



FYRE Research Catalog

The University of Oklahoma Honors College
First-Year Research Experience Cohort 2024-2025



Have you reviewed the *FYRE checklist*? Start there!

Reviewing this research catalog is the **first step**.

FYRE Checklist

Welcome to FYRE, the First-Year Research Experience program. Students are concurrently enrolled in HONR 2970 and complete 6-10 hours of research per week. *Here are five easy steps for an easy FYRE application process!*

1. Review the [FYRE Research Catalog \(2025\)](#). This resource showcases last year’s student posters and provides incoming FYRE students with an example of what their research will look like.
2. Select four mentors from the *FYRE 2025-2025 Mentors* document and order them based on your research interest areas. Research interest areas include:

(I) Bioscience & Psychology	(VII) Meteorology, Radar Engineering & Electrical Eng. (VIII) Native American Studies
(II) Biochemistry, Chemistry & Physical Chemistry	(IX) Applications of Data Science & Machine Learning/Artificial Intelligence (ML/AI)
(III) Biology, Microbiology	(X) Quantum Physics (XI) Political Science (XII) Health & Exercise Science
(IV) Bioengineering & Biomedical/Chemical Eng.	
(V) Mathematics	
(VI) Anthropology	

Prepare two statements:

- i. In less than 200 words, tell us about your expectations for the FYRE program and why you are choosing to do research.
 - ii. In less than 100 words, describe your career aspirations.
3. Complete your application and share this with your friends. The FYRE team looks forward to seeing you in class, around campus, and the outcome of your research!

Please reach out to the FYRE team via email at @fyre@ou.edu with any questions!

The following table of contents organizes mentors by discipline. Please list the mentors whose research project descriptions appeal most to you when prompted by the FYRE application.

This is **step two** from the FYRE checklist.

Table of Contents

Norman, Oklahoma Main Campus

- Biological Sciences
 - Biology
 - Microbiology
 - Plant Biology
- Biomedical Engineering
- Chemistry and Biochemistry
- Compendium:
 - Math
 - Native American Studies
 - Physics
 - Political Science
 - Psychology

Table of Contents

Norman, Oklahoma Main Campus

- Engineering
 - Aerospace and Mechanical Engineering
 - Civil Engineering and Environmental Science
 - Computer Science
 - Electrical and Computer Engineering
 - Engineering Physics
 - Industrial and Systems Engineering
 - Stephenson School of Biomedical Engineering
 - Sustainable Biological, Chemical, and Materials Engineering
- Health and Exercise Science

Table of Contents

Oklahoma City, Oklahoma Satellite Campus

- Oncology
- Occupational and
Environmental Health

Table of Contents - Mentor

Biological Sciences

Becker, Daniel
School of Biological Sciences

Our group focuses on the ecology and evolution of host–pathogen interactions, especially in wild bats and birds. For Spring 2025, we are looking for FYRE students interested in contributing to studies of the ectoparasites of North American and/or Neotropical bats and their pathogens. Work could include but not be limited to microscopically identifying ectoparasites to species, extracting DNA, and using PCR to confirm species identity as well as pathogen infection status. Mentees could also use PCR to assay pathogen infections in bat blood samples.

<https://yuanningfeng.wixsite.com/website>

Campelo dos Santos, Andre
School of Biological Sciences

The analysis of DNA can provide invaluable information about many aspects of past and current life. I investigate human and non-human evolution by analyzing DNA from both present-day and ancient populations. Using integrated genomic, microbiome, and computational approaches, I address questions of demography, migration, ancestry, health, and the role of infectious diseases in human adaptation. My work involves extracting, sequencing, and analyzing DNA from diverse regions of the globe to estimate genomic affinities between ancient individuals and present-day populations and identify signals of adaptation to distinct environmental factors, including pathogens. Beyond host genomes, I use powerful computational methods to detect ancient DNA from pathogenic microorganisms that may have caused infectious diseases over time. I also analyze ancient DNA preserved in dental calculus to reconstruct oral and gut microbiomes from past human individuals. These reconstructions offer insights into health, diet, and environmental exposures, deepening our understanding of how human biology and lifestyles evolved. By combining ancestry reconstruction with genomic evidence of disease and microbiome composition, my interdisciplinary projects bridge anthropology, genomics, and computational biology. This approach illuminates the evolutionary history of populations underrepresented in genomic studies and broadens our knowledge of human adaptation across time and space. All wet-lab procedures and computational analyses for these projects are conducted at the Laboratories of Molecular Anthropology and Microbiome Research of the University of Oklahoma, where I serve as Associate Director.

<https://scholar.google.com/citations?user=rhw0GVwAAAAJ&hl=en>

McCarthy, Heather
School of Biological Sciences

My lab conducts research on how trees and forests respond to environmental changes and how they can be managed to moderate environmental changes. Our research uses physiological and ecosystem ecology approaches to understand how tree and forest-scale water and carbon processes respond to global change factors, including changes in water availability, woody plant invasions, extreme weather events, and urbanization. We have ongoing projects in all of these areas, including predicting risks of tree fall/tree damage in urban environments; understanding how oak trees adapt to hot and dry environments; and understanding impacts and causes of juniper invasion into grassland ecosystems. We welcome undergraduates who would like to work with us on any of these topics. Both lab and field experience/projects are available.

<https://www.ou.edu/cas/sbs/people/faculty/heather-mccarthy>

Table of Contents - Mentor

Biomedical Engineering

Sliva de Miranda, Gustavo

School of Biological Sciences, Oklahoma Museum of Natural History

Decoding Arthropod Biodiversity in Oklahoma: Integrating Collections, Citizen Science, and Field Research This project explores the distribution of arthropod biodiversity across Oklahoma and how it changes over time. By combining natural history museum collections, global biodiversity databases, and citizen science observations, students will gain a complete understanding of terrestrial arthropod diversity in the state, which will help guide conservation efforts and ecological research. Students will learn to compile and analyze distributional data from the Sam Noble Museum collection, the Global Biodiversity Information Facility (GBIF), and iNaturalist. Using these resources, they will calculate biodiversity metrics and investigate historical changes in diversity, especially in areas that have undergone strong human-driven environmental change. Students will also participate in local fieldwork to gather new data, providing firsthand experience with specimen collection and natural history documentation. The project further encourages deeper engagement through targeted genetic and demographic studies of select species, giving students exposure to modern molecular approaches in biodiversity research. Citizen science participation, particularly through iNaturalist, will allow students to connect science with the public and contribute to broader monitoring efforts. By the end of the project, students will have hands-on experience with biodiversity informatics, data analysis, and field-based ecology, while also contributing to our understanding of Oklahoma's rapidly changing ecosystems.

<https://gustavomiranda.weebly.com/>

Van De Weghe, Julie

School of Biological Sciences

We work on cilia, a cellular signaling organelle that acts like an antenna, and the diseases that arise when cilia are dysfunctional (i.e., ciliopathies). Projects could include CRISPR-Cas9 genome engineering in human cells, cloning constructs for live-cell microscopy, introducing disease DNA variants into cells, cellular signaling assays, or work with *Chlamydomonas*, a unicellular bi-ciliated green algae.

<https://www.juliecvdw.com/>

Woodruff, Gavin

School of Biological Sciences

Our lab is interested in the genetic basis of diversity! We address this broad issue with nematodes, which are fast-growing and amenable to multiple genetic approaches. We have projects on: --The developmental genetics of body size divergence --Host-microbe interactions --The evolution of genome organization and transposable elements --The genetic basis of lifespan variation --The drivers of gene family evolution

https://gcwoodruff.github.io/research_interests.html

Table of Contents - Mentor

Biomedical Engineering

Balasubramanian, Priya
Neurosurgery/Medicine

Our lab has recently demonstrated that brain ECs accumulate lipids with aging. However, the physiological/pathological impact of lipid accumulation on endothelial structure and function during aging remains unknown. Given that microvascular dysfunction is a key driver of vascular cognitive impairment (VCI) and neurodegeneration, understanding whether age-related lipid dysregulation in ECs contributes to cerebrovascular aging and cognitive decline is of significant therapeutic interest. During the program, the student will develop and validate an in vitro model of lipid accumulation in human brain endothelial cells. They will perform biochemical, molecular and imaging-based experiments to assess lipotoxicity-induced changes in endothelial phenotype and function.

<https://medicine.ouhsc.edu/directory/details/priya-balasubramanian-bvsc-phd>

Clegg, John
Stephenson School of Biomedical Engineering

The Clegg laboratory leverages hydrogels, a class of water-swollen biocompatible materials, as drug carriers for a variety of applications. We are experts in the synthesis, fabrication, quality control, and application of these biomaterials for medical applications. Right now, we are focussing on using these materials / devices to address two major clinical needs -- First the need to deliver hydrophilic small molecule drugs, macromolecules, and cells that do not normally cross the blood brain barrier (BBB) into the brain parenchyma for treatment of neurological diseases, and second the need to modulate the innate immune response purposefully to improve patient responsiveness to existing treatments (e.g., for cancer, metabolic dysfunction, autoimmune disease). Each of our lab projects spans from the design / synthesis / quality control of biomaterials to their evaluation in human cell cultures and/or rodent models of human disease. Students who pair in the Clegg laboratory will spend the FYRE period learning about the process for synthesizing and applying one of our platform technologies (i.e., either an injectable hydrogel for local delivery to the CNS parenchyma or nanogels for modulation of the innate immune response, replicating lab standard operating procedures for their fabrication or application). By the end of the FYRE period, the student will be able to synthesize the biomaterial and test it in at least one model system (i.e., cell culture) independently. Continued participation in lab research beyond the FYRE program is encouraged. Students who continue in the lab beyond FYRE will design new biomaterials (i.e., advancing beyond the lab's current platform technologies), test existing devices in new model systems (e.g., co-cultures or multi-cellular organoids) or collaborate with lab staff to evaluate treatments in rodent models.

<https://www.ou.edu/coe/sbme/people/faculty/john-r-clegg>

Wilhelm, Stefan
Stephenson School of Biomedical Engineering

Our research group focuses on nanotechnology for medical applications, including drug delivery, disease diagnostics, and 3D super-resolution imaging. Students will learn the basic skills of working in a wet lab environment, including micropipetting, weighing, research documentation, nanoparticles synthesis and characterization, cell culture, aseptic techniques, and will get to experience a number of state-of-the-art research instruments, including various microscopes.

<https://wilhelm-lab.com>

Table of Contents - Mentor

Biomedical Engineering

Han, Yuan
Stephenson School of Biomedical Engineering

FYRE Project 1: Analytics of functional magnetic resonance image data acquired in patients with brain tumor Description: Functional Magnetic Resonance Imaging (fMRI) provides unique opportunity to measure neural activity at fine spatial resolution in the human brain. The imaging modality has important clinical applications in the planning of neurosurgery. In the FYRE project, the student will learn about the fMRI analytics using AFNI (<https://cbmm.mit.edu/afni>), and also programming with shell scripts and medical image processing. FYRE Project 2: Measuring the neurovascular coupling in the human brain Description: Functional near-infrared spectroscopy (fNIRS) is a noninvasive neuroimaging technology that measures hemodynamic responses in the brain using near-infrared light. It has the unique advantage of being suitable for clinic usage and compatible to medical implants. In the FYRE project, the student will learn how to measure the neurovascular coupling using concurrent fNIRS and electroencephalography (EEG). The student will also learn about programming with MATLAB® and biomedical signal processing.

https://scholar.google.com/citations?hl=en&user=GCB4m6sAAAAJ&view_op=list_works&sortby=pubdate

Table of Contents - Mentor

Chemistry and Biochemistry

Chauhan, Shikha

Chemistry and Biochemistry

Our lab focuses on understanding how the alteration of signaling networks leads to human disease and applying this knowledge to develop novel therapeutic strategies. We are an interdisciplinary group focused on investigating 2',3'-cyclic nucleotide monophosphate (2',3'-cNMPs) signaling across all three domains of life. The 2',3'-cNMP-based stress response presents a novel and intriguing area of research, as the production, degradation, or sensing of these small cellular molecules remains poorly understood. Our goal is to study the production and regulation of 2',3'-cNMPs in cells to uncover new pharmacological targets and pathways. Ultimately, we aim to utilize medicinal chemistry methods to develop novel small molecules targeting these pathways, with the goal of developing new antimicrobial and anticancer drugs.

<https://www.ou.edu/cas/chemistry/people/faculty/shikha-singh-chauhan>

Dong, Yitong

Chemistry and Biochemistry

Our group is developing and synthesizing new semiconductor quantum dots (QDs) with precise control over size, shape, and surface, and studying their optical and electronic properties at the single-particle level. Our group also aims to leverage advanced QD materials to enable cutting-edge quantum light sources.

<https://yuanningfeng.wixsite.com/website>

Feng, Yuanning

Chemistry and Biochemistry

We have well-established undergraduate projects. They can be found on the group website and discuss with the PI and current students. Research are mostly based on organic synthesis and molecular engineering. FYRE students will easily find a peer-mentor in the laboratory and can directly talk to the PI for the project design. Most of our research projects can be found on the group website. FYRE students can work on the organic synthesis and molecular engineering related to fundamental chemistry, catalysis, photophysics, soft materials, quantum materials, phototherapy, bioimaging and so on. Projects will match with interest by talking to the PI and group members. FYRE students will join a research team led by a research assistant (Samantha, Jackson or Jennifer) see group members) who graduated from OU. Independent project can be assigned if the FYRE student choose to stay after the freshman year.

<https://yuanningfeng.wixsite.com/website>

Table of Contents - Mentor

Chemistry and Biochemistry

Mooers, Blaine
Biochemistry and Physiology

Our laboratory has been developing advanced experimental designs for the optimization of RNA and protein crystal size. This area of the crystal growth workflow has been neglected for several decades. This situation hinders further progress because crystal optimization is an iterative process requiring two to four rounds of experimentation. We are developing a black-box software tool based on machine learning that takes the results of the first round of experiments as inputs and returns an updated design in minutes. This will save workers many hours of labor, uncertainty, and confusion, and will empower them to advance their projects quickly. We need help testing and validating the black box.

<https://medicine.ouhsc.edu/academic-departments/biochemistry-and-physiology/faculty/blaine-hm-mooers-phd>

Saparov, Bayram
Chemistry and Biochemistry

This project aims to develop a new type of inexpensive, high-efficiency, low temperature solution-processable, rare-earth (RE) free, environmentally-friendly and high-stability luminescent materials based on metal halides. “Materials design” with predicted functional properties remains one of the holy grails of inorganic solid state chemistry. The present project proposes utilizing a fairly simple (yet very effective) idea of using the concept of charge localization in low-dimensional structures to prepare brand new examples of metal halides with intended exceptional light emission properties some of which are capable of matching the state-of-the-art luminescent materials used in displays and LEDs. Note that the planned low-dimensional A–B–X halides (A = electropositive inorganic or organic cation; B = Cu, Mn; X = Cl, Br, I) in this project are brand new compounds that will be synthesized for the first time during this project. A remarkable combination of the relative Earth abundance, higher environmental stability, low temperature solution processability and lower elemental toxicity of Cu and Mn halides are significant advantages as compared to toxic (Pb and Sn) halides and rare-earth containing materials. Furthermore, the target materials are hypothesized to demonstrate unique luminescence mechanisms in contrast to the known materials. The FYRE students in this project will be involved in the syntheses of brand new target materials, their structural and photophysical characterization, and for the most promising new materials, demonstration of their practical applications (e.g., in LEDs).

<https://saparov-lab.com/>

Table of Contents - Mentor

Compendium

Bumm, Lloyd
Physics/Materials Science

Optics/Microscopy/2D Materials My group is working on 2D materials. Very thin materials are difficult to see, even under the microscope. However, there is an optical trick that increases the contrast. In the case of graphene, the contrast (visibility) is greatly increased if they are placed on a silicon surface with specific thicknesses of silicon dioxide (“oxide”). We are working with materials beyond graphene. The project is to calculate the oxide thickness that optimizes the contrast for these new materials. And then verify the calculations with actual observations.

<https://www.ou.edu/cas/physics-astronomy/people/directory/faculty/lloyd-bumm>

Cao, Jie
Computer Science

Multi-party Multi-modal Dialogue/Discourse Analysis on Mental Health, Education, etc LLM/MLLM Alignment and Agents, focusing on Domain Specific “World” Model and Human-AI Teaming, etc Efficient Structured Prediction and Symbolic Methods for Controlling and Augmenting Neural Networks Robust Deployment, and Evaluation of Trustworthy AI. <https://mlciv.com>

Carvallo, Mauricio
Psychology

My research aims to explore the role of culture in shaping health-related outcomes—such as anxiety and eating disorders—as well as health-related behaviors, including help-seeking for mental health concerns. By examining how cultural values, norms, and belief systems influence individuals’ experiences and responses to health challenges, this work seeks to contribute to a more culturally informed understanding of mental and behavioral health. For instance, some of my studies have examined the influence of the culture of face on the experience of anxiety and eating disorders among Asian American women. In other work, I have explored how the culture of honor may affect older adults’ willingness to seek psychological help, with findings suggesting that individuals from honor-based cultures may be less likely to pursue mental health support due to concerns about stigma, resilience, or perceived threats to reputation.

Ethridge, Lauren
Psychology

The BABL group centers on the use of dense-array EEG as a translational tool for learning more about brain function in neurodevelopmental disorders. The ultimate goal of our research is to establish non-invasive biological markers for changes in brain function that not only elucidate neural and molecular pathways affected by disorders such as Autism Spectrum Disorder (ASD) and but also serve as aids for early identification, early predictors for response to individualized treatment protocols, and reliable indicators of treatment effects. Research in the lab is highly collaborative, with a large network of investigators across the country. Current research includes: EEG as a translational, treatment sensitive, biomarker in rare genetic disorders associated with autism and intellectual disability, including Fragile X Syndrome and Phelan-McDermid Syndrome Sensory processing disorders Characteristics of EEG activity related to variation in ASD symptoms across the full spectrum Neural correlates of child well-being and adverse childhood experiences

<https://babl.oucreate.com/>

Table of Contents - Mentor

Compendium

Kim, Dongin
Pharmaceutical Sciences

Exosome biology for multidrug resistant cancer diagnosis

Lamba, Manika
Library and Information Studies

Textual analysis remains inaccessible to many researchers and practitioners due to technological barriers, particularly the coding proficiency required by existing methods. We build the Coconut Libtool (<https://www.coconut-libtool.com/>) to overcome these challenges by offering a user-friendly, web-based application that leverages natural language processing technologies. Its goal is to make advanced textual analysis more accessible to users without programming expertise.

<https://manika-lamba.github.io/>

Prichard, Adreana
Honors & History

The Listening Project is a collaboration between OU students, faculty, alumni, and Oklahoma community members to memorialize the myriad histories of OU and of local communities. Oral history interviews document these stories for posterity and foster appreciation for the diversity of experiences and events that constitute OU. Shaped by a philosophy of community-centered archiving, the project seeks specifically to empower communities (of OU stakeholders and those living in local Oklahoma communities) in the process of preserving their own histories. There are two main goals of The Listening Project: to document the history of the university and of its various stakeholders, including students, alumni, faculty, staff, and concerned community members; and to train student and faculty interviewers to work with discrete communities throughout the state and further afield to document their own histories or events. The Project enables course-based and extracurricular research experiences for students—including, using the university archives, conducting and preserving interviews, presenting at conferences, and publishing their findings.

Thelisteningproject.co

Table of Contents - Mentor

Compendium

Proietti, Tiziana
Interior Design and Architecture

The project is an interdisciplinary research endeavor that bridges the fields of architecture and neuroscience and takes place at the Sense|Base Laboratory based at the University of Oklahoma directed by principal investigator Tiziana Proietti. At Sense|Base we investigate human perception and experience of architectural proportion through methods of science. We ask the following questions: when is architectural proportion perceptible and discriminable to the human eye? How is the perception of proportion affected by perspective distortion? What are the effects of the experience of architectural proportion on human behavior? We consider the realistic conditions in which architectural proportion is experienced by the moving person, and how these conditions were addressed in the prior scientific literature. Then we explore how concepts and methods of the modern science of human behavior and experience can advance our understanding of proportion. To do so, we conduct psychophysical experiments in two distinguished formats: “external observation” and “immersive observation.” In the first approach, the observer is stationary and external to the observed scene, while in the second approach, the observer is either stationary or moving, immersed into the observed scene. Complementary to the psychophysical experiments we are creating a pedagogical model to train students’ perception of proportion. To do so we invent exercises and proportional tools. The research conducted at our laboratory will free studies of architectural proportion from speculative reasoning unsupported by empirical evidence. This novel research will reveal whether and under which spatial conditions architectural proportion affects perception and behavior.

www.tizianaproietti.com

Wang, Weinan
Mathematics

This project focuses on exploring the Susceptible-Infectious-Recovered (SIR) model, a foundational framework in mathematical epidemiology. The goal is to move beyond the basic model by investigating the impact of real-world parameters, such as vaccination rates and time-dependent transmission rates, on disease outbreak trajectories. Key Objectives: Develop a computational implementation of the basic SIR model using a system of ordinary differential equations (ODEs). Extend the model by incorporating vital dynamics (births/deaths) and a vaccination parameter to assess its effect on herd immunity thresholds. Analyze how time-varying interventions (e.g., lockdowns, mask mandates) can be modeled by making the transmission rate a function of time. Visualize and interpret the results to understand critical concepts like peak infection rates and the effect of interventions on flattening the curve. Mentorship Needs: I seek students with expertise in Matlab, ODEs, and linear algebra to help interpret the complex dynamics emerging from the simulations. This collaboration will be crucial for transitioning from a theoretical understanding to a robust, applied project.

<https://sites.google.com/view/weinanwang/home?authuser=2>

Table of Contents - Mentor

Engineering

Ghamarian, Iman
Aerospace and Mechanical Engineering

I will work on AI4Science. I can students who are interested in learning machine learning and applying it to any areas in science and technology.

Gunasooriya, Kasun
School of Sustainable Chemical, Biological , and Materials Engineerings

Project 1: Material Discovery for Sustainable Electrochemical Applications using computational modeling Project 2: Techno-Economic and Life Cycle Assessment of Electrocatalytic Processes - CO2 conversion, urea production, sustainable aviation fuesl

<https://www.gunasooriya-lab.com/>

Honeycutt, Wesley
Engineering and Meteorology

Research with Dr. Wesley T. Honeycutt FYRE students are invited to work with Dr. Wesley T. Honeycutt, a research scientist at OU, on one of his many projects. Students from all backgrounds and interests are encouraged to apply. ### Previous Research Dr. Honeycutt is a transdisciplinary research scientist, meaning he works in many fields. He is interested in sensors and making sense of how we sense the world. You can learn a little more about his research at his website: [wesleyhoneycutt.com]. Previous FYRE students have worked with him on several projects: - Study of Carbon Dioxide Behavior in Simulated Urban Canyons - Design of a Low-Cost, Smart Greenhouse for Rural India - Comparison of Retrieval Algorithms for EM27/SUN Spectrometer Data - Designing a Optocoupler Electronics for a Raspberry Pi Level Shifter - Design of a Low-Cost, Smart Compost System ### Potential Projects All FYRE projects with Dr. Honeycutt are tailored to the individual student and Dr. Honeycutt's current research needs. The following list of potential topics is subject to change: - Understanding Methane Sensor Technologies through Art - Particulate and Carbon Dioxide Emissions Near Roadways - Meteorological Simulation of Black Carbon Retrievals - Spatial Impacts of Green Spaces on Urban Heat Island Development - Interactions of Bird Migration and Human Development - Supply Chains for Chemical Industry ### Skills You Could Learn You might learn: how to design electronics, study the atmosphere, program in Python, deploy equipment in the field, model mapped information, understand social causes of inequality, reduce ecological impacts, find and read an academic paper, measure light interacting with chemicals, create 2D or 3D models, and many other things. You absolutely will learn: the fundamentals of classical theatre. Seriously. ### Expectations You will learn how to think via engagement in weekly meetings, to present knowledge in elevator pitches, and to independently wrestle with difficult topics. A successful student will put in the effort and 6-10 hours per week. While an end-of-semester report is required, grades are based on growth, not specific milestones. The pace should challenge without overwhelming you; the goal is to learn how to push your limits, not suffer. In-person/remote flexible, but in-person tends to work best for meetings. ### Want to Learn More? You are absolutely encouraged to reach out before making a decision to [honeycutt@ou.edu]. If you want to talk to my former FYRE students for a reference, I can put you in touch.

Wesleyhoneycutt.com

Table of Contents - Mentor

Engineering

Kyprioti, Aikaterini

Civil Engineering and Environmental Science

In this project, students will work on some simple image recognition system to identify different species of trees using photographs taken on campus or from open-source datasets. Students will collect and label a small dataset of tree images, train a pre-built machine learning model (e.g., transfer learning with a convolutional neural network), and evaluate its accuracy. The project introduces key concepts in computer vision, supervised learning, and data annotation. Its applied value lies in environmental monitoring, where quick identification of tree species can support urban planning, forestry management, or risk assessments in disaster-prone areas. On a second project, students may work on developing some engineering models (using engineering software) to simulate trees and their rooting systems, as well as their response to external loads (that will simulate wind, ice, etc. and other external loads). This is more of an engineering tailored project, where finite element analysis will be used (probably ANSYS or similar program) that may allow for such simulations to be performed.

