelle Harris, and Dr. Cheryl Ingram-Smith
Department of Genetics and Biochemistry

Entamoeba histolytica is a human pathogenic amoeba that causes amoebic dysentery in 90 million people and kills up to 100,000 people each year. Entamoeba has two forms: the trophozoite that causes symptoms and the dormant cyst. Infection occurs by ingesting food or water contaminated with cysts. Once ingested by the host, cysts excyst into the trophozoite form in the small intestine. The trophozoites colonize the large intestine and can encyst and pass out of the body to continue the disease cycle. Most studies on these processes have used the related species Entamoeba invadens, a reptile pathogen, because E. histolytica does not encyst well in culture. The purpose of this research was to identify genes in E. invadens involved in excystation that have orthologs in E. histolytica. The research was conducted using AmoebaDB, a bioinformatics database for pathogenic amoebas. The transcriptome data for E. invadens was searched to identify genes that are upregulated five-fold or more during the beginning stages of excystation, thus suggesting a possible role in the conversion from cyst to trophozoite. These genes encode proteins involved in energy production, motility, and pathogenesis, all of which are essential to the survival and purpose of Entamoeba in its trophozoite form.

IDENTIFICATION OF GENES REQUIRED FOR ACETATE UTILIZATION IN CRYPTOCOCCUS NEOFORMANS

ALANNA SCOGGINS and Dr. Kerry Smith
Department of Genetics and Biochemistry

Cryptococcus neoformans is an opportunistic fungal pathogen that causes cryptococcal meningitis, a potentially fatal infection that affects immunocompromised individuals, especially those with AIDS. According to the CDC, cryptococcal meningitis is responsible for 181,000 deaths worldwide each year. For infection by C. neoformans, the pathogen must survive in alveolar macrophages, the first defense mechanism in the lungs, which contain limited amounts of glucose, forcing C. neoformans to survive on nonpreferred carbon sources, such as acetate. Therefore, researchers hypothesized that genes that are needed for acetate utilization aid in establishing cryptococcal infection and contribute to virulence. Gene CNAG_00236, which had been previously deemed necessary for C. neoformans to survive on acetate, was investigated to determine possible protein functions using the online fungus database, FungiDB. Genes CNAG_05310, CNAG_07403, and CNAG_03697, which were all expressed more than log 2 higher on acetate than glucose, were also investigated to determine the possible protein functions of enzymes coded by these genes. As the current treatments for cryptococcal meningitis are not always effective, identifying genes in C. neoformans that are required for the fungus to grow on acetate may be an important step in the development of more effective treatments for cryptococcal meningitis.

NANOCELLULOSE FILMS WITH BOULIGAND MICROSTRUCTURES

GEORGE SPRINKLE and Dr. Zhaoxu Meng
Department of Mechanical Engineering

Nature has been guiding the design process of animal's bodies in order to be best optimized for their environment. An example of this can be seen in the mantis shrimp which uses its powerful club to crack open mollusk shells. Images of these natural materials at the micro-level have shown us how the exoskeleton of the club is composed of layers of nanofibers that helically rotate, which is also termed the Bouligand microstructure.

The purpose of our research is to use simulations to determine the relationship between the rotational pitch angle and the impact resistance by using thin films made of cellulose nanocrystals (CNC) nanofibers as a model system. The thin-film structure files are developed using MATLAB code. The Palmetto high-performance computing cluster is then used to run the molecular dynamics simulations on the projectile impact on the thin film. The Visual Molecular Dynamics program is used to visualize the simulation results. We find that a smaller pitch angle (18-42 degrees) for rotational degree achieves better impact resistance than other pitch angles. The project illustrates that the excellent impact resistance of the exoskeleton of the mantis shrimp is directly related to its internal microstructure.

CLINICIAN BURNOUT AND WELL-BEING DURING COVID-19

ABIGAIL WILDI and Mrs. Janice Lanham
School of Nursing

Clinician burnout and well-being are important issues impacting healthcare providers. The COVID-19 pandemic has increased susceptibility to nurse burnout (Howell, 2021). To address this issue, this research study will evaluate the effectiveness of implementing a well-being protocol in a prelicensure undergraduate baccalaureate nursing program. Burnout will be assessed by using the Maslach Burnout Inventory using a pretest-posttest design.

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HELP US THANK THE EUREKA! TEAM

This year, we are so appreciative of the many dedicated Clemson Honors College staff who worked together to provide a quality program for all of our EUREKAns. We also want to extend a special thanks to Susan Falendysz, EUREKA! Director, and Rachael Wallace, EUREKA! Program Assistant, for their leadership.

Please also help us thank our counselors, who provided care and support for the program participants on a daily basis and served as ideal role models for our students (pictured left to right):

- Liz Dillard (head counselor)
- Mariana Holladay
- Andrew O'Rourke

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