Merguizo Sanchez, Diogo

Aerospace and Mechanical Engineering

Asteroids, remnants of the solar system's formation, are classified as Near-Earth Asteroids when their orbits approach the Sun at less than 1.3 times the Earth-Sun distance (one astronomical unit). When this close approach is less than 0.05 astronomical units, asteroids with at least 140 feet (approximately 43 meters) in diameter are classified as Potentially Hazardous Asteroids (PHA) due to the risk of collision with our planet. To mitigate the potential risk of a PHA colliding with Earth, specific techniques may be employed to change the asteroid's orbit as part of a planetary defense strategy. In this project, the student will work with one of the planetary defense techniques called Kinetic Impactor, where an impactor, such as a spacecraft, is set on a collision course with the asteroid. After the collision, the asteroid is deviated from its previous orbit due to the exchange of momentum between the impactor and the asteroid. The student will learn the fundamentals of astrodynamics and how to simulate the asteroid's orbit before and after the impact using Python software. The main goal of this project is to verify the possibility of using Jupiter to increase the impactor's speed via a gravity-assisted maneuver (slingshot effect) to produce the same asteroid's orbit deviation with a smaller impactor's mass, compared to a direct hit.

<https://www.ou.edu/coe/ame/people/faculty/diogo-sanchez>

Foudazi, Reza

Sustainable Chemical, Biological and Materials Engineering

The current research activities in Dr. Foudazi's group are self-assembly of amphiphilic molecules, templating approach for synthesis of porous polymers, and rheology of soft matter, with the long-term goal of producing responsive multifunctional materials for sustainability and environmental applications. Some examples of projects for FYRE are: (1) Removal of PFAS, known as forever chemicals, from water resources. In this research, we are developing an efficient system for PFAS removal from drinking water. (2) Porous polymers for environmental applications: We synthesize multifunctional porous polymers through emulsion- and foam-templating methods. The obtained porous polymers are used for different applications, such as water retention in soil for agriculture, microfiltration membranes, and adsorbents for heavy metal removal.

<https://foudazi-lab.com/>

Table of Contents - Mentor

Engineering

Mistree, Farrokh

Aerospace and Mechanical Engineering

RESEARCHING AND DEVELOPING A BUSINESS PLAN FOR A 'GREEN WALL' TO CREATE EDUCATIONAL OPPORTUNITIES This project is open to Honors students who have a social conscience and wish to make a difference in the world by researching and entrepreneurship. Students with an interest in engineering design and business development are especially encouraged. Questions for Reflection 1 Do you wish to learn what researching is about? 2 Do you wish to learn how to identify gaps in that which exists and bridge that gap for the betterment of society? 3 Do you enjoy exploring the internet, talking to ChatGPT, Microsoft Copilot and equivalent - find information? 3. Do you wish to develop your ability to communicate your findings to a general audience? 4. Are you willing to be pushed outside your comfort zone? If the answer to any of the preceding questions is a yes - Wesley T. Honeycutt [honeycutt@ou.edu] and Farrokh Mistree [farrokh.mistree@ou.edu] are interested in mentoring you in Spring 2026. Learn more about us on our websites: [<https://wesleythoneycutt.com/>] and [<https://www.ou.edu/coe/ame/people/faculty/farrokh-mistree>]. Project Description A 'green wall' is a living architectural feature composed of plants. The presence of a green wall in educational environments offers students an opportunity to learn about STEM by interacting with living organisms. Designing a green wall from scratch is challenging, and educators may not have for this task, despite the advantages it could offer to their students. A pre-designed kit offers users a chance to build and customize a green wall with less startup effort, increasing access to this educational resource. Expectations and Grades You will approach the design in a systematic and organized fashion. You will be required to reflect on what you have done, write Take Aways and the transform these Take Aways in lessons that you will use in the future. We will meet once a week, usually via Zoom. You will be expected to turn in a progress report that will be discussed when we meet. Your grade will be based on an End of Semester Report, a Poster, and a Semester Learning Essay.

<https://www.ou.edu/coe/ame/people/faculty/farrokh-mistree>

Singh, Shanteri

Civil Engineering and Environmental Science

The Singh Lab is interested in combining the power of biochemistry and organic chemistry to provide access to novel organic molecules. We are developing a synthetic biology pipeline for the synthesis and diversification of antibiotics and anti-cancer molecules. The techniques we use in the lab include biochemical characterization of enzymes, enzyme engineering, structural biology, and organic chemistry to access and diversify the structures of pharmaceutically relevant compounds. These efforts form an innovative and powerful platform for drug discovery. Towards these goals, our projects are designed to train students either in biochemistry or organic chemistry techniques.

<https://www.ou.edu/cas/chemistry/people/faculty/shanteri-singh>

Vogel, Jason

Civil Engineering and Environmental Science

I have two major projects that FYRE mentees can participate with. The first one is wastewater-based epidemiology, where we have a large active laboratory that analyzes over 35 wastewater samples per week for infectious disease pathogens to inform public health professionals across the state of Oklahoma. We will carve out unique, individual research projects from our activities for a student interested in WBE. The other major research area is in stormwater management, where we operate the Great Plains Stormwater Center of Excellence. These research projects could evolve around green stormwater infrastructure, erosion and sediment control, stormwater policy and funding mechanisms, or other stormwater-related topics that the student might be interested in.

Table of Contents - Mentor

Health and Exercise Science

Kellawan, Mikhail
Health and Exercise Science

The labs projects are focused on mechanisms that control blood flow in skeletal muscle and cerebral circulations during exercise and environmental stress in humans. His work is designed to understand the physiological mechanisms that limit cardiovascular support of the brain and skeletal muscle with the aim of developing treatments and strategies to improve human health and performance.

<https://www.ou.edu/cas/hes/research/human-circulation-research-lab>

Lee, Jeong Kyu
Health and Exercise Science

Health information is often complex, and people frequently turn to friends, family, and social networks to help interpret, evaluate, and act on health advice. My current project is a mixed-method study that investigates how adults seek, share, and use health-related information with the support of their social ties. The first phase involves in-depth one-on-one interviews (conducted in person or via Zoom) to explore how individuals recognize informational needs, decide whom to consult, assess credibility, and ultimately act on health-related input. These interviews will provide rich qualitative insights into the relational and contextual factors that shape health information use. Building on these findings, the next phase will involve survey development and quantitative analysis. Insights from the interviews will guide the design of a measurement tool to capture access to and mobilization of informational resources within social networks. This tool will then be tested in larger population-based surveys to assess patterns of health information access and decision-making across diverse communities. The study aims to advance understanding of the social dimensions of health information use and generate evidence to inform strategies that improve equitable access to trustworthy information. By linking qualitative depth with quantitative breadth, this research will strengthen theory, support innovative measurement approaches, and guide communication practices to help diverse populations make better health decisions.

Li, Dan
Health Promotion Sciences

My research focuses on mental health promotion, with a particular emphasis on school settings. I am in the process of establishing a school mental health research lab that will serve as a hub for collaborative and interdisciplinary work in this area. A core goal of the lab is to advance evidence-based strategies that strengthen student well-being and resilience. As part of this effort, I am preparing to launch a new meta-analysis study related to school mental health. While the specific research questions are still being refined, the study will synthesize existing evidence to identify effective approaches and guide future research and practice.

<https://publichealth.ouhsc.edu/about/who-we-are/details/dan-li-phd-ncc-lsc-nc-k-12>

Lu, Yu
Health and Exercise Science

Dr. Yu Lu studies health disparities in the context of substance use and interpersonal violence, such as smoking, marijuana use, (cyber)bullying, firearm violence, and intimate partner violence. Specifically, her work examines how these behaviors progress from adolescence to adulthood and their longitudinal associations, identifies sociocultural factors influencing these behaviors, and develops and evaluates culturally competent health interventions. Students joining Dr. Lu's lab will have opportunities to participate in projects utilizing various research techniques, such as qualitative interviews, quantitative surveys, and experiments.

<https://ou.edu/cas/hes/people/faculty/yu-lu>

Table of Contents - Mentor

Oncology Science

Muthukrishnan, Sree Deepthi
Oncology Science

The Muthukrishnan laboratory at the Department of Oncology science investigates the cellular and molecular basis of glioblastoma (GBM), an aggressive and lethal primary brain tumor. GBM is highly invasive, extensively vascularized, and resistant to standard, anti-angiogenic and molecular targeted therapies. The mechanisms that contribute to GBM resistance, invasiveness and immunosuppression remain largely unknown. Research in the laboratory is focused on tackling these problems using a combination of patient-derived in vitro cell culture models, mouse GBM models and cutting-edge technologies such as bulk and single-cell transcriptomics and epigenomics to identify potential therapeutics to improve patient outcomes. Specific projects include a) elucidating the interplay of cellular metabolism, DNA repair and epigenetics in mediating therapeutic resistance, b) the mechanisms by which the tumor microvasculature contributes to GBM growth and immunosuppression and c) the functions of histone acetyltransferases in mediating phenotypic plasticity and resistance in GBM. For more details on prior research, please refer Nature communications 2022, <https://doi.org/10.1038/s41467-022-33943-0>, Cell Reports 2022 10.1016/j.celrep.2022.111511). The Muthukrishnan lab is a very friendly, collaborative, and an inclusive place that is committed to mentoring and training students to develop technical research and presentation skills and provide guidance on potential career paths in science and research

Mehla, Kamiya
Oncology Science

Our lab projects focus on interrogating the micronutrient competition between tumor and immune cells in the tumor microenvironment in pancreatic cancer. The lab utilizes state-of-the-art in vitro and in vivo mice models, and imaging tools to study this bi-directional cross-talk between tumor and immune cells. The lab also has access to the pancreatic cancer patient-derived tumor, blood, and muscle specimens that are used to validate the pre-clinical findings. In the context of immune cells, the lab focuses explicitly on studying NK cells, macrophages, MDSCs, and T cells. Additionally, we are investigating the impact of various dietary-based changes on the tumor burden and immune system. We have tested multiple high-fat diets so far in the pre-clinical model of pancreatic cancer. These studies will help unravel the key mechanisms that underlie the obesity-associated pancreatic cancer risk in the US population. We further interrogate how some of the beneficial diets can be combined with immune or chemotherapies to improve the anti-tumor immune response and attenuate the pancreatic tumor burden in mice. Our lab projects focus on interrogating the micronutrient competition between tumor and immune cells in the tumor microenvironment in pancreatic cancer. The lab utilizes state-of-the-art in vitro and in vivo mice models, and imaging tools to study this bi-directional cross-talk between tumor and immune cells. The lab also has access to the pancreatic cancer patient-derived tumor, blood, and muscle specimens that are used to validate the pre-clinical findings. In the context of immune cells, the lab focuses explicitly on studying NK cells, macrophages, MDSCs, and T cells. Additionally, we are investigating the impact of various dietary-based changes on the tumor burden and immune system. We have tested multiple high-fat diets so far in the pre-clinical model of pancreatic cancer. These studies will help unravel the key mechanisms that underlie the obesity-associated pancreatic cancer risk in the US population. We further interrogate how some of the beneficial diets can be combined with immune or chemotherapies to improve the anti-tumor immune response and attenuate the pancreatic tumor burden in mice.

<https://medicine.ouhsc.edu/academic-departments/oncology-science/faculty-and-staff/details/dr-kamiya-mehla-phd>

Table of Contents - Mentor

Oncology Science

Shukla, Surendra
Oncology Science

We would like to evaluate the novel therapeutic combinations for pancreatic cancer. We will evaluate the chemotherapeutic drugs 5-FU, Oxaliplatin, and Irinotecan in combination of epigenetic inhibitors. The programme will be focused on improving the therapeutic efficacy of the current standard of care by utilizing epigenetic inhibitors.

<https://medicine.ouhsc.edu/academic-departments/oncology-science/faculty-and-staff/details/dr-surendra-shukla-phd>

Yoon, Je-Hyun
Oncology Science

Dr. Yoon's main research interest is understanding the “RNP Code”, that is, the composition and function of RNA-binding proteins bound to RNAs, both coding and noncoding. He has contributed to efforts to characterize the assembly, composition, and function of ribonucleoprotein (RNP) particles, the influence of long noncoding (lnc)RNAs in translation and ubiquitin-mediated proteolysis, and the mechanisms that determine lncRNA abundance in the cell. He is interested in elucidating the rules that govern the assembly of RBPs into RNA-containing functional complexes, the influence of signaling events that regulate RNPs, and the impact of specific RBPs and RNAs on RNP activity and ensuing gene regulation. He is specifically interested in studying the consequences of RNPs on cellular events such as proliferation, survival, senescence, aging and age-associated human diseases such as cancer.

<https://medicine.ouhsc.edu/directory/details/je-hyun-yoon-phd>

Table of Contents - Mentor

Occupational and Environmental Health

Cai, Changjie

Occupational and Environmental Health

Research in my lab focuses on four directions: (1) identifying and assessing exposure of hazards (e.g., aerosols, bioaerosols, gases, etc.) and their controls; (2) integrating advanced techniques (e.g., machine-learning, advanced materials) into Occupational and Environmental Health fields; (3) studying air pollutants and their climate effects using atmospheric dynamic models (e.g., WRF-Chem); and (4) environmental sustainability. I am the founding Directors of the Children's Environmental Health Center in U.S. Southern Great Plains, and an Aerosol Measurement Core, which are two core research labs in the Hudson College of Public Health at the OUHSC. Young children (birth to five) can be at greater risk to environmental stressors than adults due to unique activity patterns, behaviors, and biology. Children's Total Environment that will be the focus of the researchers in our Center.



The UNIVERSITY *of* OKLAHOMA

NOTE

The 2024-2025 FYRE Cohort produced the following projects. The purpose of these posters is to provide an **example** of research FYRE students complete! Some mentors may not be available to mentor 2025-2026 mentees; *please check the table of contents carefully.*

Allelopathic effects of *Juniperus virginiana* on native grassland plant species in Oklahoma

Michael Dinh, Dr. Heather McCarthy

Department of Microbiology and Plant Biology, University of Oklahoma, Norman, OK

Allelopathic effects of *Juniperus virginiana* on native grassland plant species in Oklahoma

Michael Dinh, Dr. Heather McCarthy, Department of Microbiology and Plant Biology, University of Oklahoma, Norman, OK

Introduction

- Eastern redcedar trees (*Juniperus virginiana*) are encroaching rapidly all over Oklahoma and on native grasslands
- This takes land away from agriculture and livestock, creates a significant fire hazard as the trees are quite flammable, and displaces native birds that inhabit these grasslands
- Studying how these trees spread so fast might give us a better solution
- One possibility is that *J. virginiana* uses allelopathy, which is when an organism releases chemicals that affect the growth or survival of another organism



Figure 1. A row of *J. virginiana* trees

Questions

- Do *J. virginiana* roots exhibit allelopathic properties towards common grassland plant species?
- If *J. virginiana* roots exhibit allelopathy, do they affect each grassland species differently?

References

BRIGGS, J. M., KNAPP, A. K., BLAIR, J. M., HEISLER, J. L., HOCH, G. A., LETT, M. S., & McCARRON, J. K. (2005). An ecosystem in transition: Causes and consequences of the conversion of mesic grassland to shrubland. *BioScience*, 55(3), 243–254. [https://doi.org/10.1641/0006-3568\(2005\)055\[0243:oeita\]2.0.co;2](https://doi.org/10.1641/0006-3568(2005)055[0243:oeita]2.0.co;2)

Wang, J., Xiao, X., Qin, Y., Doughty, R. B., Dong, J., & Zou, Z. (2018). Characterizing the encroachment of juniper forests into sub-humid and semi-arid prairies from 1984 to 2010 using polaris and Landsat Data. *Remote Sensing of Environment*, 205, 166–179. <https://doi.org/10.1016/j.rse.2017.11.019>



Results

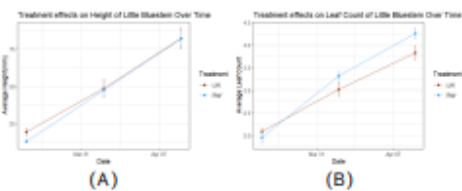


Figure 2. A graph depicting the effect of different water treatments on height (A) and leaf count (B) of Little Bluestem (*S. scoparium*)

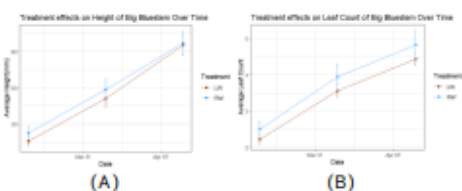


Figure 3. A graph depicting the effect of different water treatments on height (A) and leaf count (B) of Big Bluestem (*A. gerardi*)

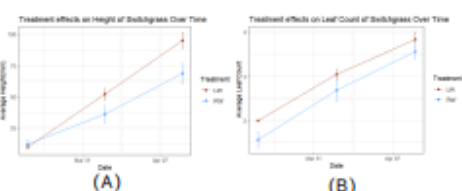


Figure 4. A graph depicting the effect of different water treatments on height (A) and leaf count (B) of Switchgrass (*P. virgatum*)

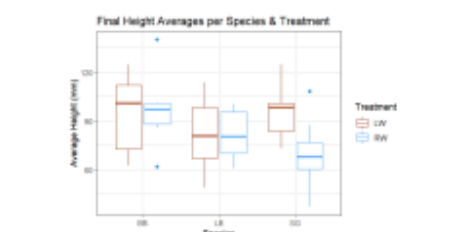


Figure 5. A box and whisker plot comparing the final height averages for each species and treatment. Neither treatment nor species had a significant effect on height

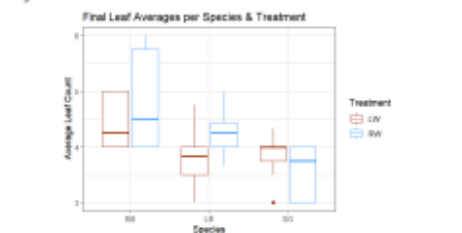


Figure 6. A box and whisker plot comparing the final leaf count averages for each species and treatment. Species had a significant effect on leaf count; however, treatment did not

Conclusion

After running ANOVA tests for both the height and leaf count data, the results showed that treatment had no statistical effect on the height or number of leaves. This implies that *J. virginiana* roots have no or very minimal allelopathic properties. This is not to say the plant has no allelopathic effects whatsoever, but the data suggests that there are none caused by the roots.

Methods

In this study, we examined five common grassland species: buffalo grass (*Bouteloua dactyloides*), little bluestem (*Schizachyrium scoparium*), big bluestem (*Andropogon gerardii*), switchgrass (*Panicum virgatum*), and black-eyed Susan (*Rudbeckia hirta*). We planted 20 pots for each species, for a total of 100 pots. Each pot was supposed to have only 3 seeds planted, but some pots inadvertently had extra seeds, so we were not able to assess germination. Buffalo grass and black-eyed Susan were also fully excluded because of a lack of germination. We then created leachate by soaking 10g of roots for every 100 ml of deionized water and leaving for at least 12 hours before straining. We watered half of a species' pots with 10 ml of regular water and the other half with 10 ml of *J. virginiana* root leachate once every other day. The plants were allowed to germinate for one week. Afterward, we measured each pot's average above-surface plant height and average leaf count weekly.

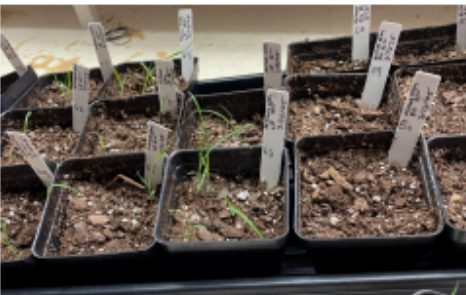


Figure 7. A flat containing some *S. scoparium* pots

Acknowledgements

Lynn Nichols for allowing us to use the greenhouse, the OU Honors College for giving me this opportunity, Aaron Walker from OU's School of Biological Sciences for printing this poster, and Dr. Abigail Moore for providing us with the buffalo grass and little bluestem seeds.

Comparing grassland diversity in open grasslands versus areas encroached by *Juniperus virginiana*

Daniel Pham, Dr. Heather McCarthy
School of Biological Sciences



Comparing grassland diversity in open grasslands versus areas encroached by *Juniperus virginiana*

Daniel Pham, Dr. Heather McCarthy, School of Biological Sciences

Introduction

Juniperus virginiana (eastern redcedar) trees are encroaching into North American grasslands and converting them into forests.

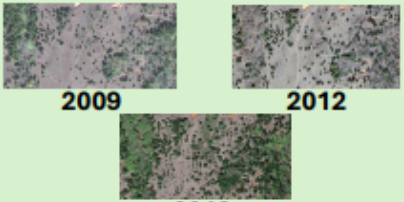


Image credit: Google Earth. Taken in KAEFS.

Loss of grasslands raises concerns about diversity, forage productivity and fire risk (Smith, 2011).

As *J. virginiana* spreads, it fragments grasslands into patches. Fragmentation effects have been observed in other woody plants (Alofs & Fowler, 2010), but less research exists of *J. virginiana* from this perspective.

Research Question: Does grassland species diversity differ in open grasslands compared to areas encroached by *J. virginiana*?

We hypothesized that diversity would differ in encroached areas, with less diversity and more woody species.

Results

We identified 27 unique species across the 10 plots sampled, 19 to the species level and 5 to family level.

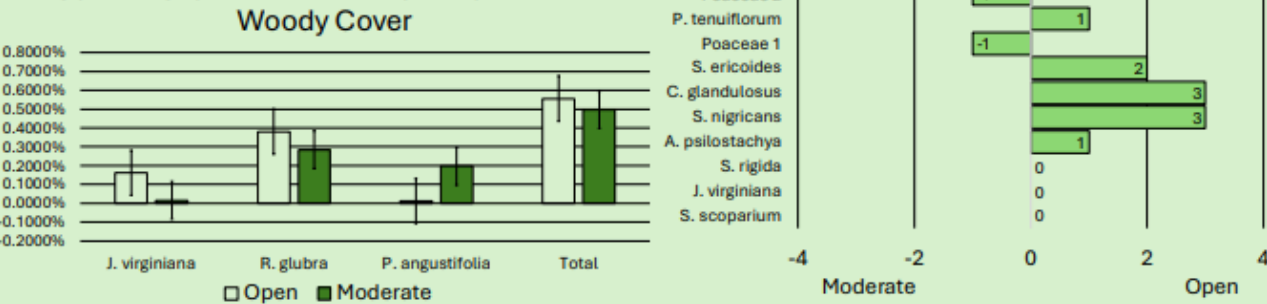
Comparing Richness: We performed a two-sample t-test to determine if there was a significant difference in species richness between open and moderate cover plots.

	Mean	Variance	Observations	Pooled Variance	df	t Stat	P(T<=t) two-tail	t Critical two-tail
Open	9.2	1.2	5	1.95	8	-1.13228	0.290312	2.306004
Moderate	10.2	2.7	5					

The result $t_{df=8} = 1.13228$, $p > 0.05$ indicates that the observed differences were not significant.

Comparing Evenness: We looked at species that occurred more than 3 times in either cover class and graphed the difference in occurrence between the two classes (right).

We also graphed differences in percent cover of woody plants by species and in total (below).



We did not find significant differences in species richness or woody cover, though these results suggest that community composition of herbaceous species may differ between open and encroached areas.

Methods

- Our research site was the Kessler Atmospheric and Ecological Field Station (KAEFS) in Purcell, OK. We took our samples on April 8 and April 10, in early spring.
- We classed 20x20m plots as open, moderate or dense cover from visual estimate of satellite imagery.
- We sampled 5 open and 5 moderate cover plots. At the center of these plots, we designated a 5m² (open) or 2.5m² (moderate cover) area for sampling woody plants, and established 4 0.5m² subplots for sampling herbaceous species, avoiding mature *J. virginiana* canopy cover.
- We measured species richness (total number of species) and which species were present for each plot.
- We estimated shrub cover by species in the plot by measuring individuals' canopy widths.



Discussion

Our results support prior studies in finding that *J. virginiana* encroachment causes compositional changes in grassland communities.

Our study also establishes that community changes are apparent as *J. virginiana* begins to encroach on areas.

For further research: Establish a causal relationship (whether *J. virginiana* causes community changes or grows preferentially in these communities) and examine the impact of these related species.

Acknowledgements

Thanks to Dr. McCarthy for being a kind and thoughtful mentor to a first-time researcher. And thanks to the FYRE program for connecting me to her.
Thanks to Mark David for letting us do our study at KAEFS.
Thanks to Marisa Saubry for helping with most of the plant identification.
Finally, thanks to my parents for keeping me housed, fed and loved throughout this research journey.

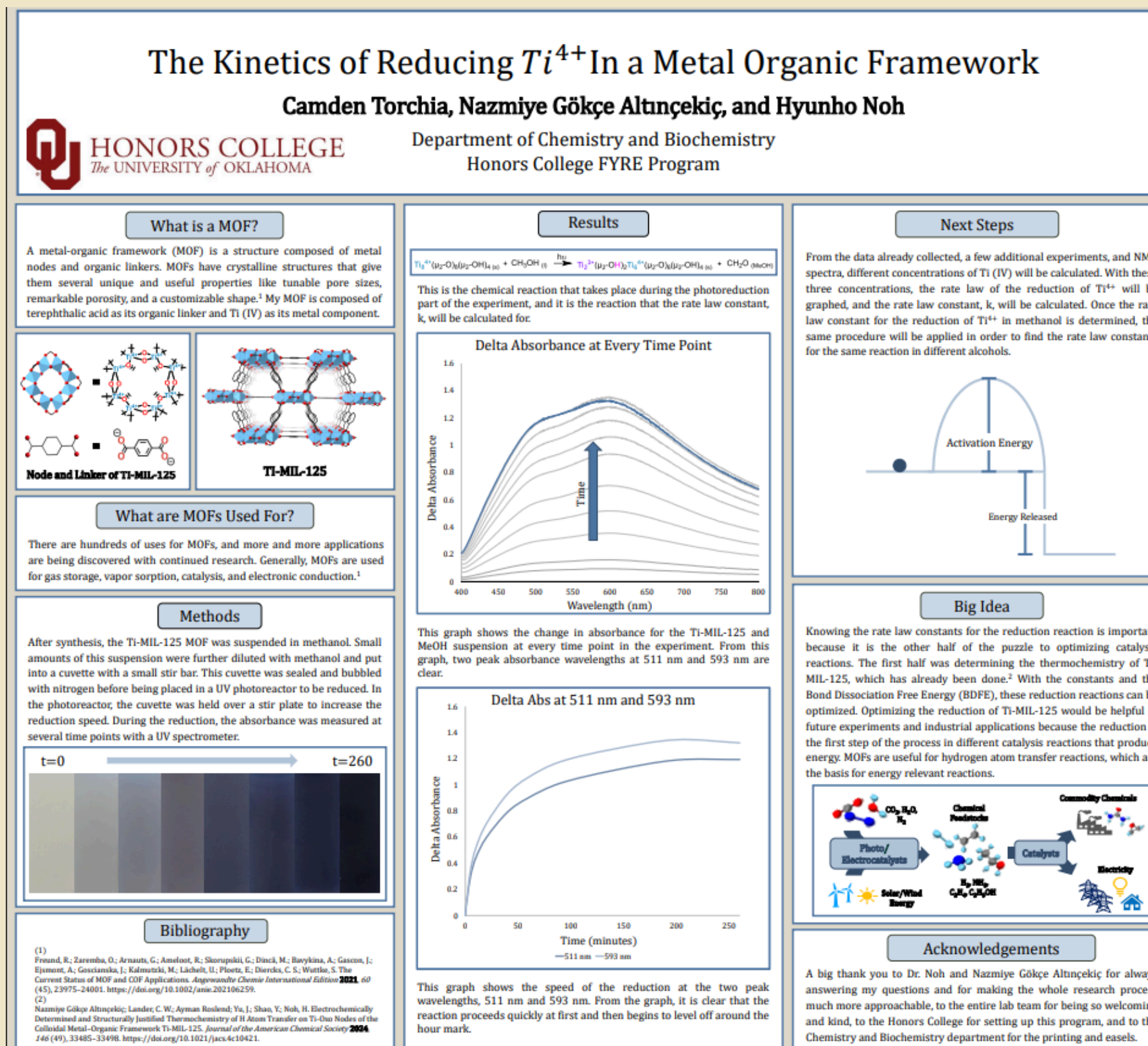
References

Alofs, K. M., & Fowler, N. L. (2010). Habitat fragmentation caused by woody plant encroachment inhibits the spread of an invasive grass. *The Journal of Applied Ecology*, 47(2), 338-347.
<https://doi.org/10.1111/j.1365-2664.2010.01785.x>
Smith, S. (2011). *Eastern red-cedar: positives, negatives and management*. Samuel Roberts Noble Foundation.

The Kinetics of Reducing Ti^{4+} In a Metal Organic Framework

Camden Torchia, Nazmiye Gökçe Altınçekiç, and Hyunho Noh

Department of Chemistry and
Biochemistry Honors College FYRE
Program



Role of MicroRNAs in Maintaining the Health of the Retinal Pigment Epithelium

Shelby Naser, Neloy Kundu, Jiyang Cai, PhD

Department of Chemistry, University of Oklahoma, Oklahoma City

Role of MicroRNAs in Maintaining the Health of the Retinal Pigment Epithelium

Shelby Naser, Neloy Kundu, Jiyang Cai, PhD
Department of Chemistry, University of Oklahoma, Oklahoma City



Purpose-

The *Dgcr8* gene plays a key role in miRNA biogenesis. The RPE is an epithelial tissue that supports the structure and functional health of the neural retinal tissue in the eye. RPE and photoreceptor neurons are metabolically coupled, and such functional interaction likely involves regulation by microRNAs. The dysfunction of *Dgcr8* expression may contribute to the degeneration of the RPE via lack of sufficient miRNA-mediated gene regulation in the RPE. The objective of this study is to perform the initial characterization of retinal structure and function in mice where the *Dgcr8* gene has been genetically knocked out in the RPE, and generate a testable hypothesis for our future studies.

Methods-

In order to eliminate the *Dgcr8* in the RPE, various strains of mice were injected with tamoxifen in order to delete the *Dgcr8* gene. Clinical eye examinations, including fundus photography, optical coherence tomography (OCT), and electroretinogram recording (ERG) were performed on live animals. Mouse dissections preparing the posterior eye segments were processed via immunostaining of the RPE/choroid flatmount.



Fig. 1 Knocking out *Dgcr8* gene and selective breeding. In order to generate *Dgcr8* knockout mice, mice were injected with tamoxifen, a drug that affects *Dgcr8* gene expression by selectively deleting that gene. (A) Selective breeding strategy between Cre mouse and *Dgcr8* exon 3-floxed mouse combined with tamoxifen induction to produce *Dgcr8* knockout mice. (B) Image indicates the process of analyzing live mice sample in which OCT imaging and fundus photography were used.

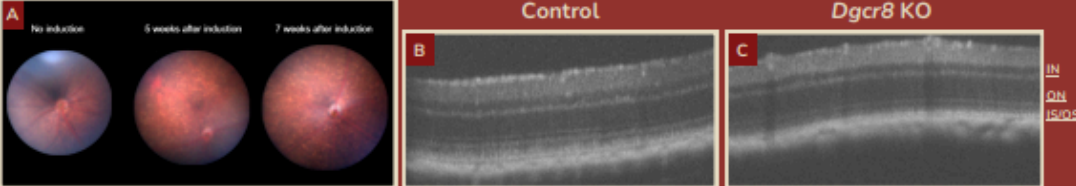


Fig. 2 RPE pigment loss after tamoxifen induction. Fundus imaging was performed on the live retina of the tamoxifen-induced mouse, followed by OCT imaging. (A) Fundus imaging of eye indicates RPE health prior to induction, 5 weeks after induction, and 7 weeks after induction. Images show general degradation of the RPE post-tamoxifen induction. (B) OCT imaging of the RPE layers of mouse without tamoxifen induction. (C) OCT imaging RPE layers of *Dgcr8* Knockout mouse. There is no indication of weakened tissue or damage in either sample.

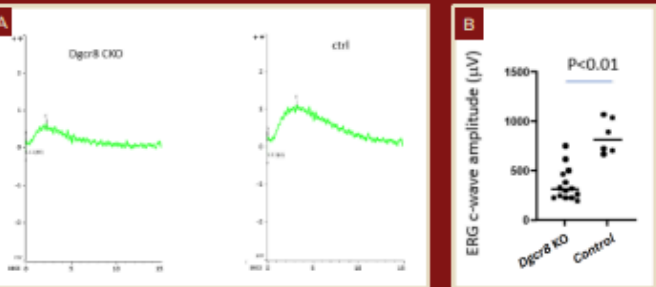


Fig. 3 ERG responses from control and *Dgcr8* KO mice. Data gathering retinal electrical activity in the live mice. (A) Graph of ERG c-wave activity indicating increased electrical activity in the retina of the control mice containing the *Dgcr8* gene. (B) Plot of ERG c-wave amplitudes measured in microvolts. *Dgcr8* Knockout mice are shown to have exhibited lower amplitudes of c-waves, indicative of RPE damage following the deletion of the *Dgcr8* gene.

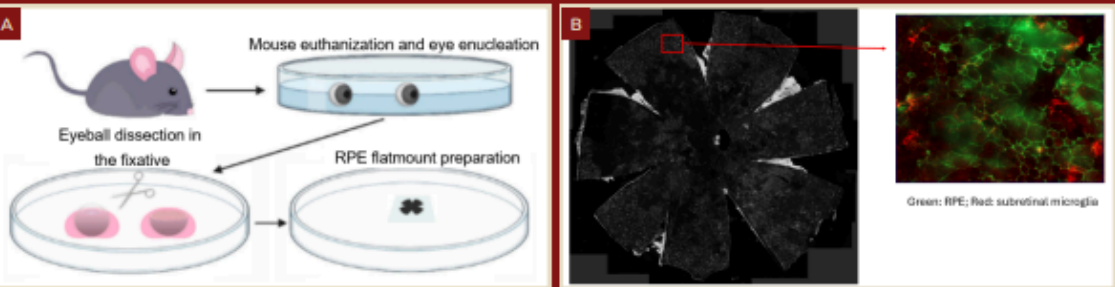


Fig. 4 Flatmount preparation and immunofluorescence staining. Mice samples were obtained and prepared for flatmount to be viewed under a microscope for presence of activated microglia. (A) Diagram showing the process of receiving retinal sample for immunofluorescent staining procedure. Describes stages of mouse euthanization and removal of eye, placement of eye sample in fixative liquid, and dissection the eye to obtain position for flatmount. (B) Fluorescence microscopy imaging of RPE depicting weakened concentration of activated microglia in tamoxifen-induced mouse.

Results-

Fundus photos of mice with RPE-specific knockout of *Dgcr8* shows signs of RPE pigment loss and intra-retinal cell infiltration. Light-induced ERG responses were markedly lower in the knockout retina, however, OCT scan showed no apparent retinal thinning. Immunostaining of RPE flatmounts identified numerous Iba-1+ subretinal microglia, indicating chronic inflammation after RPE degeneration.

Conclusion-

The results of the study indicate that the *Dgcr8* gene plays a significant role in RPE health due to its role in metabolic coupling between the RPE and photoreceptor neurons. Future studies will use bulk RNA sequencing to identify differential gene expression in RPE after *Dgcr8* knockout.

Acknowledgements-

I would like to sincerely thank my mentor, Dr. Jiyang Cai for supporting me and guiding me through my first collegiate research project. His expertise in his field of study provided me invaluable knowledge and experience. Secondly I would like to thank Neloy Kundu, who provided me lots of assistance in the laboratory and developing my laboratory techniques.

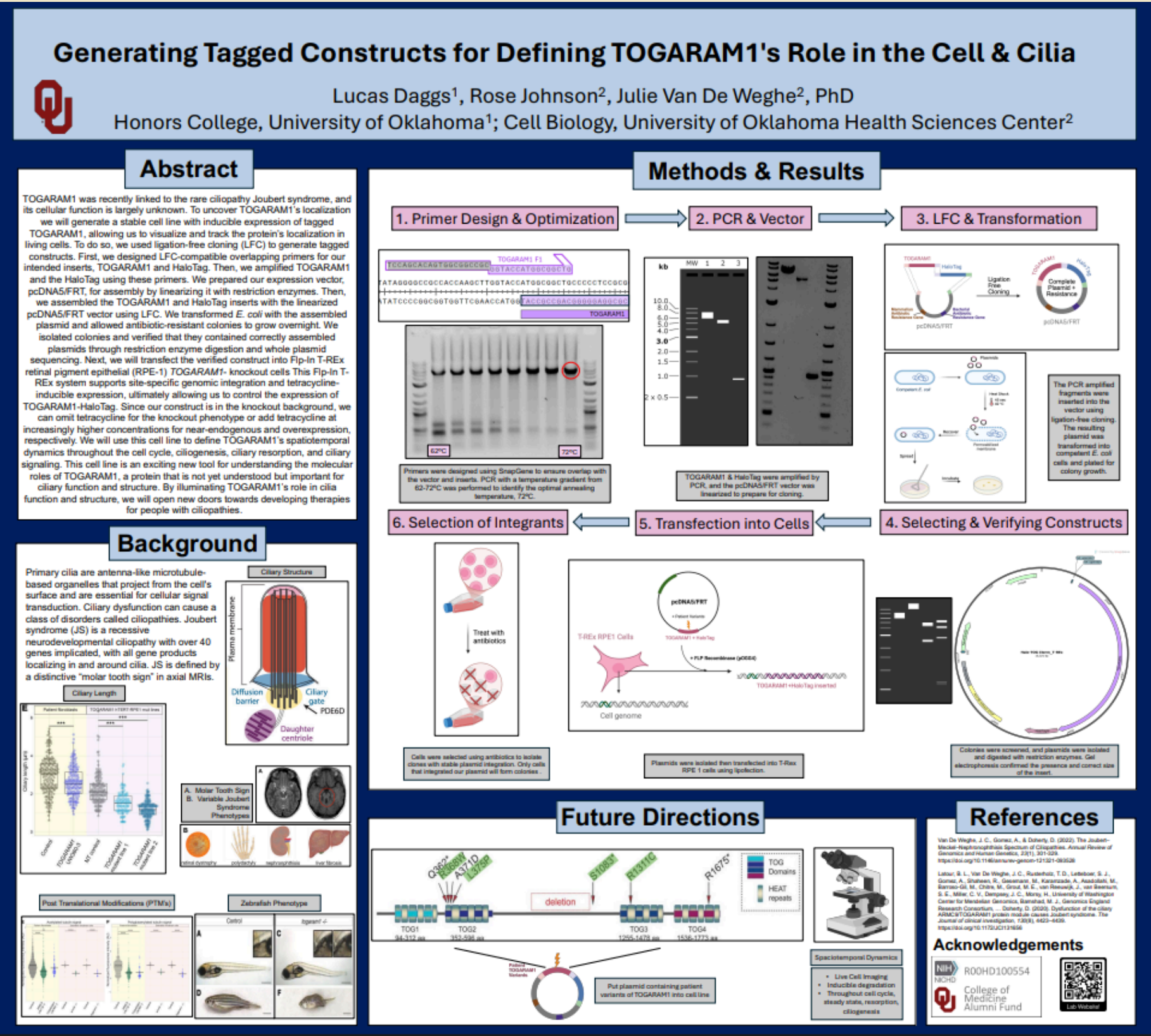
University of Oklahoma Honor's College, Stephenson School of Biomedical Engineering, Stephenson Cancer Center, Stephenson Cancer Center, Harold Hamm Diabetes Center, Institute for Biomedical Engineering, Science, and Technology, University of Oklahoma, Norman, OK.



Generating Tagged Constructs for Defining TOGARAM1's Role in the Cell & Cilia

Lucas Daggs, Rose Johnson, Julie Van De Weghe, PhD

Honors College, University of Oklahoma;
Cell Biology, University of Oklahoma
Health Sciences Center



Investigating the Lipid Content in Pancreatic Cancer Tissue

Aanya Veragiwala, Vira Chumak, Kamiya Mehla

University of Oklahoma, Department of Oncology Science



Investigating the Lipid Content in Pancreatic Cancer Tissue

Aanya Veragiwala₁, Vira Chumak₂, Kamiya Mehla₂

University of Oklahoma₁, Department of Oncology Science₂



Introduction and Background

- Pancreatic ductal adenocarcinoma (PDAC) is a leading cause of cancer mortality with a 5-year survival rate of less than 8%.
- PDAC cells have high metabolic demands, relying on glycolysis, oxidative phosphorylation (OXPHOS), and β -fatty acid oxidation (β -FAO) for energy production to produce ATP.
- Cholesterol metabolism is crucial for PDAC cell growth, membrane stability, intracellular signaling, and invasion.
- PDAC alters lipid metabolism, promoting tumor growth, metastasis, and drug resistance.
- The liver is central to lipid metabolism. Disrupting it can restrict PDAC energy supply and inhibit tumor growth.
- Steroid hormones, derived from cholesterol, regulate tumor growth and metabolism. Altering cholesterol levels can impact their biosynthesis and tumor progression.
- Several studies performed in cancer cells reveal that cholesterol synthesis is enhanced compared to normal cells.
- Cholesterol sulfates influence membrane stability, cancer survival, and chemotherapy resistance. Targeting cholesterol sulfate levels may offer therapeutic benefits.

Project Overview

- To investigate the effects of steroid hormones on lipid metabolism in pancreatic cancer tissues. Specifically, we aim to observe how steroid hormones and STX64, a steroid sulfatase inhibitor, influence the accumulation of fat droplets and the amount of cholesterol in the tissue samples.
- We hypothesize that steroid hormones are expected to increase fat droplet buildup and cholesterol levels, while STX64 may reduce or change these effects by blocking steroid sulfatase activity.

Methods

Tumor Implantation, Tissue Collection, and Fixation

- Mice were injected and implanted with tumors.
- Treatment groups: steroid hormone (dissolved in sesame oil) or STX64 (solubilized in polyethylene glycol, dimethyl sulfoxide, and saline).
- Tissues were rapidly frozen at -80°C for preservation.
- Fixed in 4% paraformaldehyde (PFA) for 15 minutes to maintain cellular structure.

Cryosectioning

- Frozen tissues were embedded in an optimal cutting temperature (OCT) compound and frozen with liquid nitrogen.
- Cryostat set to -25°C was used to section tissue into $5\text{ }\mu\text{m}$ slices.
- Sections mounted on poly-L-lysine-coated slides for adhesion and stored at -25°C until imaging.
- Tissues sections were fixed in 4% paraformaldehyde (PFA) for 15 minutes at room temperature to maintain cellular structure.

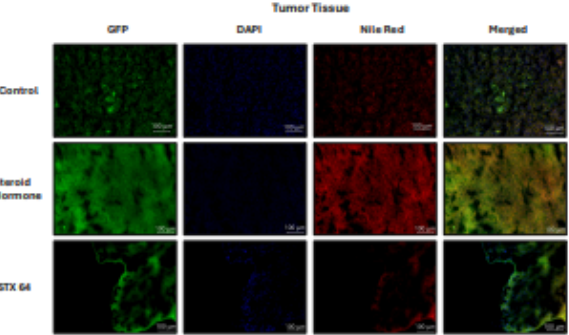
Figure 1: Cryostat Machine

The image here is a cryostat machine that was used to cut thin sections of frozen liver and tumor tissues for staining and imaging. It allowed for a detailed analysis of cellular structures within the samples.

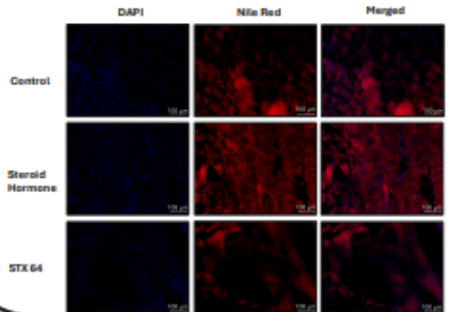


Fluorescent Staining and Imaging

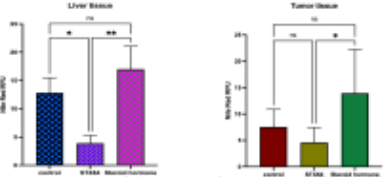
- Lipid distribution and cell structures were analyzed with fluorescence microscopy.
- Nile Red is used to localize and quantitate lipids, particularly neutral lipid droplets within cells, containing TAG and cholesterol esters.
- 4',6-Diamidino-2-phenylindole (DAPI) for cell nuclei visualization.
- Green fluorescent protein (GFP): GFP expressing lentivirus used for specific labeling of cancer cells.
- Slides were imaged using fluorescence microscopy, and Fiji software was used for the fluorescence quantification.



Liver Tissue



Results



- Our analysis shows that steroid hormones increase the Nile Red fluorescence intensity. This suggests an increase in cholesterol and/or fatty acids within the cells.
- Statistical analysis revealed that the difference between the steroid hormone and STX64 treatment is statistically significant ($p < 0.05$) in both cancer and liver tissues. This effect is particularly distinguishable in the liver.
- These results support the hypothesis that steroid hormones promote lipid accumulation, particularly in the liver. The findings align with the idea that lipid metabolism is altered in tumors, but further research is needed to confirm these effects.

Conclusion

- Statistically significant differences were observed between experimental groups ($p < 0.05$), allowing us to reject the null hypothesis.
- Steroid hormones increased fatty acid and cholesterol accumulation in tumors, supporting their role in lipid metabolism and tumor progression.
- STX64 treatment significantly reduced fatty acid content in both tumor and liver tissues, suggesting effective inhibition of lipid metabolism.
- These findings highlight the potential of targeting systemic lipid metabolism—especially through steroid hormone pathways—as a therapeutic strategy in PDAC.
- Given the liver's role in regulating lipid balance, further research is needed to explore how hormonal changes affect metabolism beyond the tumor environment.

References

- Baenke, F., Peck, B., Missa, H., & Schulze, A. (2013). Hooked on fat: The role of lipid synthesis in cancer metabolism and tumor development. *Disease Models & Mechanisms*, 6(6), 1353–1363. <https://journals.biologists.com/dmm/article/6/6/1353/3490/Hooked-on-fat-the-role-of-lipid-synthesis-in>
- Chimento A, Casaburi I, Avena P, Trotta F, De Luca A, Rago V, Pezzi V, Sirlanni R. Cholesterol and its Metabolites in Tumor Growth: Therapeutic Potential of Statins in Cancer Treatment. *Front Endocrinol (Lausanne)*. 2019 Jan 21;9:807.
- Liu, J., Li, D., Zhou, J., et al. (2023). The role of cholesterol metabolism in cancer. *Journal of Translational Medicine*, 21, 121. <https://cancer.biomedcentral.com/articles/10.1186/s12935-023-03138-8>
- Orth, M., Metzger, P., Gerum, S., et al. (2019). Pancreatic ductal adenocarcinoma: Biological hallmarks, current status, and future perspectives of combined modality treatment approaches. *Radiation Oncology*, 14, 141. <https://oncojournal.biomedcentral.com/articles/10.1186/s13014-019-1345-6>
- Pei, Y., Fu, Q., Li, L., et al. (2017). Cholesterol and cancer: From cell biology to pharmacology of metabolism. *Acta Biochimica et Biophysica Sinica*, 49(1), 11–19. <https://www.sciencedirect.com/science/article/pii/S0962892417301022?via=ihIuh>

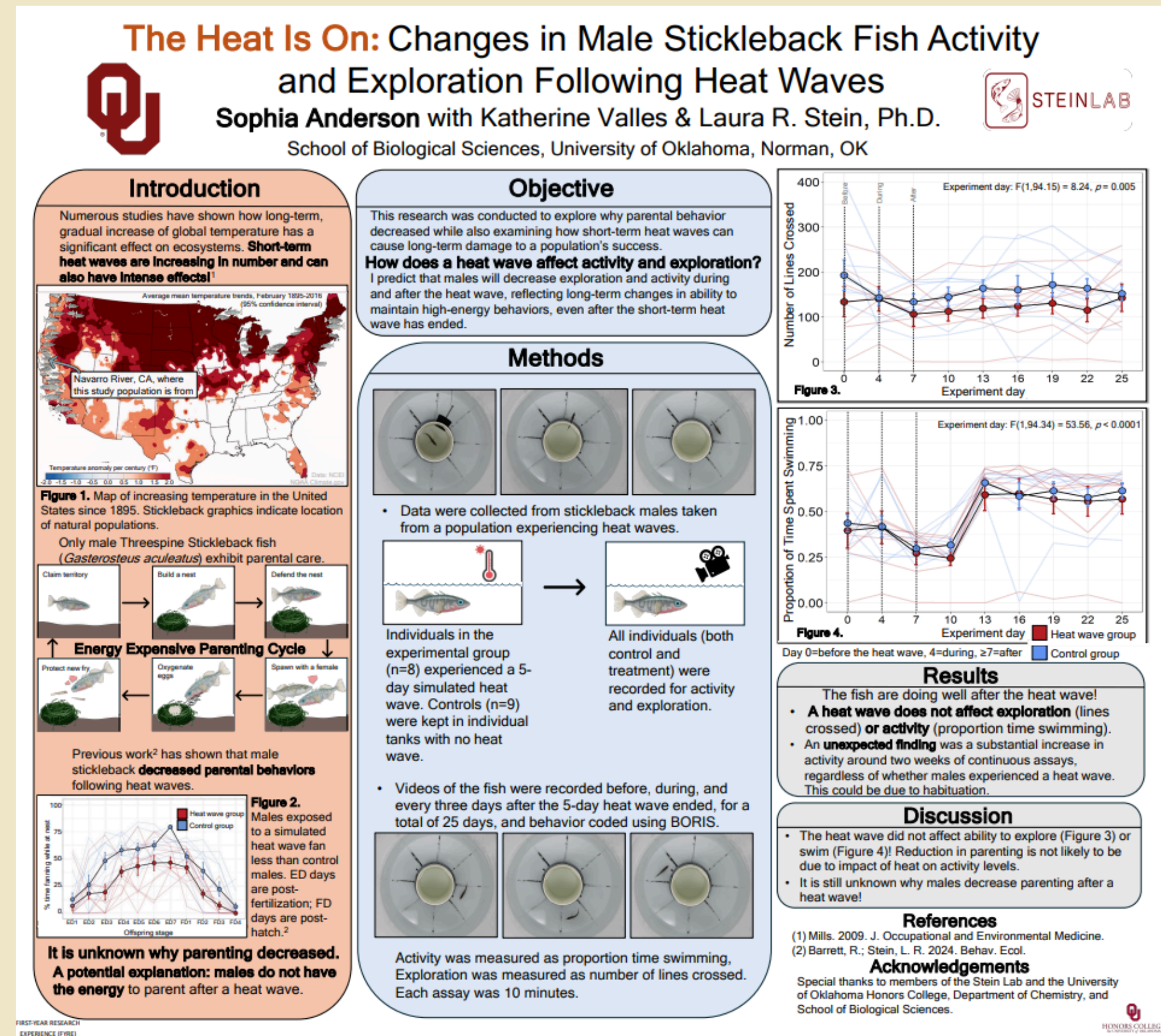
Acknowledgments

- I would like to thank the Department of Oncology Science for the opportunity to conduct the experiments. I would also like to thank Dr. Heather Ketchum and Dr. Miloš Savić for their leadership of the First Year Research Experience (FYRE).

The Heat Is On: Changes in Male Stickleback Fish Activity and Exploration Following Heat Waves

Sophia Anderson with Katherine Valles & Laura R. Stein, Ph.D.

School of Biological Sciences, University of Oklahoma, Norman, OK



Neural Correlates for Divided Attention in Children: Relationships with Behavioral Treatment and Demographic Factors

Sanjana Kota, Brenna Arledge, Lauren Ethridge

Department of Psychology, University of Oklahoma



Neural Correlates for Divided Attention in Children: Relationships with Behavioral Treatment and Demographic Factors

Sanjana Kota, Brenna Arledge, Lauren Ethridge
Department of Psychology, University of Oklahoma

Background

Divided attention is the ability to attend to multiple sources of information simultaneously and is a critical component of cognitive development in childhood. Studies have shown that the neural mechanisms supporting divided attention are still maturing during this period, with potential variability based on both age and gender (Rueda et al., 2005). As children grow older, improvements in cognitive control and attentional flexibility are often accompanied by changes in brain activity, particularly in regions involved in executive function and sensory processing (Casey et al., 2005). Additionally, previous studies suggest that gender differences may influence how attention is allocated and sustained, potentially reflecting both biological and environmental factors (Loe & Feldman, 2007). These developmental and demographic factors can further interact with behavioral interventions, potentially altering the neural pathways involved in attention.

The present study focuses on the neural correlates of divided attention in children using EEG data collected during the Auditory Attention Task (AUDAT) in the CAPS study (Nekkanti et al., 2020) to assess how age, gender, and participation in behavioral treatment relate to neural responses during divided attention.

Methods

- 204 Parent/Child dyads with indication of maltreatment were recruited from Oregon DHS.
 - Sexual abuse cases were excluded and only children 3-8 years old were included.
- Selected dyads were randomly assigned to PCIT treatment group or services as usual control group.
- Parents and children completed the AUDAT to assess attentional control. The AUDAT presented two stories simultaneously, one on each side, and participants were tasked to only listen to one of them.
- Participants listened to four different narratives lasting approximately 2.5 to 3.5 minutes.
- EEG data was collected pre and post PCIT during AUDAT using a 64 channel EGI HydroCel Geodesic Sensor Net with a sampling rate of 500 Hz.
- Event-Related Potentials (ERPs) are recorded to identical 100 ms probes embedded in stories when attended and unattended. Area under the curve (AUC) was calculated during 100-200 ms post stimuli for each trial.
 - Each trial differed in interstimulus intervals (ISI), sounds, and narratives.



Figure 1. AUDAT Paradigm

Results

- A repeated measures ANOVA revealed that interstimulus intervals (ISI) had a significant effect on area under the curve over time ($F(5, 147)=6.941, p<0.001$). Post hoc tests showed significant differences between trials that used 200 and 1000 ms intervals, where 200 ms intervals had larger area under the curve ($t(1, 735)=-3.35, p=0.012$).

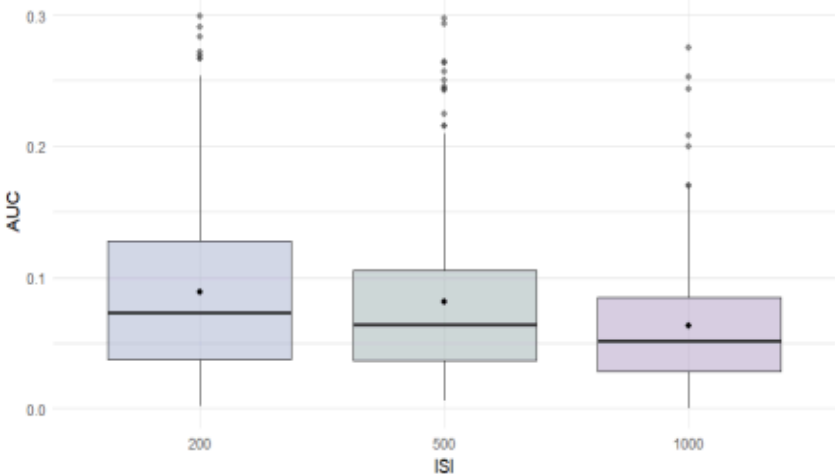


Figure 2. Boxplot of AUC by ISIs. Significant difference is between 200 and 1000 ms ISIs.

- To test for gender and age effects, a linear mixed-effects model was run. A significant effect of age was found ($\chi^2(1) = 5.25, p = .022$), indicating that attend 200 values varied as a function of participant age. Analysis also revealed a significant gender \times age interaction ($\chi^2(1) = 3.93, p = .048$), indicating that the effect of age on attend 200 differed between gender groups.

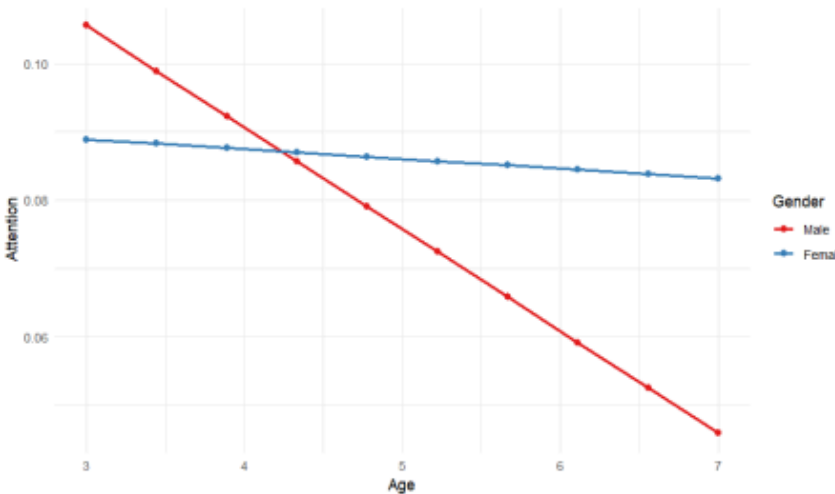


Figure 3. Interaction plot of Gender x Age for the Attend 200 condition.

Discussion

- Results showed that interstimulus intervals, particularly the 200 and 1000 ms intervals, differed significantly in their AUC. The increase in peak amplitude during the trials with 200 ms intervals suggests that the shorter trials may demand participants to engage more and facilitate more attention during the shorter intervals. Previous studies support these findings (Hamada et al., 2003; Wirkström et al. 1996). In addition, prior research has showed that longer ISIs may peak later in comparison to the shorter ISIs (Näätänen et al. 1981).
- Gender and age appear to be a contributing factor in the attend 200 condition, such that as older children exhibited less attention overall. This pattern was particularly strong for males, whereas females had a slight decrease across ages (Loe & Feldman, 2007).
- The results of this study corroborate prior work on ISIs by indicating that there is optimal timing between stimuli. Planned work will be done to assess the latencies of the ISIs to examine if longer ISIs peak in different time ranges.
- The aspect of maltreatment may also have a large and unknown effect on the brain activity of the participants. Additional analysis will be conducted to determine the effect of child maltreatment on these results.

References

1. Casey, B. J., Davidson, M. C., Hara, Y., Thomas, K. M., Martinez, A., Galvan, A., Halperin, J. M., Rodriguez-Aranda, C. E., & Tottenham, N. (2004). Early development of subcortical regions involved in non-cued attention switching. *Developmental Science*, 7(5), 534-542. <https://doi.org/10.1111/j.1467-7687.2004.00377.x>
2. Loe, I. M., & Feldman, H. M. (2007). Academic and Educational Outcomes of Children With ADHD. *Journal of Pediatric Psychology*, 32(6), 643-654. Oxford Academic. <https://doi.org/10.1093/jpepsy/jpl054>
3. Näätänen, R., Gaillard, A. W., & Vaurio, C. A. (1981). Attention effects on auditory EPs as a function of inter-stimulus interval. *Biological psychology*, 13, 173-187. [https://doi.org/10.1016/0301-0511\(81\)90034-x](https://doi.org/10.1016/0301-0511(81)90034-x)
4. Nekkanti, A. K., Jeffries, R., Scholtes, C. M., Shimomae, L., DeBow, K., Norman Wells, J., Lyons, E. R., Giuliano, R. J., Gutierrez, F. J., Woodlee, K. X., Funderburk, B. W., & Skowron, E. A. (2020). Study protocol: The coaching alternative parenting strategies (CAPS) study of parent-child interaction therapy in child welfare families. *Frontiers in Psychiatry*, 11. <https://doi.org/10.3389/fpsyg.2020.00839>
5. Rueda, M. R., Rothbart, M. K., McCandliss, B. D., Saccomanno, L., & Posner, M. I. (2005). From The Cover: Training, maturation, and genetic influences on the development of executive attention. *Proceedings of the National Academy of Sciences*, 102(41), 14931-14936. <https://doi.org/10.1073/pnas.0506897102>
6. Wirkström, H., Huttunen, J., Koverojo, A., Virtanen, J., Salonen, O., Aronen, H., & Ilmoniemi, R. J. (1996). Effects of interstimulus interval on somatosensory evoked magnetic fields (SEFs): a hypothesis concerning SEF generation at the primary sensorimotor cortex. *Electroencephalography and Clinical Neurophysiology/ Evoked Potentials Section*, 100(6), 479-487.

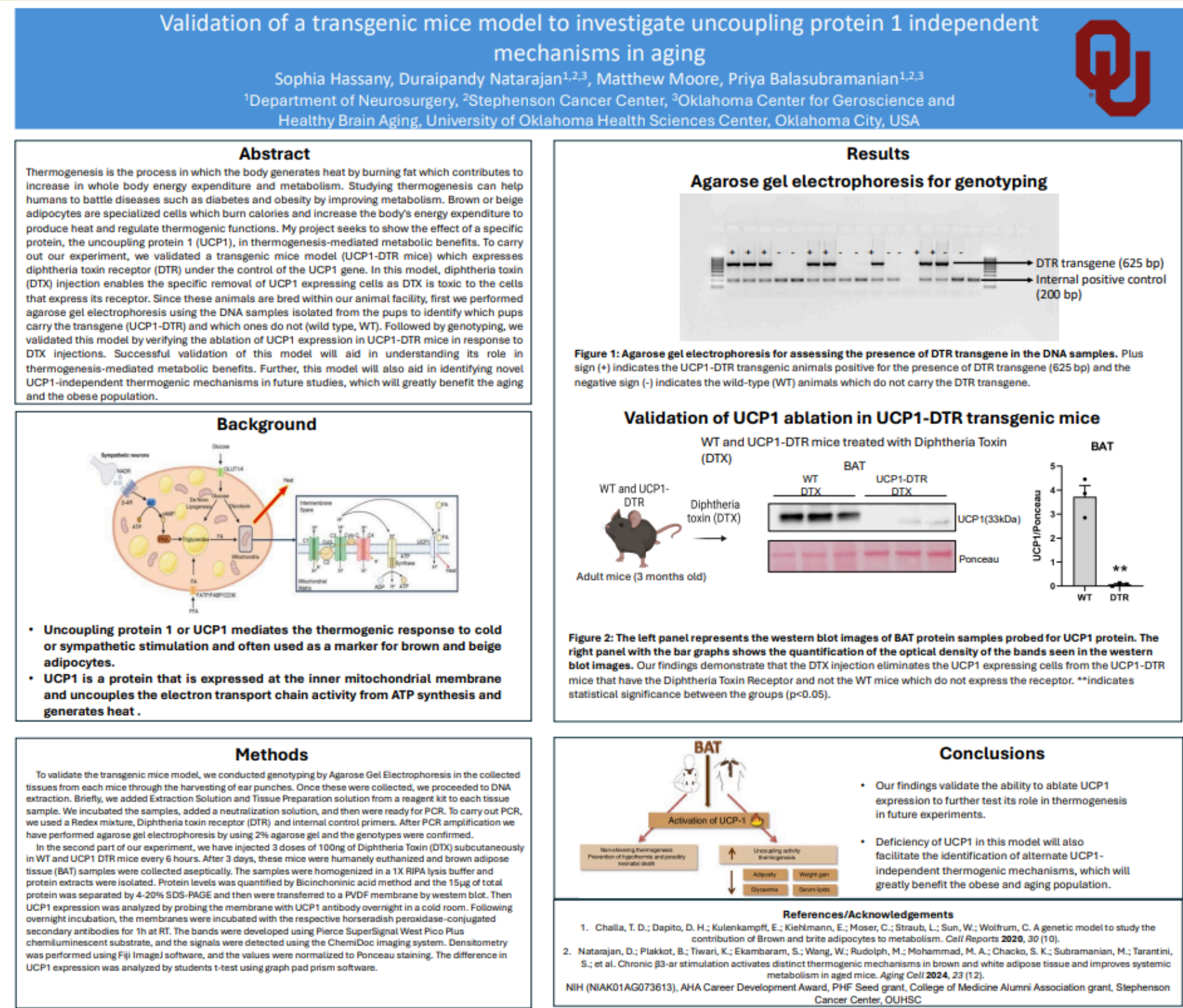
Acknowledgements

We acknowledge the support of the University of Oklahoma Honors College, Department of Psychology, and the Dodge Family College of Arts and Sciences.

Validation of a transgenic mice model to investigate uncoupling protein 1 independent mechanisms in aging

Sophia Hassany, Duraipandy Natarajan, Matthew Moore, Priya Balasubramanian

Department of Neurosurgery, Stephenson Cancer Center, Oklahoma Center for Geroscience and Healthy Brain Aging, University of Oklahoma Health Sciences Center, Oklahoma City, USA



Role of Uncoupling Protein 1 in the Metabolic benefits of Thermogenic Stimulation in Aging

Matthew Moor, Duraipandy Natarajan Ph.D., Priya Balasubramanian Ph.D.

Stephenson Cancer Center, Oklahoma Center for Geroscience and Healthy Brain Aging, Department of Neurosurgery, University of Oklahoma Health Sciences Center

Role of Uncoupling Protein 1 in the Metabolic benefits of Thermogenic Stimulation in Aging



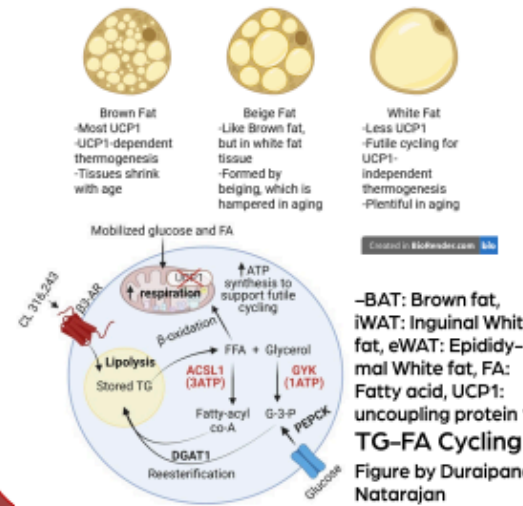
Matthew Moore, Duraipandy Natarajan Ph.D.^{1,2}, Priya Balasubramanian Ph.D.^{1,2*}
Stephenson Cancer Center¹, Oklahoma Center for Geroscience and Healthy Brain Aging, Department of Neurosurgery, University of Oklahoma Health Sciences Center²

Background:

- Previous study by Natarajan et al. investigated effects of β 3-AR stimulation on thermogenesis in aged (18 month-old) mice.
- The study found that β 3-AR stimulation improved glucose metabolism and reduced fat mass of mice mostly due to 2 thermogenesis mechanisms:
 - UCP1-dependent in brown fat.
 - UCP1-independent in white fat, via TG-FA futile cycling
- However, it is unclear which mechanism contributed more to the metabolic benefits.

Important Terms:

–Thermogenesis: the process of increasing energy usage by heat production in the body.



Acknowledgments:

- Dr. Priya Balasubramanian, Dr. Duraipandy Natarajan, and Dr. Sarah Otu-Boakye for their help in making this poster.
- Biorender.com for the diagrams.
- Sofia Hassany, my fellow FYRE student.
- My loving family and friends for their support during tough times



The Big Question:

Which contributed more to overall metabolic benefits: UCP1-dependent, or UCP1-independent thermogenesis?

Results:

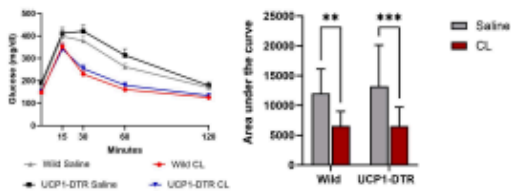


Figure 1: GTT. Left shows blood glucose levels (mg/dL) in mice at each measurement time \pm standard deviation. Mice treated with CL return to baseline blood glucose levels much faster than saline. Right shows the area under the curve (arbitrary units) for the data shown on the left, \pm standard deviation, asterisks indicate statistical significance ($p < 0.05$).

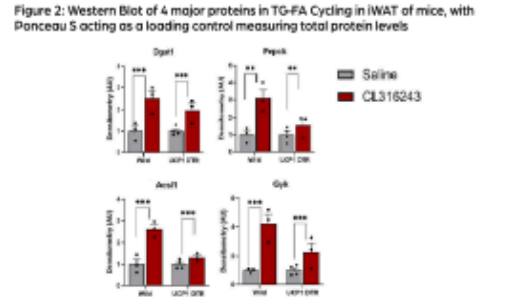
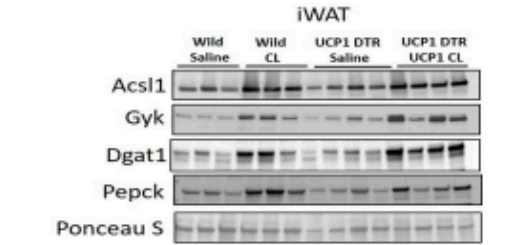
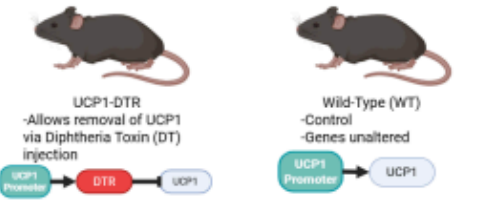


Figure 3: Graphs showing optical density of above Western Blot, normalized to Ponceau 5 standard. \pm standard deviation. Asterisks indicate statistical significance ($p < 0.05$). CL treatment upregulated levels of all 4 major proteins in TG-FA cycling in UCP1-DTR mice, but not as much as in WT mice.

Methods:

- Used UCP1-DTR mouse model to selectively ablate UCP1 expressing cells by diphtheria toxin (DT) injection.
- UCP1 ablation prevents UCP1-dependent thermogenesis in BAT of experimental mice.

Mouse Model



- At 18 months all mice were chronically treated with β 3-AR agonist CL316,243 (CL) or saline for 28 days via osmotic minipump implanted subcutaneously. All mice were injected with DT 3 days before GTT and final tissue collection.
- After 28 days, mice were anesthetized by isoflurane, then perfused with ice cold PBS. BAT, iWAT, eWAT, liver, and brain tissues were then collected.
- For Glucose Tolerance Test (GTT), mice were fasted for 4 hours, injected with 20% glucose solution. Blood glucose measurements taken just prior to injection, and 15, 30, 60, and 120 minutes after.
- Protein extraction and Western Blotting for proteins involved in TG-FA futile cycling were performed as described in previous study by Natarajan et al.

Conclusion:

- UCP1-independent thermogenesis via TG-FA cycling contributes significantly to CL-induced metabolic benefits in aged mice.
- Quite significant, since UCP1-dependent thermogenesis is impaired in aging due to both limited brown fat, and reduced effects of beiging in older populations (Shin et al., 2017).
- Since UCP1-independent thermogenesis mostly occurs in white fat, which is plentiful in aging, this opens up new possibilities for treating age-related metabolic dysfunction.


References:

- Natarajan D, Prakash B, Tiwari K, Ekambaram S, Wang W, Rudolph M, et al. (2024). Chronic β 3-AR stimulation activates distinct thermogenic mechanisms in brown and white adipose tissue and improves systemic metabolism in aged mice. *Aging Cell*, 23:e14321.
- Shin W, Okamoto-Ogura Y, Machida K, Tsubota A, Nio-Kobayashi J, Kimura K (2017). Impaired adrenergic agonist-dependent beige adipocyte induction in aged mice. *Obesity*, 25:417–423.


Characterizing Cancer Cells to be Targeted with Gas Vesicles

Isabel Harlan, Sangpil Yoon, Syndey
Turner

Honors College, School of Electrical and
Computer Engineering, The University
of Oklahoma



Characterizing Cancer Cells to be Targeted with Gas Vesicles



Isabel Harlan₁, Sangpil Yoon₂, Syndey Turner₃

₁Honors College,₂School of Electrical and Computer Engineering,₃The University of Oklahoma

Introduction

Cancer Imaging and the Role of Ultrasound-

- Early and accurate cancer detection is critical to improve patient outcomes
- Traditional imaging like MRI, PET are expensive or invasive^[1]
- Ultrasounds are safe, inexpensive, and widely available but limited in molecular specificity
- The Yoon Lab develops molecular ultrasound imaging using engineered contrast agents to overcome this^[2]

What Are Gas Vesicles (GVs)?

- GV's are gas-filled protein nanostructures made by microbes
- Their air-filled core reflects ultrasounds, making them ideal as contrast agents
- GV's can be engineered and functionalized, unlike microbubbles^[3]
- Compared to standard agents, GV's are smaller, more stable, and biocompatible

Why Use Targeted Antibodies?

- Many cancer types express unique surface proteins
- Antibodies allow us to target GV's directly to these proteins, enabling highly specific imaging

Why our Specific Antibodies?

- PD-L1 indicates immune evasion and can be upregulated with IFN-γ treatment^[4]
- E-cadherin/N-cadherin expression changes during EMT, a process linked to metastasis^[5]
- These markers help distinguish cancer subtypes and progression stages

Gas Vesicle Preparation & Imaging

- Gas vesicles (GVs) were isolated from *Anabaena flos-aquae*.
- Imaging was performed before lysis (Fig. 4), after lysis (Fig. 5), and after separation (Fig. 6).
- A titration-based separation was used to allow GV's to float via buoyancy.
- GV's were prepared for conjugation using EDC chemistry (performed by lab personnel).
- Ultrasound imaging was later used to assess GV signals at different purification stages.

Mystery Cell Characterization via IF

- Three unknown cancer cell lines were plated and stained with antibodies targeting HER2, PD-L1, and TROP2.
- Fluorescence microscopy revealed distinct expression patterns:
- Mystery 1 (HER2+): Strong red signal (Fig. 10)
- Mystery 2 (PD-L1+): Very faint red signal (Fig. 11)
- Mystery 3 (TROP2+): Moderate red signal (Fig. 12)
- Based on staining intensity and flow cytometry (Fig. 13), I believe the mystery cells were matched to SK-BR-3, EO771, and MCF7, respectively.

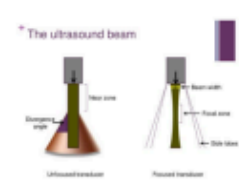


Figure 1. Comparison of unfocused and focused ultrasound beams showing divergence angle, near zone, and focal regions.^[6]

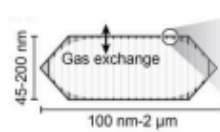


Figure 2. Schematic of a gas vesicle showing size, gas-permeable shell, and hydrophobic core.^[7]

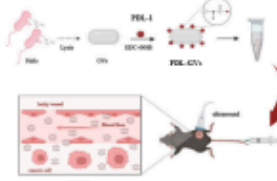


Figure 3. Overview of gas vesicle preparation and targeted ultrasound imaging.^[8]

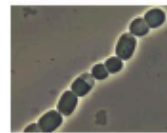


Figure 4. Intact *Anabaena* filament (pre-lysis)




Figure 5. A GV post lyse / pre-purification

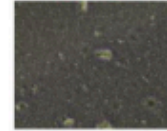


Figure 6. Post-lysis and post-purification vesicles

Protein Detection in EO771 Cells

- EO771 cells were cultured to ~80% confluency and monitored with phase contrast.
- Protein expression was assessed with western blotting and immunofluorescence (IF).
- Anti-PD-L1 antibodies were used to confirm expression (Fig. 7).
- Western blotting showed faint bands consistent with PD-L1 or HER2 (Fig. 8), though image quality was limited.

Protein Detection in EO771 Cells

- Cells were transfected with fluorescent constructs: mCherry (red), mNeon (green), and CFP-YFP.
- Expression patterns confirmed successful transfection in a subset of cells under fluorescence microscopy (Fig. 9).

Conclusion


- Learned foundational lab skills in cell culturing, protein detection, and phase contrast imaging.
- Successfully performed western blotting and immunofluorescence (IF) to detect PD-L1 and other cancer-related markers.
- Identified unknown breast cancer cell lines using antibody-specific IF staining (HER2, PD-L1, TROP2).
- Tracked gas vesicle (GV) purification through lysis and titration steps; visualized under phase contrast microscopy.
- Each technique practiced supports the Yoon Lab's broader goal: developing targeted ultrasound contrast agents for precise cancer imaging.
- Results correspond with known expression patterns in EO771, SK-BR-3, and MCF7 cells and introduce me to real-world translational workflows in molecular imaging.

References

1. Hlatky, R., et al. (2018). Early diagnosis of cancer: The role of liquid biopsy. *Nature Reviews Clinical Oncology*, 14(1), 1-15.
2. Yoon, S., et al. (2020). Molecular Ultrasound Imaging of Breast Cancer Metastases. *AIP Advances*, 10(10), 105101.
3. Yoon, S., et al. (2021). Ultrasound-guided drug delivery using gas vesicles. *Journal of Controlled Release*, 330, 1-10.
4. Chen, L., et al. (2019). PD-L1 expression in tumor cells: Correlation with response to anti-PD-L1 antibody therapy. *Clinical Cancer Research*, 25(18), 5366-5375.
5. Kalluri, M., et al. (2004). The epithelial-mesenchymal transition occurs in breast cancer and promotes invasion. *Nature Medicine*, 10(11), 1179-1184.
6. Yoon, S., et al. (2020). Ultrasound-guided drug delivery using gas vesicles. *Journal of Controlled Release*, 330, 1-10.
7. Yoon, S., et al. (2021). Ultrasound-guided drug delivery using gas vesicles. *Journal of Controlled Release*, 330, 1-10.
8. Yoon, S., et al. (2020). Ultrasound-guided drug delivery using gas vesicles. *Journal of Controlled Release*, 330, 1-10.
9. Yoon, S., et al. (2021). Ultrasound-guided drug delivery using gas vesicles. *Journal of Controlled Release*, 330, 1-10.

Acknowledgments

I would like to thank the FYRE Program for providing this research opportunity and continued support throughout the semester. Special thanks to Sydney Turner for her guidance and mentorship in the lab, and to Dr. Yoon for leading such innovative work in molecular ultrasound imaging and welcoming me into the lab team.

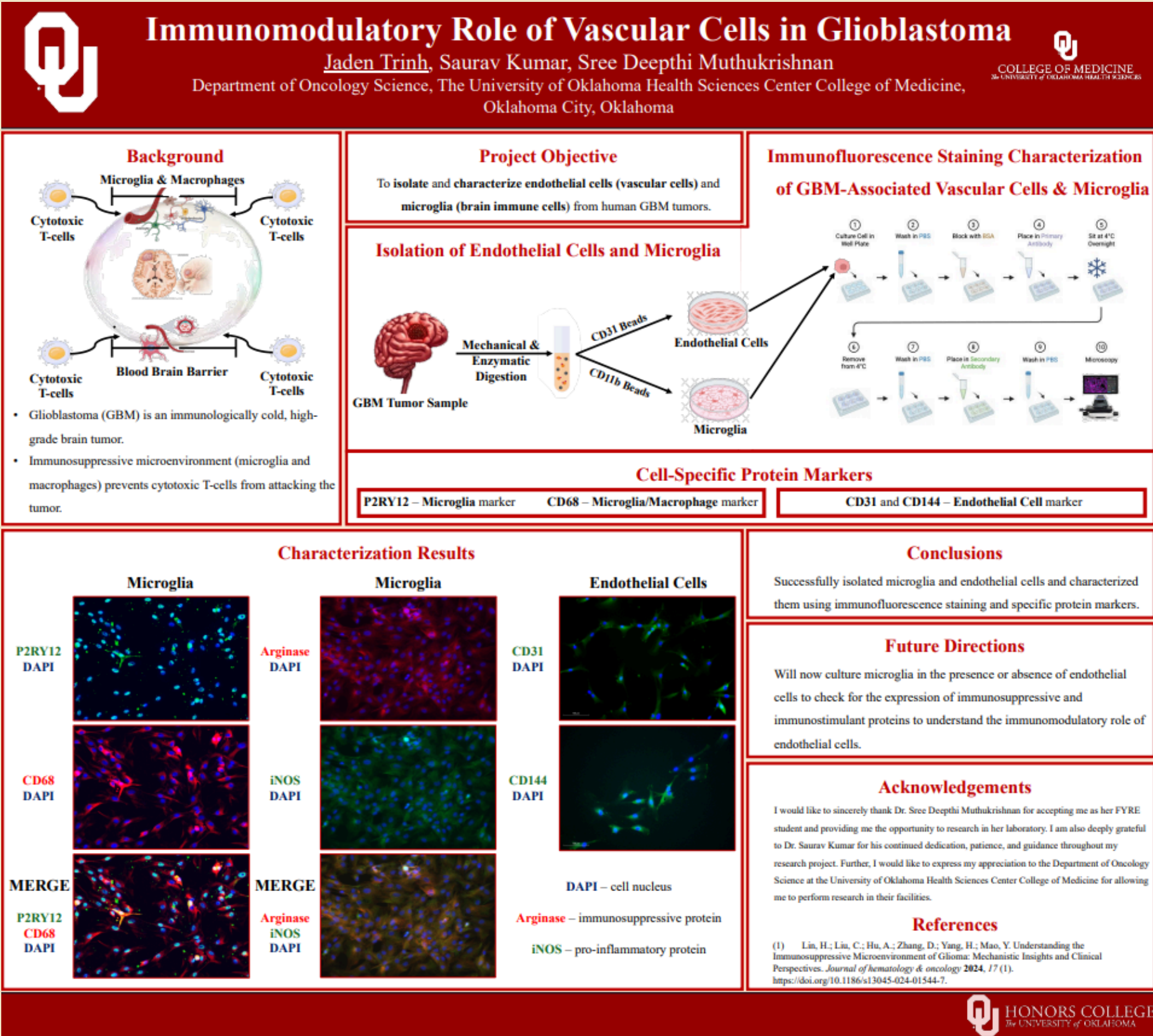


HONORS COLLEGE
UNIVERSITY OF OKLAHOMA

Immunomodulatory Role of Vascular Cells in Glioblastoma

Jaden Trinh, Saurav Kumar, Sree Deepthi Muthukrishnan

Department of Oncology Science, The University of Oklahoma Health Sciences Center College of Medicine, Oklahoma City, Oklahoma



Constructing overexpression of wild type TtcA plasmid

Nate Rouse, Hang Zhou, Valentin V. Rybenkov

Department of Chemistry and Biochemistry, University of Oklahoma

Constructing overexpression of wild type TtcA plasmid

Nate Rouse, Hang Zhou, Valentin V. Rybenkov
Department of Chemistry and Biochemistry, University of Oklahoma



Introduction

- We have found a certain gene, TtcA, that is resistant to PAMA, a potential antibacterial agent
- Plasmids are circular pieces of DNA in which we can modify and insert into bacteria such as E. coli to analyze the effects they have
- Overexpression allows us to increase the production of certain proteins within bacteria

Primary Objective

- To successfully create a recombinant plasmid in which the TtcA gene is inserted through purification, restrictive digestion, and Gibson assembly.
- To insert the recombinant plasmid into E. coli DH5a cells
- To construct overexpression to produce TtcA proteins in large amounts in the E. coli DH5a cells.

Procedure

- Prepare E.coli BW25113 genomic DNA by bacterial genomic DNA kit
- PCR amplify TtcA gene using primers OPA 1012 and OPA1013 by Phusion polymerase
- Prepare plasmid pBAD by GeneJet plasmid Miniprep kit
- Restriction digestion pBAD plasmid by PacI and NcoI
- Clean products from step 2 and step 4 by PCR DNA purification kit
- Gibson assembly product from step 4 by GeneArt Gibson HiFi Kit
- Transform to E.coli DH5α competent cells
- Pick positive transforms and confirm result by restriction digestion.

Results

Confirmation of Genomic DNA



Plasmid pBAD Purification

	ng/μl	A 260/280 (1.8-2.0)	A 260/230 (2.0-2.2)
pBAD 1 (trial 1)	5.2	2.30	2.06
pBAD 2 (trial 1)	4.2	2.56	1.76
pBAD 1 (trial 2)	74.0	1.9	1.86

Future Work

- Once we have confirmed the insertion of the recombinant plasmid into E. coli DH5a cells, we can continue research on the effects of increased TtcA proteins in bacteria.

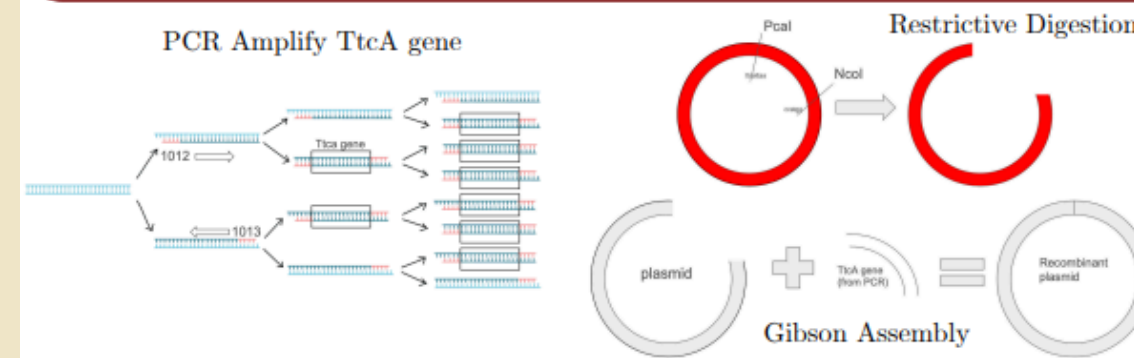
Acknowledgements

- Hang Zhou, Research Assistant Professor
- Valentin V. Rybenkov, Research Mentor
- Honors College/FYRE Program

References

Khan Academy, Khan Academy, www.khanacademy.org/science/ap-biology/gene-expression-and-regulation/biotechnology/a/polymerase-chain-reaction-per. Accessed 17 Apr. 2025.


Overview



Cloning of Mutant Ttca Gene

Isabella Kunnath, Hang Zhao, Valentin V. Rybenkov

Department of Chemistry and Biochemistry, University of Oklahoma



The UNIVERSITY of OKLAHOMA

Cloning of Mutant Ttca Gene

Isabella Kunnath, Hang Zhao, Valentin V. Rybenkov

Department of Chemistry and Biochemistry, University of Oklahoma

Introduction

Currently, there is an urgent need for new drugs. PAMA is a new potential antibacterial agent. We have found a combination of gene mutations that are super resistant to PAMA; Ttca is one of the genes where some of the mutation is found (Zhao et al., 2018) We plan to test Ttca interactions with PAMA. As of now, we have started the process of cloning the mutant Ttca gene.

Project Objective

- To construct clones of the mutant Ttca gene
- Long term Goal: To see if Ttca gene is directly involved in interactions with PAMA or not

Methods

- Genomic DNA encodes for Ttca gene and plasmid is used for DNA insertion
- Mutation is added to the gene through primer and restriction enzymes are added to plasmid
- End Result: multiple copies of mutated Ttca gene

Experiment

- Prepare E.coli BW25113 genomic DNA by bacterial genomic DNA kit
- PCR amplify Ttca gene using primers OPA 1025 and OPA1026 by Phusion polymerase, genomic DNA as template
- Clean product from step 2 by PCR DNA purification kit
- PCR amplify Ttca gene with flanking parts using primers OPA 1027 and OPA1028 by Phusion polymerase, product from step 3 as template
- Prepare plasmid pBAD by GeneJet plasmid Miniprep kit
- Restriction digestion pBAD plasmid by PaeI and NcoI
- Clean product from step 4 and step 6 by PCR DNA purification kit
- Gibson assembly product from step 7 by GeneArt Gibson HiFi Kit
- Transform to E.coli DH5α competent cells
- Pick positive transforms and prepare plasmid, sequencing the result

Results

A. Genomic DNA

B. PCR1

C. PCR2

D. Plate 1: Experimental group, with the Gibson Assembly product, 1 colony present
Plate 2: Positive control, with pBAD plasmid
Plate 3: Negative control, with competent cells only

Purified Samples	ng/ul	A260/A280	A260/A230
PCR2 L1+L2	15.6	1.93	0.05
PCR2 L3+L4	11.6	1.8	0.28
Plasmid	9.5	1.78	0.23

Future Application

- We are developing a small molecule drug
- We want to see if Ttca mutation causes resistance to PAMA.

Acknowledgements

Would like to acknowledge:

- Hang Zhao- Research Assistant Professor
- Valentin V. Rybenkov- Research Mentor
- Honors College/FYRE Program and Mentors

References

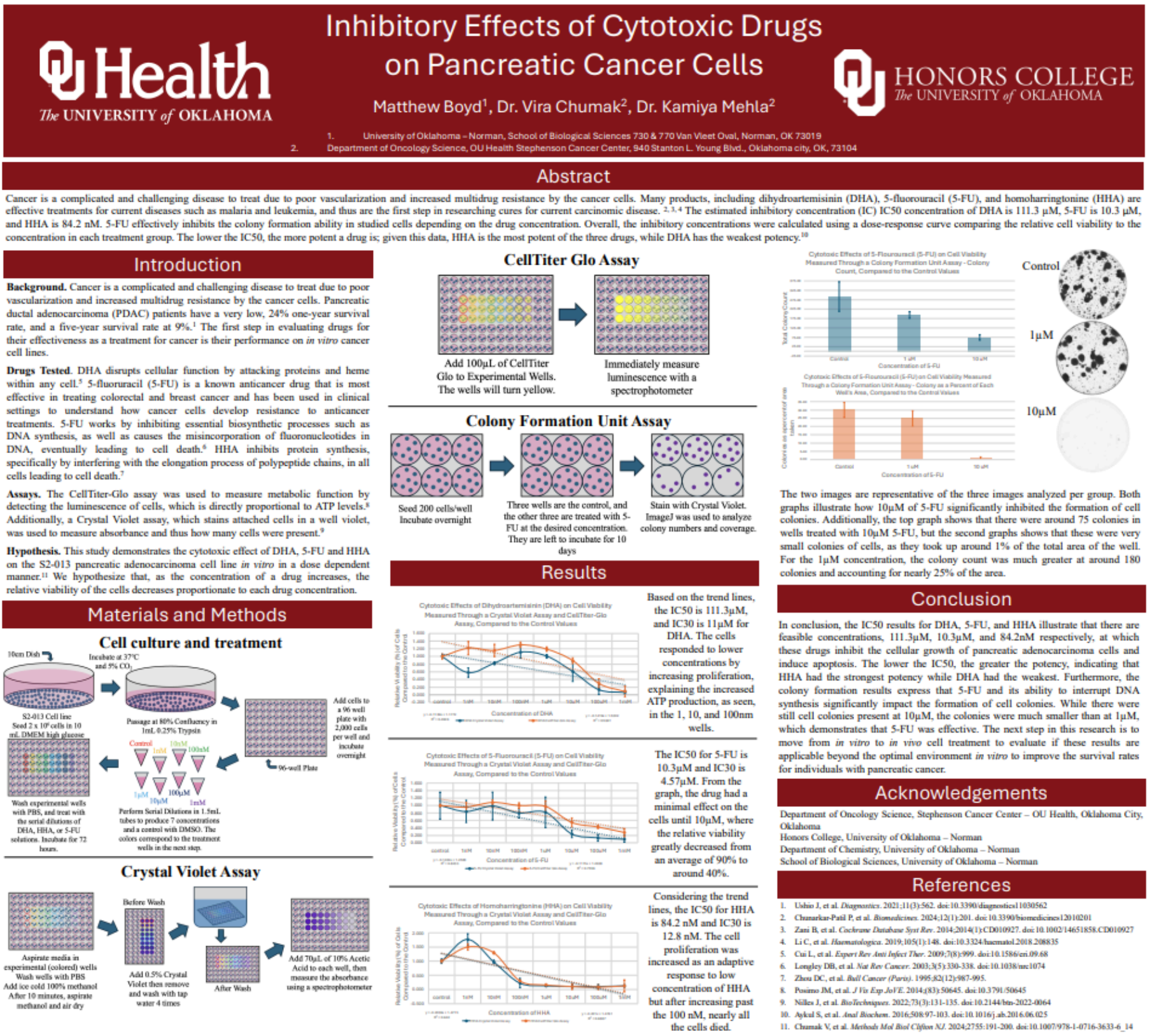
Zhao, H., Petrushenko, Z. M., Walker, J. K., Baudry, J., Zgurskaya, H. I., & Rybenkov, V. V. (2018). Small Molecule Condensin Inhibitors. ACS infectious diseases, 4(12), 1737–1745. <https://doi.org/10.1021/acsinfedis.8b00222>

Inhibitory Effects of Cytotoxic Drugs on Pancreatic Cancer Cells

Matthew Boyd, Dr. Vira Chumak, Dr. Kamiya Mehla

University of Oklahoma – Norman,
School of Biological Sciences 730 & 770
Van Vleet Oval, Norman, OK 73019

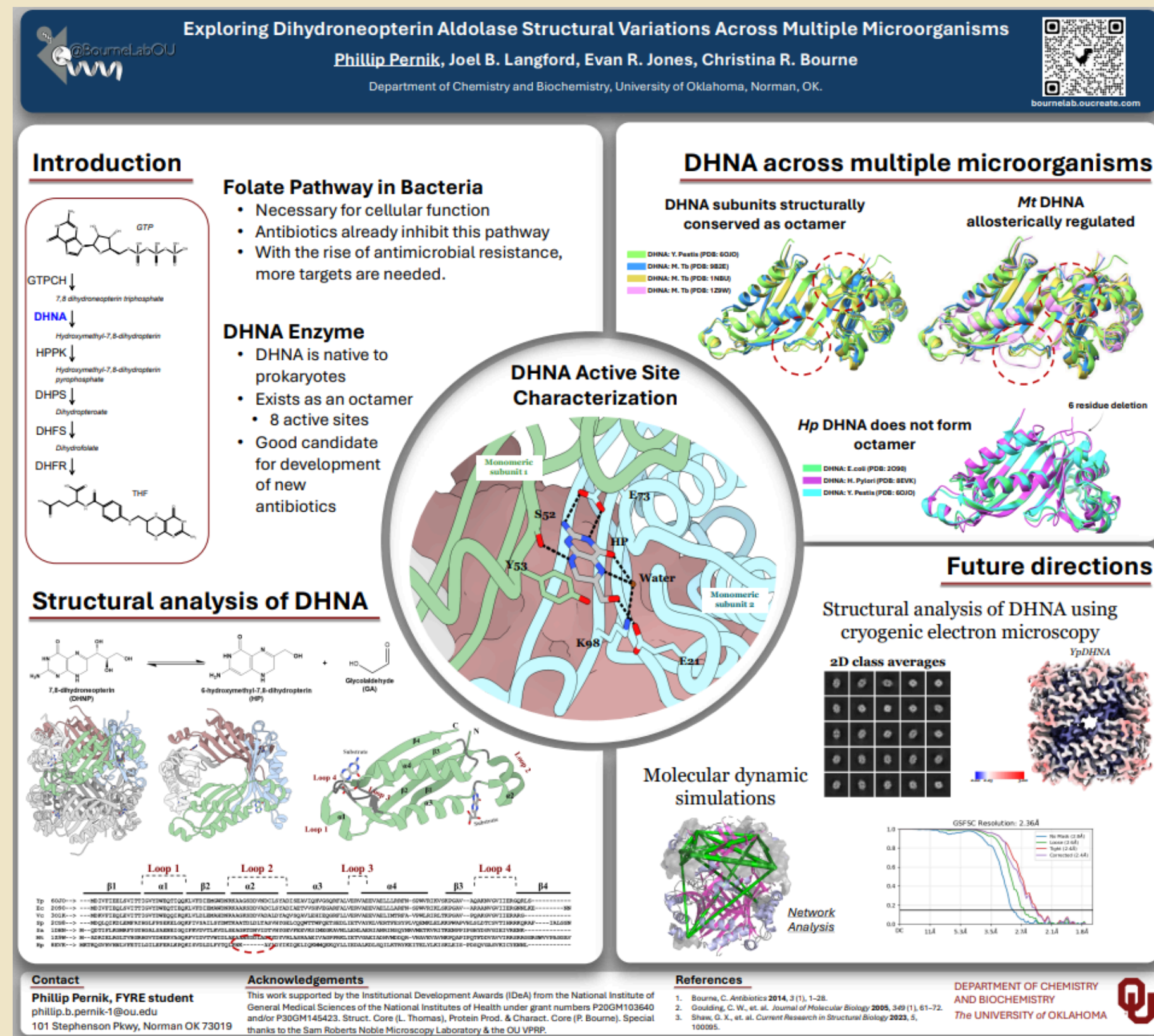
Department of Oncology Science, OU
Health Stephenson Cancer Center, 940
Stanton L. Young Blvd., Oklahoma city,
OK, 73104



Exploring Dihydroneopterin Aldolase Structural Variations Across Multiple Microorganisms

Phillip Pernik, Joel B. Langford, Evan R. Jones, Christina R. Bourne


Department of Chemistry and Biochemistry, University of Oklahoma, Norman, OK



Native vs Denaturing Mass Spectrometry Analysis of Proteins

Rory E. Polson, Cynthia Nagy, Luca Fornelli,

Fornelli Lab, School of Biological Sciences, University of Oklahoma, OK
Fornelli Lab, Department of Chemistry and Biochemistry, University of Oklahoma, OK



DODGE FAMILY COLLEGE OF ARTS AND SCIENCES
DEPARTMENT OF CHEMISTRY
AND BIOCHEMISTRY
The UNIVERSITY of OKLAHOMA

Native vs Denaturing Mass Spectrometry Analysis of Proteins

Rory E. Polson¹, Cynthia Nagy¹, Luca Fornelli^{1,2}
¹Fornelli Lab, School of Biological Sciences, University of Oklahoma, OK
²Fornelli Lab, Department of Chemistry and Biochemistry, University of Oklahoma, OK

DODGE FAMILY COLLEGE OF ARTS AND SCIENCES
SCHOOL OF BIOLOGICAL SCIENCES
The UNIVERSITY of OKLAHOMA

Background and Motivation

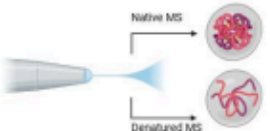


Fig. 1 – Native and denaturing electrospray (ESI). Native ESI allows the preservation of the tertiary and quaternary structure of proteins/protein complexes. (Figure created with BioRender)

Denaturing Mass Spectrometry (dMS) generally involves the use of acidic solvents having high organic content (e.g., methanol). Such conditions unfold the structure of protein species, hence valuable higher-order information is lost¹. **Native Mass Spectrometry (nMS)** applies conditions that allow the native folded structure of biomolecules to be retained. As such, it enables the study of a variety of macromolecular assemblies, providing information on topology, or non-covalently bound ligands, cofactors, from which biologically relevant insights can be gathered². **Our objective** was to perform gas-phase sequencing of myoglobin (Mw ~ 17 kDa) to confirm the presence and location of the heme group – a task not possible using generic denaturing environment during MS analysis.

Materials

The clean-up of myoglobin standard was performed with 7K MWCO Zeba™ spin columns (Thermo Scientific). Sample background was acetonitrile:water = 1:1 + 0.1 % formic acid for denaturing, and 150 mM ammonium acetate (pH 7.0) for native mode analysis. Samples were directly infused into an Orbitrap Eclipse™ Tribrid™ mass spectrometer using a Nanoflex ESI source (Thermo Scientific). Borosilicate emitters were pulled using the Sutter P-1000 Micropipette Puller and coated with Au-Pd alloy using a sputter coater.

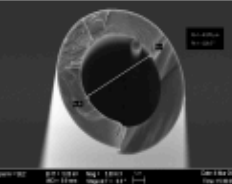


Fig. 2 – Scanning electron microscopy (SEM) image of an emitter tip (id.: 6.576 μm).

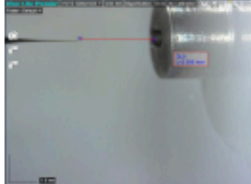


Fig. 3 – Positioning the emitter in front of MS inlet for performing nanoESI.

Results

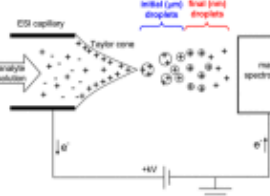


Fig. 4 – The ESI process³. A fine mist of droplets is emitted from the Taylor-cone. These droplets undergo repeated evaporation/fission events until gaseous analyte ions are generated.

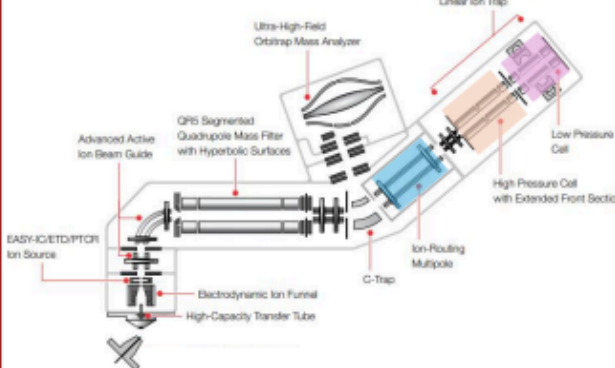


Fig. 5 – Schematics of the Orbitrap Eclipse Tribrid MS. Compartments where ion activation took place are highlighted with different colors. Color codes: blue – HCD; orange – CID; purple – UVPD. Generated fragment ions were directed into the Orbitrap mass analyzer for detection.

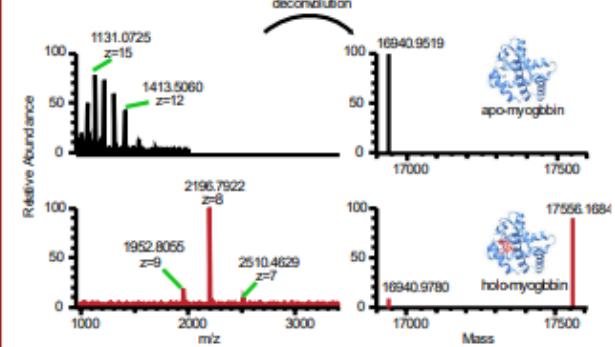


Fig. 6 – Raw and deconvolved (zero-charge) mass spectra of myoglobin. Top: spectrum acquired in denaturing mode. Bottom: native MS spectrum.

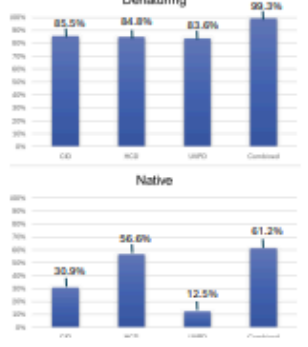


Fig. 7 – Combined fragmentation maps of myoglobin in native mode using HCD, CID and UVPD. Top: harsher ion activation (HCD and CID NCE 33-42 %). Bottom: milder ion activation (HCD and CID NCE 27%, UVPD reaction time 50 ms). Heme cofactor is attached to histidine residue highlighted in yellow (UniProt #P68082). Red circles indicate cleavage sites that produced fragments carrying the cofactor.

Fig. 8 – Sequence coverages obtained with different ion activation methods.

Future Directions

Submicron emitters can significantly improve the quality of native mass spectra due to decreased salt adduction⁴. Plans include developing a reproducible method for creating nanoscale emitters. Use of submicron emitters can be exceptionally useful when extending our study to larger protein complexes, e.g., hexameric enzyme glutamate dehydrogenase (~ 320 kDa).

Acknowledgements

The study was supported by the research grant number R35GM147397 awarded by the National Institute of General Medical Sciences of the National Institutes of Health to L.F. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

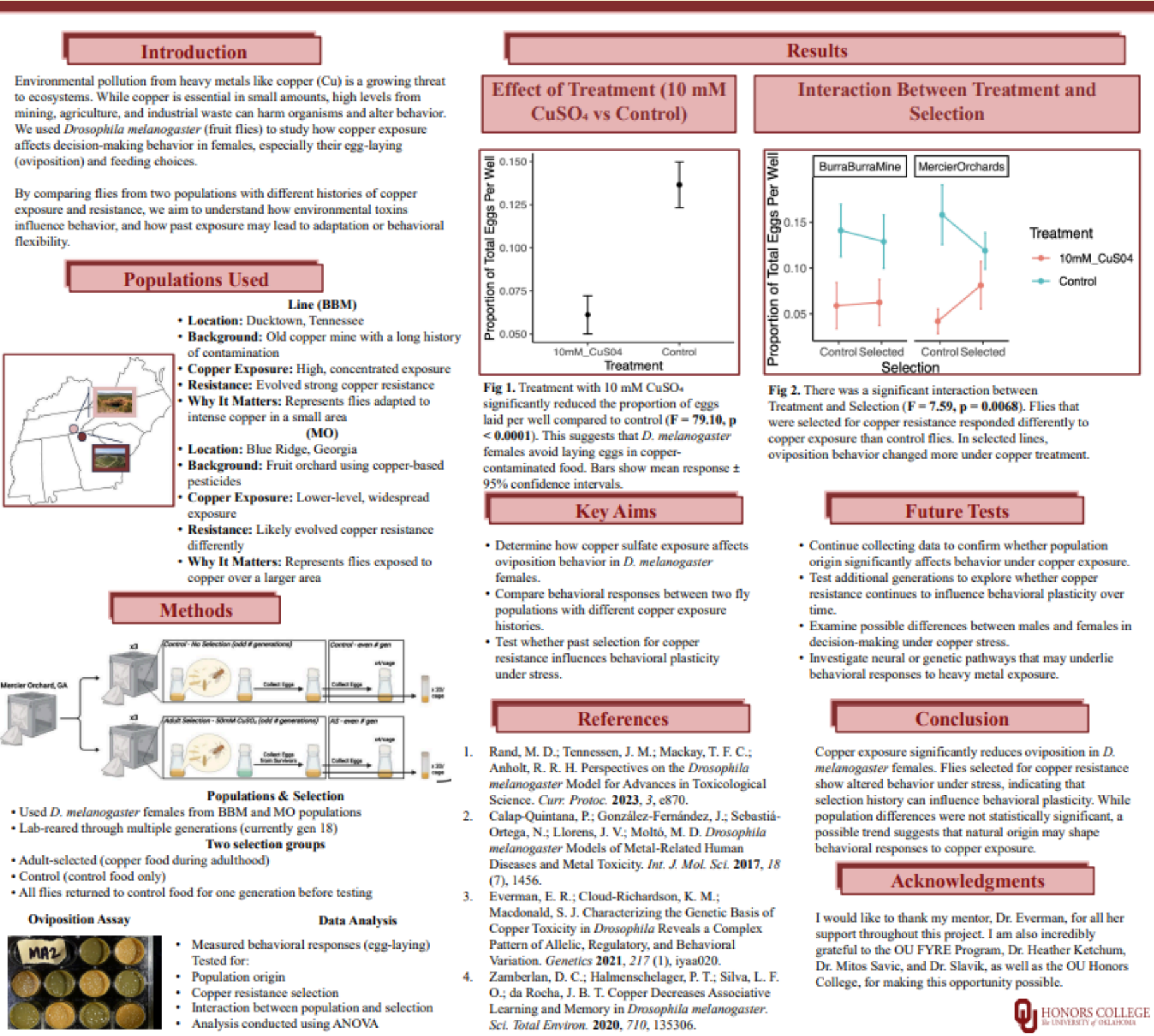
References

[1] F. Lemmle, Y. O. Taylin, P. B. O'Connor, J. A. Loo. Top or Middle? Up or Down? Toward a Standard Lexicon for Protein Top-Down and Allied Mass Spectrometry Approaches. *JASMS*, (2019) 30, 1149–57. <https://doi.org/10.1007/s13361-019-02201-x>
[2] A.C. Laney, A.J.R. Heck. Native Mass Spectrometry: What is in the Name? *JASMS*, (2017) 28, 5–13. <https://doi.org/10.1007/s13361-016-1545-3>
[3] Lars Konermann, Elias Ahadi, Antony D. Rodriguez, Siavash Vahidi. Unraveling the Mechanism of Electrospray Ionization. *ACS Anal. Chem.* (2013) 85, 1, 2–9. <https://doi.org/10.1021/acs.202789c>
[4] G.T.H. Nguyen, T.N. Tran, M.N. Podgorski, S.G. Bell, C.T. Suprun, W.A. Donald. Nanoscale Ion Emitters in Native Mass Spectrometry for Measuring Ligand-Protein Binding Affinities. *ACS Cent. Sci.* (2019) 5, 308–318. <https://doi.org/10.1021/acscentsci.8b00787>

Effects of Copper on Decision-Making Behavior in *Drosophila melanogaster* Females

Anna Akula, Elizabeth Everman

Honors College, The University of Oklahoma, Norman, Oklahoma 7301, First-Year Research Experience (FYRE), School of Biological Sciences



CeMBio Microbial Affect on Population Growth and Behavior of *C. inopinata*

Nicole Estrada

School of Biological Sciences, University of Oklahoma

CeMBio Microbial Affect on Population Growth and Behavior of *C. inopinata*

Nicole Estrada
School of Biological Sciences, University of Oklahoma

The Experiment

Meet the Participants

For this experiment, we used nematodes as our experimental subjects. Nematodes share approximately 81.3% of the human genome and are excellent lab subjects due to their easy handling, rapid reproduction rate, price, and low maintenance.¹ In our study, we used the species *C. inopinata* to conduct our experiment and thus, we were able to easily manipulate its environment by controlling temperature, bacterial strain, incubation time, etc.




Figure 1. *C. inopinata* under microscope.
<https://www.eurekalert.org/multimedia/062710>




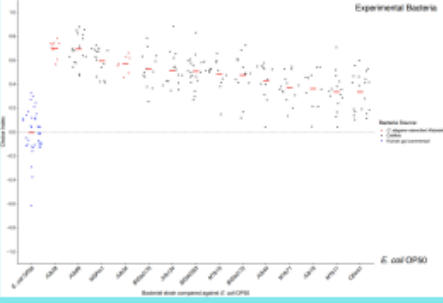
Figure 2. *C. inopinata*'s primary habitat: figs.
<https://www.mithrasianmag.com/science-nature/california-search-for-ultimate-wild-fig-habit-up-18097953/>

Purpose

Food is perhaps the most essential aspect of an animal's existence. Without it, it is impossible to grow or reproduce. The broader purpose of this study is to explore the biological and genetic factors that drive species, specifically *C. inopinata*, to choose their food. Focusing on observing whether *C. inopinata* displays preference for certain bacterial strains and the possible reasons why, this study also was designed to investigate differences in behavior compared to its close relative, *C. elegans*.

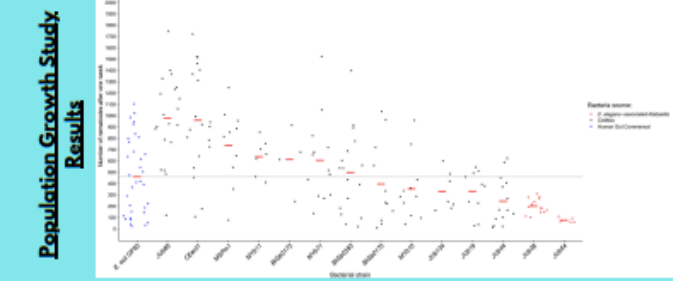
Results

Behavior Study Results



Behavior Study Results

Population Growth Study Results



Population Growth Study Results

Methods

Population Growth Study

Nematode embryos of *C. inopinata* were obtained from stock populations kept at 25 degrees Celsius through a procedure called "bleaching." After performing crosses (4 adult males and 1 larval stage 4 female) and letting the nematodes reproduce for a period of seven days, each plate was observed under a microscope to count the number of total nematodes on the plate after one week. This is what we plotted in our population growth figure. Each dot is the number of worms on a single plate (resulting from a single cross) after a week of population growth when reared on a given bacterial isolate. We only have population growth for *C. inopinata* on all the CeMBio strains, none of the fig bacteria.

Behavior Study

After nematode embryos of both species (*C. inopinata* and *C. elegans*) were obtained by the "bleaching" process, the embryos were placed in the center of agar plates seeded with two choices of bacteria, each lawn the same distance from where the embryos were placed and on opposite ends of the plate. One lawn was the control, *E. coli*; the other lawn was the experimental bacteria. For the experimental bacteria, we used 12 strains from the CeMBio collection, a group of bacterial isolates associated with *C. elegans*; additionally, we used 7 fig bacterial isolates (isolated by the Woodruff lab) that are associated with the natural environment of *C. inopinata*. As a further control, we used plates with both the experimental and control lawns being *E. coli*. After a period of twelve hours, we counted the worms in each environment: the experimental bacteria, the control (*E. coli*), and not on either lawn. We only measured choice with the CeMBio bacteria. The fig bacteria data shown is only with *C. inopinata*.

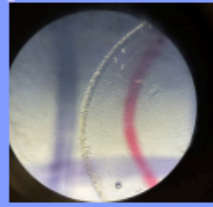


Figure 3. Zoomed in Behavior Plate

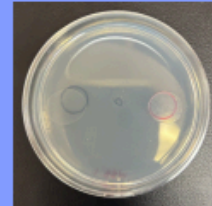


Figure 4. Behavior Study Plate

Analysis & Discussion


The results of the behavior study show that *C. inopinata* displayed a **significant preference for CeMBio bacterial strains** over the control *E. coli* strain. However, the population growth study observed that only 7 out of the 14 CeMBio strains yielded a higher population size than the control, and the other 7 yielded a lower population size than the control. Therefore, the preference of *C. inopinata* is unlikely attributed to boosts their population sizes. Statistically, the p-values of the behavior study were all shown to be significant when run through ANOVA. However, population growth study was only found to be significant for strains JuB66 and CEent1.

Next Steps

- Observe whether *C. inopinata*'s preference or CeMBio bacteria arises genetically (is there a specific gene that codes for it?).
- Investigate if there is a biological phenotype in *C. inopinata* that draws it to CeMBio strains (protein detection, smell, etc.).
- Explore the relationship between the genetics of the CeMBio bacteria and *C. inopinata*: are there aspects in both that spawn this preference?

Austin Link
Gavin Woodruff, Ph.D
Fig Worm Lab
Colleagues

Acknowledgments



School of Biological Sciences | The University of Oklahoma

References

1. Kawahara, Kazuma, et al. "Differentially Expressed Genes Associated with Body Size Changes and Transposable Element Insertions between *Caenorhabditis elegans* and Its Sister Species, *Caenorhabditis inopinata*." *Genome Biology and Evolution*, Vol. 15, Iss. 4, Apr. 2023. <https://doi.org/10.1093/gbe/evad063>

Fig Worm Laboratory, School of
Biological Sciences, University of
Oklahoma, OK



HONORS COLLEGE
The UNIVERSITY of OKLAHOMA

Artificial Selection of Lifespan in Obligate Outcrossing Nematodes

Val Yocom, Catherine Everitt, Jonathan Palamattam, Kimberly Moser, Gavin Woodruff, Ph.D.

OU School of Biological Sciences

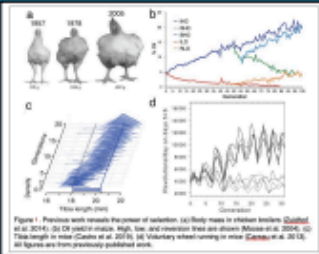


Why lifespan?

Artificial selection is a valuable tool for selecting desired traits.

Lifespan selection projects are rare due to their difficulty and impracticality, where common experimental subjects are long-lived systems with fixed reproductive periods.

A viable method of studying longevity alleles could expand the known limitations of science and medicine.



Why *C. elegans*?

Caenorhabditis elegans is a species of nematode known for its simple biological makeup, small size, and short lifespan. Its progeny can be cryopreserved indefinitely, making it an ideal model for aging experiments.

C. elegans was the first multicellular organism with a fully sequenced genome, known to have a significant overlap with that of humans².

Nearly every trait imaginable can be molded by selection. Artificial selection for lifespan poses unique challenges, setting *C. elegans* up as an ideal tool for such experimentation.

Acknowledgements

- Funded in part by an award from the NSF (grant # 2239788).
- Thank you to:
- Harley, thanks for sitting through all my worm ramblings. You haven't heard the end of them.
- Kim, you led me into my passion for this microscopic world.
- Gavin, this opportunity has meant more than you know.
- Professors Kechum and Savic, and the Honors College. Without you I wouldn't have even known where to start.

Artificial Selection of Lifespan in Obligate Outcrossing Nematodes

Val Yocom, Catherine Everitt, Jonathan Palamattam, Kimberly Moser, Gavin Woodruff, Ph.D.

OU School of Biological Sciences



Introduction:

The goal of medicine is the maintenance of health and a subsequent maximization of lifespan. To progress this goal, an understanding of allelic drivers of long, healthy life must be established.

- Aging-associated neurodegenerative syndromes affect large proportions of the global population. In 2021, an estimated 6.2 million seniors were living with Alzheimer's in the US alone¹.
- Further allele sequencing of nematodes could identify those associated with degenerative conditions, and with improved health and lifespan.
- Known life-extending mutations are commonly associated with adverse effects on fertility/reproductive fitness³.
- There may exist novel allelic relationships with fewer negative associations.

Using the model species *Caenorhabditis elegans*, our lab aims to employ artificial selection in the exploration of novel allelic connections that contribute to longevity.

Methods:

Our first objective was to establish ancestral strains and test for variation in lifespan. Each of three observers tracked 200 worms from each strain, for a total of 600 worms per observer (1,800 overall). We monitored three strains: a wild-type *C. elegans*, a *fog-2* mutant (the base obligate outcrossing line), and a further mutagenized *fog-2* (tagged WOU), predicted to have greater variation in lifespan. These worms were grouped 10 to a plate, transferred as needed, and checked for life daily. Upon their natural deaths, the date and manner of death for each worm was recorded. This data was then pooled for analysis in R.

Results:

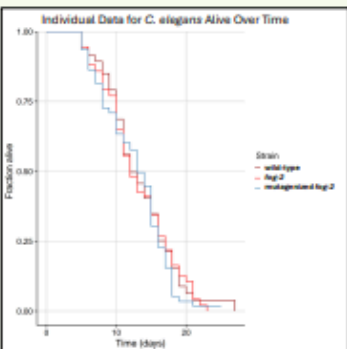


Figure 2. Data analysis for my population of 600 nematodes.

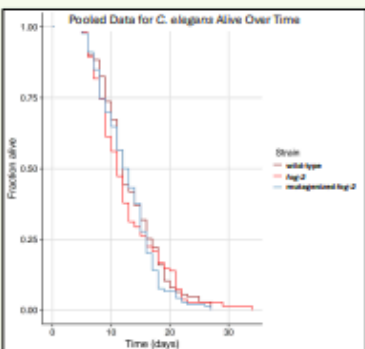


Figure 3. Data analysis for the experiment's total population of nematodes.

The first point of interest for analysis was the median number of days lived between strains (the no. of days at which 50% of worms were alive). In the analysis of the 600 worms I observed, we found medians of 12, 12, and 13 for the wild-type (WT), *fog-2*, and WOU mutants, respectively (Figure 2). This was like the pooled data, which had medians of 11, 12, and 13 (Figure 3). Despite the slight changes, the difference in lifespan variation between strains was not high enough to be considered statistically significant. Lifespan of all strains had a skewed-right distribution (Figure 4).

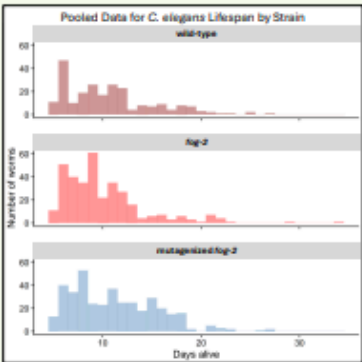


Figure 4. Histograms for each strain reflect the overall trend, a skewed-right distribution for lifespan.

Discussion & Conclusion:

On average, we found no median difference in lifespan variation between any of our strains. We failed to reject the experiment's null hypothesis, so whatever variation observed was likely due to chance alone.

While no significant relationship between strain and lifespan variation was discovered, this protocol allowed for the projection of lifespan distributions, where proportions of each are to be subjected to future selection.

Future Experimentation:

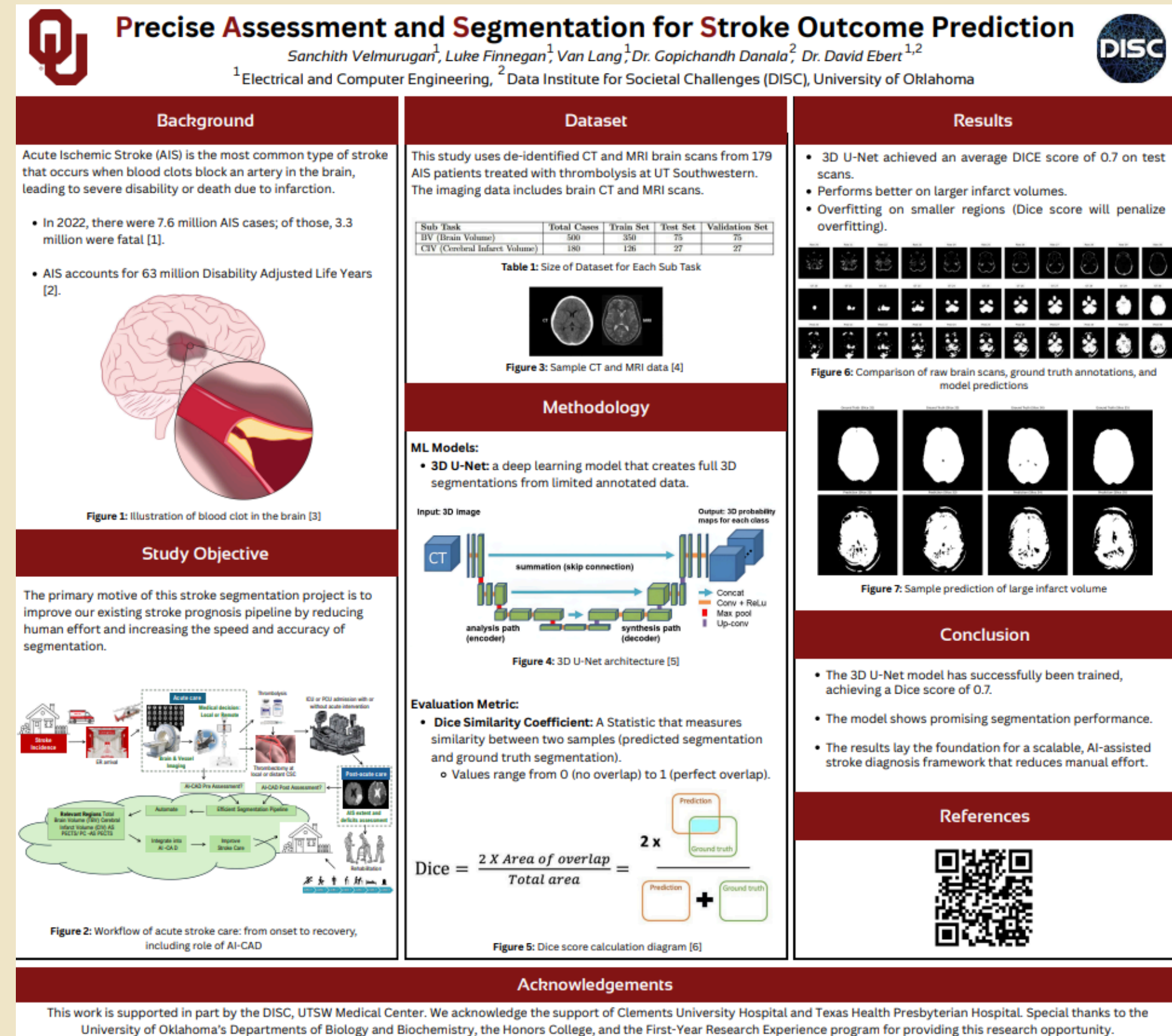
Now that ancestral populations and lifespan distributions have been established, rounds of truncation selection are to be carried out under three selection regimes: none (random), long-life (top 20% lifespan), and short-life (bottom 20% lifespan). This will be repeated with 40-80 generations across 2-3 years. Eventually, a number of these replicate populations will be sequenced against the ancestral population, where any significant allele shifts can be explored as areas under selection.

Alleles which consistently and uniquely shift in long- and short-lived worms, and not in the randomized regime, could be examined as potential modulators for lifespan. Further, alleles coding for long life in *C. elegans* can be checked for orthologs in humans, hopefully allowing for steps to be made in understanding longevity on an even greater scale.

Works Cited:

- Alzheimer's Association (2021). Alzheimer's disease facts and figures. *Alzheimer's & dementia: the journal of the Alzheimer's Association*, 17(3), 327-486.
- Shay, D. D., & Greenwell, L. (2011). *Ortelus*: a companion of *C. elegans* genes with human orthologs. *PLoS one*, 6(5), e20885.
- Wojew A Van Voorhies, James W Carlsberg, Michael R Rose (2006). Do longevity mutants always show trade-offs? *Experimental Gerontology*, 41(10), 1055-1058.
- M.J. Zindler, B.L. Schneider, V.L. Carey, D.R. Korten, J.E. Robinson (2014). Growth, efficiency, and yield of commercial broilers from 1975, 1979, and 2005. *Poultry Science*, 93(12), 2976-2982.
- Mason, S. P., Doolley, J. W., & Rutherford, T. R. (2004). Mass selection passes the century mark: A unique resource for 21st century genetics. *Trends in Plant Science*, 9(7), 359-364.
- Cotto, J. P., Vancosten, M. N., Mochizuki, M., Beldkley, S., Harman, L., Kozak, M., Beldkley, W. H., Nussman, R., Skopik, L., Cobb, J., Barton, N. H., Rollan, C., & Chen, Y. F. (2019). An integrative genomic analysis of the Longevity selection experiment for longer lives in mice. *eLife*, 8, e42814.
- Casas, V., Wold, M. E., & Garland, T. Jr. (2013). LIMITS TO MICROBIAL EVOLUTION: THE QUANTITATIVE GENETICS OF A COMPLEX TRAIT UNDER DIRECTIONAL SELECTION. *Evolution*, 67(11), 3102-3119.

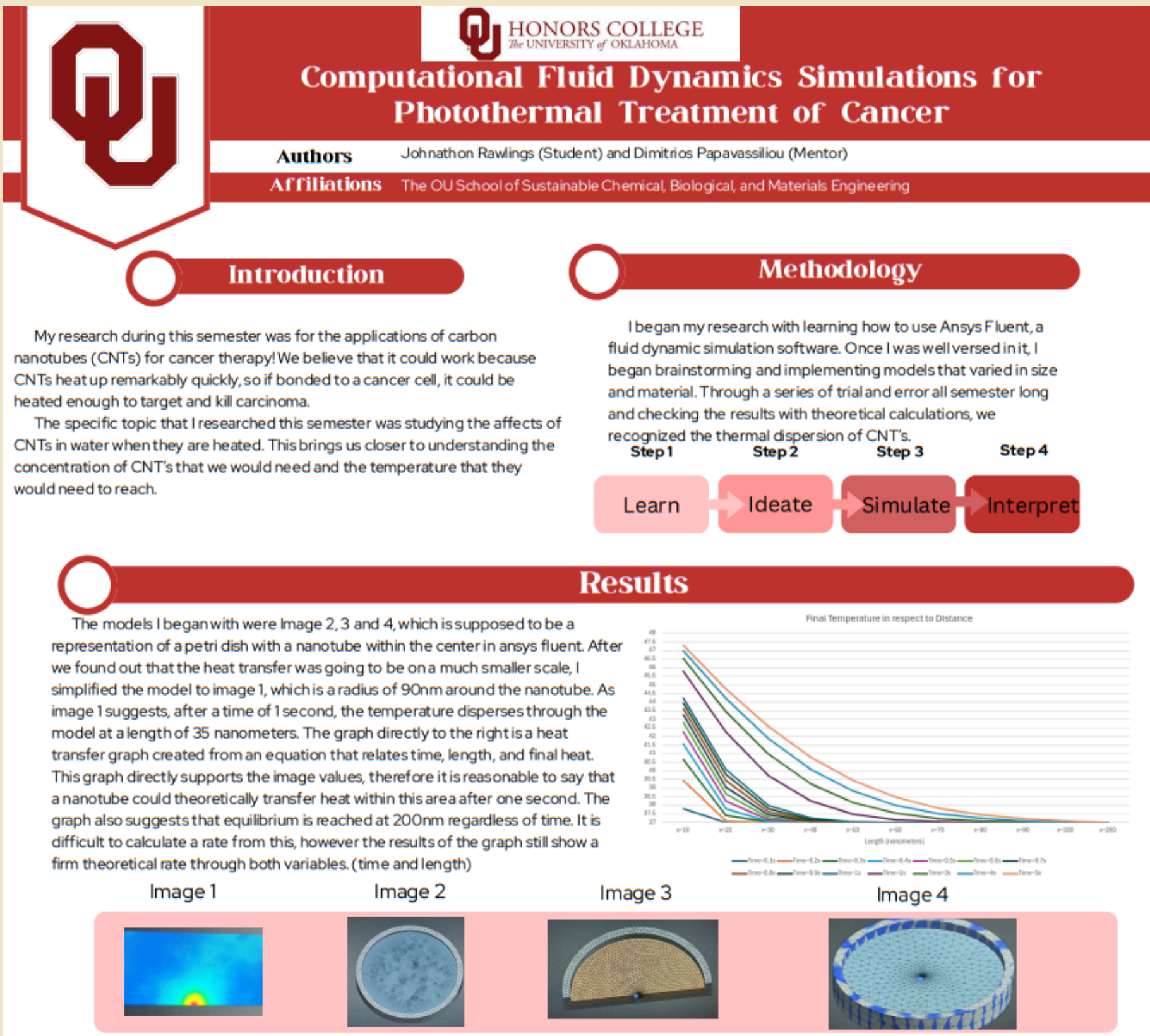
Electrical and Computer Engineering,
Data Institute for Societal Challenges
(DISC), University of Oklahoma



Computational Fluid Dynamics Simulations for Photothermal Treatment of Cancer



Johnathon Rawlings (Student) and
Dimitrios Papavassiliou (Mentor)

The OU School of Sustainable Chemical,
Biological, and Materials Engineering





Exploring a Database of Arctic Cloud Properties Derived from In-situ Aircraft Measurements

Sydney Schubert



Exploring a Database of Arctic Cloud Properties Derived from In-situ Aircraft Measurements

Sydney Schubert



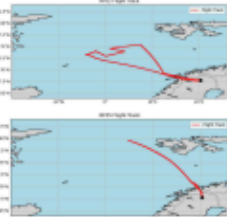
Why the Arctic?

- The Arctic is experiencing warming at twice the global average rate
- Models for Arctic warming are not accurate as much is unknown about cloud - aerosol interactions in Arctic clouds especially in cold-air outbreaks (CAOs)
- Arctic climate projections are filled with uncertainty as how cloud properties will change in a warming environment is unknown
- Objective: help develop future parameterization for models

CAESAR Campaign

- Cold-Air Outbreak Experiment in the Sub-Arctic Region (CAESAR)
- 23 February - 7 April 2024
- 8 flights out of Kiruna, Sweden by NCAR/NSF C-130 aircraft
- Many remote sensing and in-situ instruments were installed on the C-130 aircraft for measuring properties of clouds and aerosols
- Goal: improve understanding and prediction of Arctic clouds during CAOs

Flight Paths



Figures 1 and 2 - Flight paths for NSF/NCAR C-130 for flight 2 (2/28/2024) and flight 5 (3/11/2024) out of Kiruna, Sweden

Instruments




Figure 3 - NSF/NCAR C-130

Analysis of Two CAESAR Flights

Clouds can be ice-phase, liquid-phase, mixed-phase (ice and liquid co-exist), or drizzle (larger water drops). Phase is identified by looking at data from several probes (CDP, F2DS, HVPS, RICE, and King Probe), using an algorithm developed by OU cloud group.

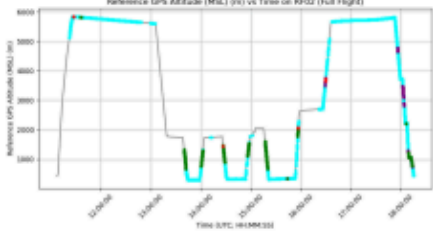


Figure 4 - Phase Identification for altitude versus time in flight 2. For each vertical profile of cloud, liquid is seen throughout cloud most frequently, while ice is seen below cloud.

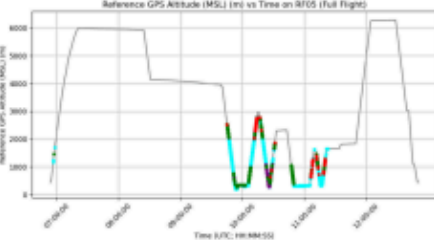


Figure 5 - Phase Identification for altitude versus time in flight 5. The phase identification for flight 5 varies with each vertical profile. For example, the decent from 09:45:07 to 09:46:50 is dominated by liquid cloud while the decent from 11:06:16 to 11:08:31 has layers of ice, liquid and drizzle.

Effective diameter is a way to characterize the average size of cloud droplet particles. It relates total volume of cloud particles to total surface area of cloud particles.

Figure 6 - Plot of CDP effective diameter versus normalized altitude for each cloud vertical profile for flight 2. There is an increasing trend of effective diameter as height within cloud increases.

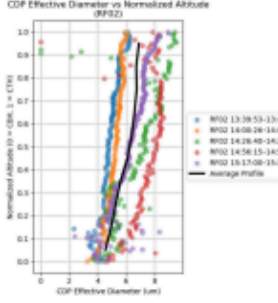


Figure 7 - Plot of CDP effective diameter versus normalized altitude for each cloud vertical profile for flight 5. Like flight 2, generally there is an increasing trend of effective diameter as height within cloud increase.

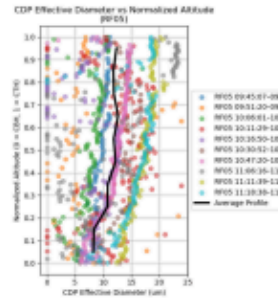


Figure 8 - Plot of CDP number concentration of cloud particles versus normalized altitude for each cloud vertical profile for flight 2. Generally, there is a increase in concentration in mid-height in cloud while concentration decreases towards the top of cloud.

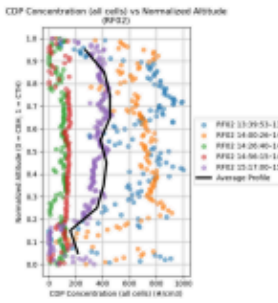
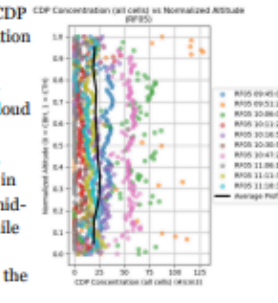


Figure 9 - Plot of CDP number concentration of cloud particles versus normalized altitude for each cloud vertical profile for flight 5. Concentration is low for this flight and is consistent throughout cloud height.



Conclusions

- There are more varied phases of cloud particles for flight 5 compared to flight 2
- Average CDP concentration is higher for flight 2 than for flight5
- Flight 5 has a wider range of effective diameter
- Flight 5 has a more rapid increase in effective diameter than flight 2
- Both flights have a greater increase in effective diameter at lower heights in cloud

Moving Forward


- Explore data collected from other probes in order to examine different properties of ice and larger particle sizes
- Expand analysis to all CAESAR flights
- Analyze the environmental conditions that may cause the differences in microphysical properties between flights
- Compare CAESAR flights with data from other campaigns such as M-PACE and ISDAC

Acknowledgements

- Dr. Greg McFarquhar
- OU School of Meteorology
- First Year Research Experience
- CIWRO

References



- Baumgardner, D., et al. "Cloud Ice Properties: In Situ Measurement Challenges." *Meteorological Monographs*, vol. 58, Jan. 2017, pp. 9.1–9.23, <https://doi.org/10.1175/monographs-4-16-0011.1>. Accessed 14 Apr. 2025.
- University of Oklahoma Norman Campus. "Proposal to the National Science Foundation." Proposal submitted to the National Science Foundation, Program Announcement/Solicitation.



HONORS COLLEGE
The UNIVERSITY of OKLAHOMA

Data Comparison of Arctic Cloud Properties from In-Situ Aircraft Measurements in CAESAR

Sao Aphisith Sithisack



Data Comparison of Arctic Cloud Properties from In-Situ Aircraft Measurements in CAESAR

Sao Aphisith Sithisack¹

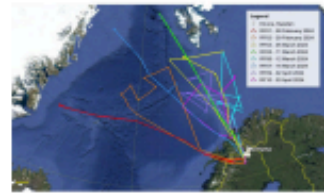
¹OU School of Meteorology, Norman, OK,
²Cooperative Institute for Severe and High-Impact Weather Research and Operations

Why Study Microphysical Properties of Cloud?

- Precipitations in some specific areas is often poorly understood
- Factors influencing precipitation including environmental conditions are complex and vary between regions
- Goal: Understand how microphysical properties of clouds depend on environmental conditions to improve understanding

CAESAR Overview

- Investigation of Microphysics from several different vertical profiles obtained during CAESAR (Cold Air Experiment in Sub-Arctic Region) campaign in Kiruna, Sweden 2024
- NSF/NCAR C-130 aircraft flew into cloud from cloud base to top and collected data
- Analyze differences in vertical profiles



Instrumentation




Figure 2 – Probes used to collect data of size distribution of particles in the cloud with different probes measuring different size of particles

Data Analysis

Compare different microphysical properties of water clouds for liquid- and mixed-phase clouds. The probes used to derive properties included CDP, F2DS, HVPs, RICE, and King Probe. The data are represented in terms of normalized cloud altitude, from cloud base (normalized altitude = 0) to top (normalized altitude = 1).

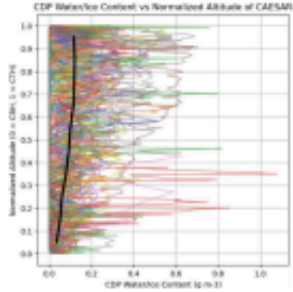


Figure 3 – CDP water content increases with altitude, suggesting condensation occurring throughout cloud as air rises. Some decrease in water content near cloud top due to mixing of dry air

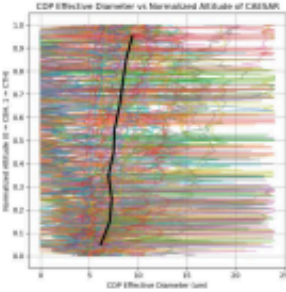


Figure 4 – CDP effective diameter increases with height showing water droplets grow due to both condensation and collision/coalescence in rising air.

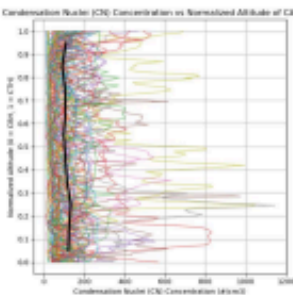


Figure 5 – Condensation Nuclei (CN) concentrations do not vary significantly with height.

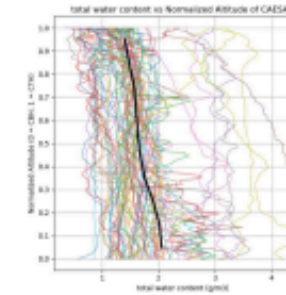


Figure 6 – Compared with Figure 3 where water content is the largest at cloud top, here the total water content (i.e., ice + water) decreases with altitude, suggesting that ice particles grow as they fall through cloud

Results & Conclusion



- Liquid particles grow throughout cloud as air rises, where more ice near bottom of the cloud as ice grows as particles descend.
- Collision/coalescence likely takes place as drops rise in updrafts
- Changes in cloud particle properties with height were less than expected.

Next Steps

- Examine other probes (in addition to CDP) in how size distribution of ice/water particles varies with height
- Analyze the environmental conditions which affect the microphysical properties of cloud.
- Construct Phase Identification to identify ice, water, or mix-phased regions in the cloud.
- Analyze individual profiles that are outlined in the data
- Compare the data from this flight with other similar campaigns

Acknowledgements

- First Year Research Experience – OU Honors College
- Cooperative Institute for Severe and High-Impact Weather Research and Operations
- Dr. Greg McFarquhar
- OU School of Meteorology



Using Physics Informed Neural Networks to Model Heat Transfer in One and Two Dimensions

Conner Russian & Iman Ghamarian

School of Aerospace and Mechanical Engineering



Using Physics Informed Neural Networks to Model Heat Transfer in One and Two Dimensions

Conner Russian & Iman Ghamarian
School of Aerospace and Mechanical Engineering

Introduction

Physics Informed Neural Networks, or PINNs, are a method of modeling a real-world situation better than a non physics informed neural network can. It works by taking the mean squared error (MSE) between the result and the expected result from the physics equation and adding it to the basic loss equation.

My Objectives

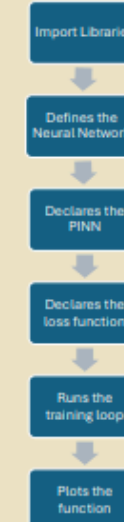
- Write a PINN to model the one-dimensional heat transfer problem
- Extend that PINN to two dimensions
- Learn about and understand how Neural Networks work

Methods

In order to build this model, I had to write the code to first declare a model, then train that model. I used PyTorch libraries to handle some of the main requirements of a neural network, including

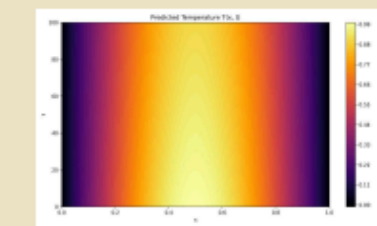
- Defining the Neural Network
- Telling the network how to flow through the network
- Defining the boundaries
- Taking derivatives of the equation
- Computing the loss
- Running the training loop
- Plotting the plots

After the code was complete, I changed the variables around to match various materials and cover various amounts of time.

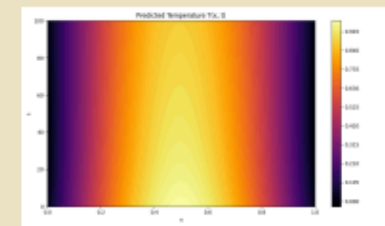


One Dimension

The first graph is not really modeling any specific material, I used a random place holder for the thermal diffusivity (α) which, if based on material properties, is based on thermal conductivity k , density ρ , and specific heat capacity cp . The second graph represents a situation exactly the same except over a longer time period.



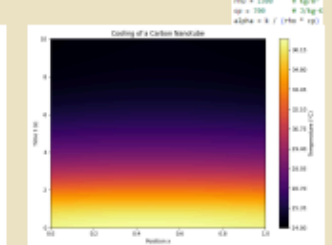
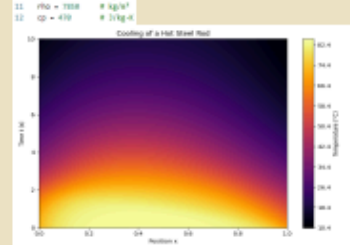
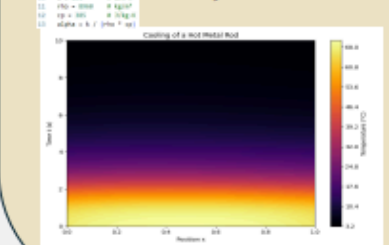
$$\frac{\partial T}{\partial t} = \alpha \frac{\partial^2 T}{\partial x^2}$$



```
# Collocation points (Interior)
x_f = torch.rand(10, 1)
t_f = 100 * torch.rand(10, 1)

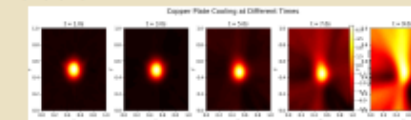
# Collocation points (T = 0, 10000)
x_f = torch.rand(10, 1)
t_f = 10000 * torch.rand(10, 1)
```

Each of the next three graphs model a one-dimensional rod of different materials with time on the y axis.



Two Dimensions

This set of graphs models a copper plate with a heat source at the center at 5 different points in time. You can see how the heat spreads through plate over time. The model is currently incomplete and needs further refined, however, it still demonstrates a decent start into modeling heat transfer in two dimensions.



Conclusion

In conclusion, these coding these models have taught me a lot about how Neural Networks and Physics Informed Neural Networks. These PINNs are able to effectively model real-life situations with a few hundred lines of code (when borrowing from library databases like PyTorch). A PINN that can successfully model heat transfer can help engineers in many fields better understand how heat moves throughout a body. Additionally, because carbon nano tubes are so thin, the one-dimensional model for it already closely models a real-world situation involving carbon nano-tubes. For example, in a future space elevator design where it would be very important to know how heat is moving through the structure with a lack of a way to dissipate heat in space.

Transformers VS LSTM Models for Time-Series Data

Max Herbert, David and Judi Proctor

Department of Mathematics

Transformers VS LSTM Models for Time-Series Data

Max Herbert, David and Judi Proctor Department of Mathematics

Maxwell.D.Herbert@ou.edu



Introduction

What is Time Series Data?

Time-series data is a sequence of data points collected or recorded at specific time intervals. It's used to track changes over time, such as stock prices, weather patterns, or sensor readings.

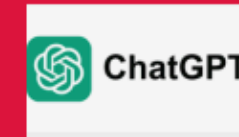


Why is it important to forecast it?

Forecasting time-series data helps us predict future values based on past trends. This is useful for making decisions in areas like finance, weather, energy, and healthcare, where knowing what might happen next can save money, time, and resources.

Why compare LSTM and Transformer Models?

- Both LSTM and Transformer models are designed for sequential, time-based data but function differently.
- LSTMs have been widely used in applications like speech recognition and stock prediction.
- Transformers, a newer model, excel in tasks like natural language processing and complex pattern recognition (eg. Chatgpt).
- Comparing them helps determine which is more accurate and efficient for time-series forecasting.



Methodology

Data Source

For this project, I used the ETTh1 dataset, which records the oil temperature inside electrical transformers — an important measurement for managing power systems.

It covers 2 years of hourly data from two counties in China. Each record contains: Oil temperature (the value I forecast) along with 6 additional power load features

Preprocessing Steps

- Applied Pandas and MinMaxScalar
- Created lagged features for variables
- Normalized all features to a 0-1 range
- split data into 80-20 training and test



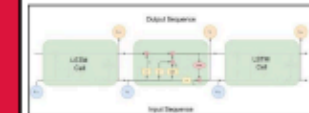
Evaluation Metrics

I evaluated model performance by comparing the Mean Squared Error (MSE) between the test and train datasets over 100 epochs.

•MSE was used to measure how well the model predicted the target (oil temperature).

•After training, I visualized the results using Matplotlib to compare the loss curves of both datasets.

Model Architectures



The LSTM contains:

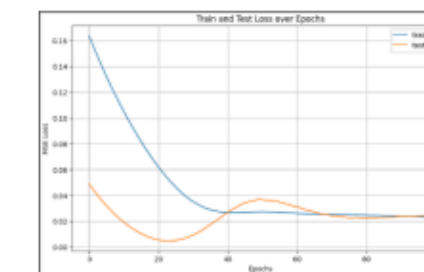
- 1.Input Layer: Takes in past data (e.g., power load, oil temperature).
- 2.LSTM Layer: Captures long-term dependencies using memory cells.
- 3.Dense Layer: Processes the LSTM output for prediction.
- 4.Output Layer: Provides the final forecast (e.g., next oil temperature).

Temporal Fusion Transformer Architecture

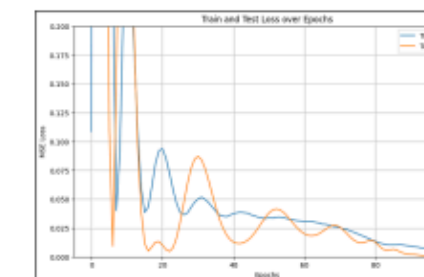
- 1.Input Layer: Takes in past data (e.g., power load, oil temperature).
- 2.Attention Mechanism: Focuses on the most important parts of the data to make predictions.
- 3.Transformer Layer: Analyzes the input data at different time points to capture complex patterns.
- 4.Output Layer: Provides the final forecast (e.g., next oil temperature).



Results



LSTM

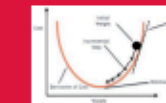


Transformers

What I learned

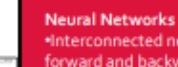
Regression Models

- Predict continuous values with a direct relationship between inputs and outputs.



Gradient Descent

- Optimizes by minimizing loss through iterative updates



Neural Networks

- Interconnected neurons that learn data patterns via forward and backward propagation.



RNNs (Recurrent Neural Networks)

- Designed for sequential data, where past inputs influence future predictions.

What I used

Temporal Fusion Transformer (TFT)

A deep learning model designed for time-series forecasting, created by researchers at Google and the University of California, Berkeley.

Conclusion

Limitations

- Not Enough Data
- Limited Processing Power
- Single Dataset
- No external Factors



Results


The Transformer model outperformed the LSTM in terms of accuracy, but it required significantly more processing power. The LSTM completed both training and testing in approximately 4 seconds, while the Transformer took around 45 seconds to finish the same tasks.

Future work

Future research could focus on optimizing model hyperparameters, testing with additional datasets, and incorporating external variables for more accurate forecasting. Exploring alternative evaluation metrics and improving model explainability would also be beneficial. Lastly, real-time deployment could provide insights into the models' practical applicability.

Inertial Damper Optimal Design and Performance Assessment for Multi-Story Buildings under Seismic Excitation

Dr. Aikaterini Kyprioti, Max Cheng



GALLAGHER COLLEGE OF ENGINEERING

SCHOOL OF AEROSPACE AND MECHANICAL ENGINEERING

THE UNIVERSITY OF OKLAHOMA

Inertial Damper Optimal Design and Performance Assessment for Multi-Story Buildings under Seismic Excitation

Dr. Aikaterini Kyprioti, Max Cheng

Introduction

As technological advancements allow buildings to become slimmer, stronger, and taller, and as climate change has increased the frequency of natural accidents, the need for structural stabilizing solutions has grown. By leveraging Newton's laws of motion in conjunction with the Lagrangian Theory, Tuned Mass Dampers are an effective, completely passive means of reducing structural displacement.

This project seeks to:

- Explore the applicability of passive Tuned Mass Dampers in modern structures.
- Calculate optimal parameters for Tuned Mass Dampers.
- Investigate a real-life case study in the Taipei 101 tower.

Conceptual Background

Conceptually, TMDs are quite simple: mass resists acceleration; therefore, by attaching a mass to a structure in a particular fashion, acceleration due to resonance may be reduced (or entirely eliminated).

When modeling the performance of a Tuned Mass Damper, we approximate a structure as a system with several dynamic degrees of freedom (concentrating the mass of the structure at these points); conceptually, several discrete masses attached via springs and dampers.

After applying the Lagrangian, and through some derivation:

In the most simple case, a single degree of freedom (SDOF) system with TMD (a two DOF combined system) can be modeled as follows (Yang):

$$\begin{bmatrix} M & 0 \\ 0 & m \end{bmatrix} \begin{Bmatrix} \ddot{x} \\ \ddot{y} \end{Bmatrix} + \begin{bmatrix} c + c & -c \\ -c & c \end{bmatrix} \begin{Bmatrix} \dot{x} \\ \dot{y} \end{Bmatrix} + \begin{bmatrix} K + k & -k \\ -k & k \end{bmatrix} \begin{Bmatrix} x \\ y \end{Bmatrix} = \begin{Bmatrix} F \\ 0 \end{Bmatrix}$$

Using properties of the transfer function of a single-degree-of-freedom system (see fig), (Hartog) was able to derive the optimal TMD stiffness and damping factors by tuning the magnitude at two distinct vibration frequencies to be identical. To achieve this,

$$f = \frac{1}{1 + \mu}$$

must be true. (Where f represents the frequency ratio, $f = \omega_T / \omega_M$, $\omega_T = \sqrt{k_T / m}$, $\omega_M = \sqrt{k_T / m}$, and $\mu = M / m$)

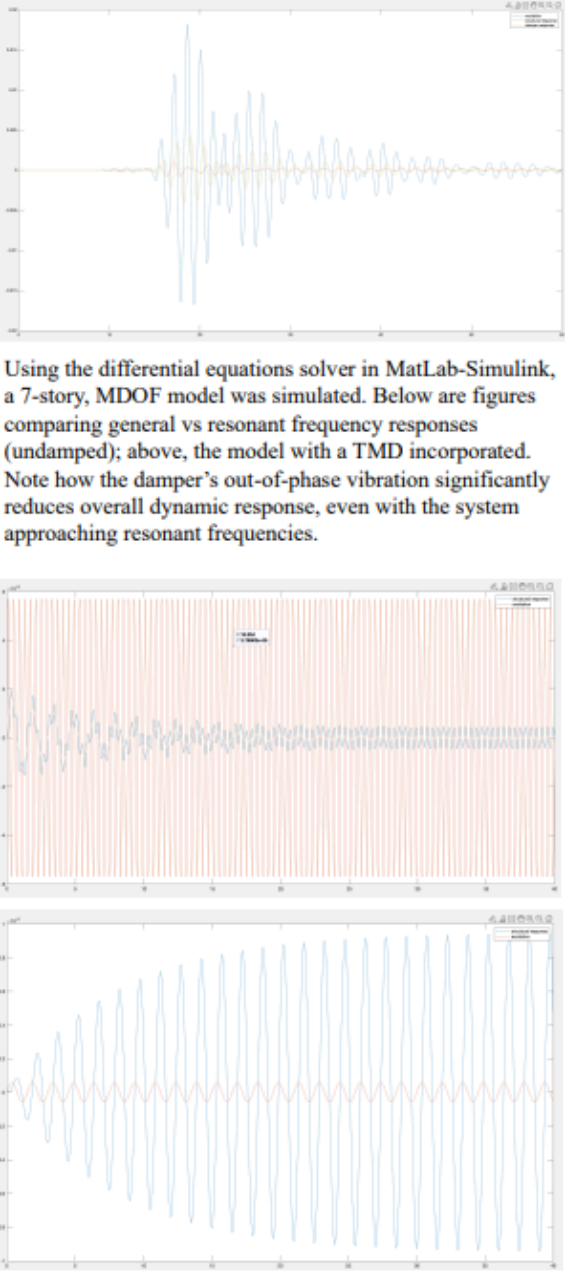
Where the optimal TMD stiffness (k_T) satisfies this equation. Through minimization, it can also be found that the optimal damping ratio obeys (eq'n 10):

$$\zeta = \sqrt{\frac{3\mu}{8(1 + \mu)^3}}$$

Where $\zeta = \frac{c_T}{c_c}$ is the damping factor and $c_c = 2m\omega_T$ is the TMD critical dammine coefficient.

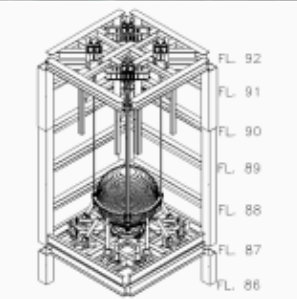

Experimental Results

Using the differential equations solver in MatLab-Simulink, a 7-story, MDOF model was simulated. Below are figures comparing general vs resonant frequency responses (undamped); above, the model with a TMD incorporated. Note how the damper's out-of-phase vibration significantly reduces overall dynamic response, even with the system approaching resonant frequencies.




Figures (from top): Response to Kobe earthquake, incorporating TMD; Response to sinusoidal excitation (non-resonant); Response to sinusoidal excitation (resonant).

Taipei 101 Tower



The Taipei 101 Tower has an estimated natural frequency between 0.103 and 0.150 Hz; recorded excitation under several typhoons and the Wenchuan earthquake were in the 0.145-0.147 Hz range.

Throughout these potential disasters, the 660-ton TMD suspended from the upper floors successfully mitigated up to 40% of the building's sway.



HONORS COLLEGE

The UNIVERSITY of OKLAHOMA

Coconut Libtool 2.0: Enhanced Text Analysis Tool

Tam Le, Manika Lamba

Gallogly College of Engineering; 2
School of Library and Information
Studies

Coconut Libtool 2.0: Enhanced Text Analysis Tool

Tam Le¹, Manika Lamba²

¹ Gallogly College of Engineering; ² School of Library and Information Studies



The UNIVERSITY of OKLAHOMA

INTRODUCTION

Many people have faced technological barriers to textual analysis due to the requirement of coding knowledge for many text analysis methods. Coconut Library tool (Santosa et al., 2024) aims to address these difficulties as a user cohesive, web-based application with modern natural language processing technology to improve accessibility to advanced textual analysis.

In this poster, we present Coconut Library Tool 2.0, an enhanced version of the tool that improve accessibility and usability by adding new techniques such as sentiment analysis and data sources. New data sources include metadata files from research databases such as Dimensions AI and PubMed alongside the HathiTrust Digital Library. Further, additional features to improve user experience include downloadable results generated by several analysis and visualization techniques: topic modelling, scattertext, and sunburst visualization.

METHOD

Several new features, techniques, and data sources have been integrated since the release of Coconut Library Tool 1.0.

Coconut Libtool 2.0

Data Sources

- HathiTrust Digital Library
- Dimensions AI Database
- PubMed Database

Algorithms

- Sentiment Analysis
 - TextBlob
 - VaderSentiment (Hutto & Gilbert, 2014)

Features

- Users can now download the results generated from
 - Topic Modeling
 - Scattertext
 - Sunburst

Coconut Libtool 1.0

Data Sources

- Scopus
- Web of Science
- Lens

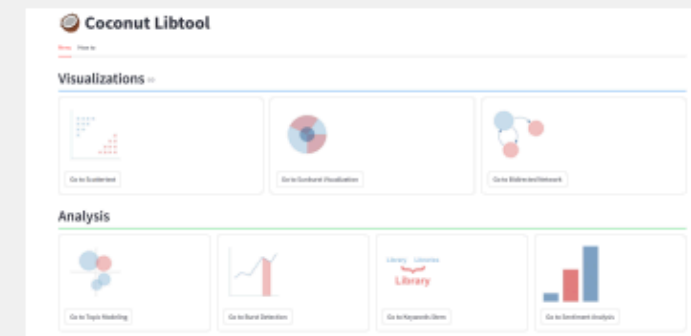
Algorithms

- Topic Modelling
 - LDA (Sievvert & Shirley, 2014)
 - Biterm (Yan Guo, Lan & Cheng, 2013)
 - BERTopic (Goortendorst, 2022)
- Network Text Analysis (Lamba & Madhusudhan, 2022a)
- Sunburst Visualization
- Burst Detection (Lamba & Madhusudhan, 2022b)
- Scattertext (Kessler, 2017)
- Keyword Stemming (Bird, Loper, & Klein, 2009)

Deployment

- Hugging Face Space, Streamlit SDK

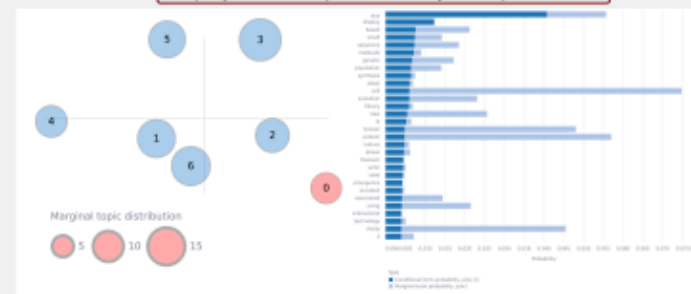
INTERFACE PREVIEW



Coconut Library Tool Interface with methods and 'How to' section



Example of sentiment analysis visualization of Amazon product reviews



Example of using Biterm with data from PubMed



Scattertext visualization made using data from Dimensions AI

DISCUSSION & LIMITATIONS

With the new updates, users can now use sentiment analysis to observe opinion and subjectivity within a text. Researchers using Dimensions AI, PubMed, or HathiTrust Digital Library can analyze their data, and advanced users can use the results generated from topic modelling, scattertext, or sunburst visualization for their own analyses.

Coconut Libtool is currently compatible only with data in English, and some methods are resource intensive. New data sources, text analysis methods, and visualization options will continue to be added beyond current selection.

This application aims to support researchers and students in the social sciences and humanities field by providing an accessible space for artificial intelligence tools and promote interdisciplinary collaboration.

FUTURE DIRECTION

Moving forward, new features for users will continue with additional visualizations like **word shift graphs**. Compatibility will be expanded to other data sources such as **Semantic Scholar**. **User studies** will be conducted to evaluate design changes and direct new additions.

REFERENCES

- Bird, S., Loper, E., & Klein, E. (2009). Natural Language Processing with Python. O'Reilly Media Inc.
- Grootendorst, M. (2022). BERTopic: Neural topic modeling with a class-based TF-IDF procedure. arXiv preprint arXiv:2203.05794. <https://arxiv.org/abs/2203.05794>
- Hutto, C.J. & Gilbert, E.E. (2014). Vader: A Parsimonious Rule-based Model for Sentiment Analysis of Social Media Text. Eighth International Conference on Weblogs and Social Media (ICWSM-14). Ann Arbor, MI, June 2014.
- Kessler, Jason S. (2017). Scattertext: a Browser-Based Tool for Visualizing how Corpora Differ. Proceedings of ACL-2017 System Demonstrations. <https://doi.org/10.48550/arXiv.1703.00565>
- Lamba, M., & Madhusudhan, M. (2022a). Network Text Analysis. Text Mining for Information Professionals, 10. https://doi.org/10.1007/978-3-030-85085-2_5
- Lamba, M., Madhusudhan, M. (2022b). Burst Detection. In: Text Mining for Information Professionals Springer, Cham. https://doi.org/10.1007/978-3-030-85085-2_6
- Santosa, F. A., Lamba, M., George, C., & Downie, J. S. (2024). Coconut Libtool: Bridging Textual Analysis Gaps for Non-Programmers. Proceedings of the Association for Information Science and Technology, 61(1), 639-644. <https://doi.org/10.1002/inf2.1072>
- Sievvert, C., & Shirley, K. (2014). LDAs: A method for visualizing and interpreting topics. Proceedings of the Workshop on Interactive Language Learning, Visualization, and Interfaces. <https://doi.org/10.3115/v1/w4-3110>
- Yan, X., Guo, J., Lan, Y., & Cheng, X. (2013). A biterm topic model for short texts. Proceedings of the 22nd International Conference on World Wide Web. <https://doi.org/10.1145/2488388.2488514>



WEB-APP



GITHUB

ACKNOWLEDGMENTS

DODGE FAMILY COLLEGE OF ARTS AND SCIENCES
DEPARTMENT OF CHEMISTRY
AND BIOCHEMISTRY
The UNIVERSITY of OKLAHOMA



HONORS COLLEGE
The UNIVERSITY of OKLAHOMA

Exploring the Relationship Between Concerns of Losing Face and Social Anxiety in Asian Americans

Jermelia Spivey and Carsen Hill
(Advisor; Dr. Mauricio Carvallo)



Exploring the Relationship Between Concerns of Losing Face and Social Anxiety in Asian Americans

Jermelia Spivey and Carsen Hill (Advisor; Dr. Mauricio Carvallo)



INTRODUCTION

Social Anxiety Disorder (SAD) can be defined as the persistent and intense fear of social and/or performance situations due to the belief that one may be judged negatively, embarrassed, or humiliated (Brooke & Intreiri, 2021; Mayo Clinic, 2021). Research has shown that within the U.S., there is an estimated SAD prevalence of 57.6% (Jefferies & Ungar, 2020). SAD can prove to be harmful to people in numerous ways, as its effects can even inhibit one's everyday life. More specifically, it can be detrimental to one's work and increase risk for other health issues, both physical and mental (Gallagher et al., 2014; Katzelnick & Greist, 2001; Stein & Kean, 2000, as cited in Zentner et al., 2023). Biology (Panayiotou et al., 2014), environment (Hidalgo et al., 2001), and culture (Braje and Hall, 2016) can all serve as factors in developing SAD. However, our study mostly focuses on one specific aspect of culture, that being concerns of losing face. These concerns generally stem from a Culture of Face, where harmony and humility within the hierarchy are essential (Kim & Cohen, 2010). Though not exclusive to them, Cultures of Face tend to align with the values of Asian Cultures (Leung & Cohen, 2011). Because of these core values, status (or face) can be lost among others by failing to meet their expectations (Tsong et al., 2023). In these cultures, how one is perceived by others is imperative to one's perception of oneself (Kim & Cohen, 2010). Similar to SAD, loss of face concerns have been found to have adverse effects on mental health, notably including potential links to social anxiety (Lau et al., 2009). But while existing literature may identify this link, the factors that can explain it remain understudied.

OBJECTIVE & HYPOTHESIS

In the present study, we examine the relationship between concerns about losing face and social anxiety among Asian Americans living in the United States. To investigate this association, we propose a parallel mediation model, hypothesizing that fear of negative evaluation and self-silencing sequentially mediate the link between concerns about losing face and social anxiety.

METHODS

Participants

- 304 Asian American adults aged 18-61 ($M = 32.98$, $SD = 9.06$) were sampled through Prolific
- Male to female ratio is relatively balanced (males, $N = 171$; non-binary, $N = 3$)
- Most participants are U.S. born ($N = 203$) and speakers English as their first language ($N = 242$)
- Participants are mostly Chinese ($N = 102$), with the rest of participants identifying as Filipino ($N = 41$), Indian ($N = 36$), Korean ($N = 29$), Japanese ($N = 11$), Vietnamese ($N = 29$), Other ($N = 25$)

METHODS CONT.

Measures

- Self-Silencing** (revised Silencing of the Self Scale, $\alpha = .92$; Jack & Dill, 1992). "When my partner's needs and feelings conflict with my own, I always state mine clearly" modified into "When other people's needs and feelings conflict with my own, I always state mine clearly", "I don't speak my feelings in my relationship with others when I know they will cause disagreement"
- Fear of Negative Evaluation** (Brief Fear of Negative Evaluation Scale, $\alpha = .93$; Leary, 1983) "I worry about what other people will think of me even when I know it doesn't make any difference," "I am afraid others will not approve of me"
- Social Anxiety** (Social Interaction Anxiety Scale, $\alpha = .93$; Mattick & Clarke, 1998) "I have difficulty making eye contact with others," "I find difficulty mixing comfortably with the people I work with"
- Direct Coping** (Cope Inventory – Short Form, $\alpha = .85$; Carver, 1997) (Positive reframe, active coping, planning, acceptance, emotional support, religious coping, instrumental support). "I've been trying to find comfort in my religion or spiritual beliefs"
- Indirect Coping** (Cope Inventory – Short Form, $\alpha = .81$; Carver, 1997) (Self-Distraction, denial, substance use, behavioral disengagement, venting, and self-blame). "I've been using alcohol or other drugs to make myself feel better"
- Self-Esteem** (Rosenberg Self-Esteem Scale, $\alpha = .93$; Rosenberg, 1979). "I certainly feel useless at times"

RESULTS

- Bivariate correlations, means, and standard deviations for the study can be found in Table 1.
- Utilized 5,000 percentile-bootstrap confidence intervals in PROCESS macro-Version 4.1 (Model 4) in SPSS to test the parallel mediation model
- As shown in Figure 2, the overall mediation model was statistically significant, $R^2 = .60$, $F(6, 297) = 73.21$, $p < .001$.
- This model explained approximately 60% of the variance in social anxiety

Table 1 Bivariate Correlations, Means, and Standard Deviations									
Variable	1.	2.	3.	4.	5.		M	SD	Possible Range
1. Concerns about Losing Face	-	-	-	-	-	-	4.63	.91	1-7
2. Fear of Negative Evaluation	.58**	-	-	-	-	-	3.17	.92	1-5
3. Self-Silencing	.65***	.51***	-	-	-	-	4.14	.78	1-7
4. Social Anxiety	.59***	.65***	.64***	-	-	-	2.61	.82	1-5
5. Direct Coping	-.05	-.21***	-.15**	-.18*	-	-	2.52	.54	1-4
6. Indirect Coping	.31***	.32***	.41***	.43***	.17*	-	1.89	.48	1-4
7. Self-Esteem	-.30***	-.48***	-.54***	-.55***	.44***	-.34***	2.74	.67	1-4
N = 304, ** $p < .01$, *** $p < .001$, * $p < .05$									

RESULTS CONT.



Figure 1. Relationship between concerns about losing face and social anxiety mediated by fear of negative evaluation and self-silencing, controlling for direct coping, indirect coping, and self-esteem. Unstandardized coefficients reported. $N = 304$. * $p < .05$, ** $p < .01$, *** $p < .001$. $R^2 = .60$. (control variables: direct and indirect coping and self-esteem)

DISCUSSION

The data supports our hypothesis that Asian American individuals who have concerns about losing face are likely to experience social anxiety symptoms that can be explained by the mediating effects of self-silencing behaviors and a fear of being negatively evaluated. Those who are concerned with losing face evaluate their own actions based on how they believe they will be perceived by others. Because they are concerned with being negatively evaluated, they engage in self-silencing behaviors that suppress their emotions and behaviors in order to maintain an image that coincides with positive face value. The engagement in these behaviors in turn leads to social anxiety. It is imperative that cultural concepts such as concerns of losing face and mediators such as fear of negative evaluation and self-silencing are taken into consideration when evaluating social anxiety symptoms and creating treatment plans particularly among Asian Americans in the United States.

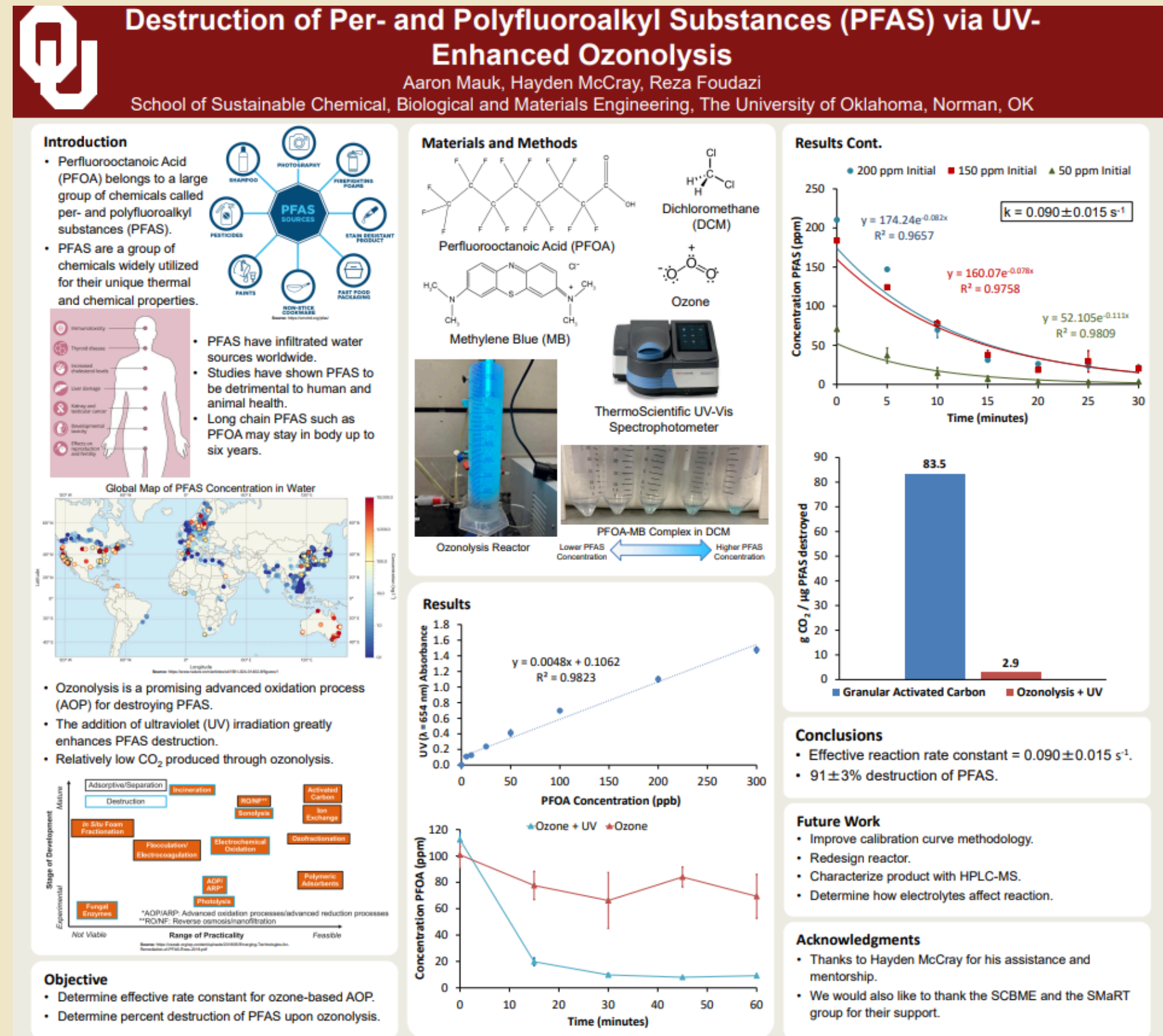
ACKNOWLEDGEMENTS

We would like to express our deepest gratitude to Dr. Mauricio Carvallo of the Department of Psychology for voluntarily and graciously guiding us through our first research experience. We would also like to express great thanks to Ranyu Bo for allowing us to be a part of her study, providing guidance, and allowing us to present the findings here. Additionally, this would not have been possible without the FYRE program and its coordinators, Drs. Miloš Savić and Heather Ketchum. Lastly, we'd like to acknowledge the University of Oklahoma's Honors College, for providing us the opportunity to be a part of the FYRE program.

Destruction of Per- and Polyfluoroalkyl Substances (PFAS) via UV-Enhanced Ozonolysis

Aaron Mauk, Hayden McCray, Reza Foudazi

School of Sustainable Chemical, Biological and Materials Engineering,
The University of Oklahoma, Norman, OK



The Effect of SDS and Silica on Foam Stability and Swelling Capacity in Foam-Templated Porous Hydrogels

Sydney Hulen, Sarah Onyembe, Reza Foudazi

School of Sustainable Chemical,
Biological and Materials Engineering,
University of Oklahoma, Norman, OK,
73019

The Effect of SDS and Silica on Foam Stability and Swelling Capacity in Foam-Templated Porous Hydrogels

Sydney Hulen, Sarah Onyembe, Reza Foudazi

School of Sustainable Chemical, Biological and Materials Engineering, University of Oklahoma, Norman, OK, 73019

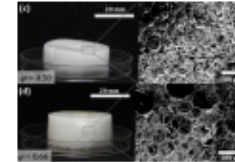
Introduction and Motivation

❖ A foam is the dispersion of a gas into a liquid.



❖ Foam-templated hydrogels are porous materials made from polymerized foams.

❖ They can absorb and retain water without dissolving in it.



❖ They have high porosity and good swelling kinetics.

❖ Since they are lightweight and easily altered, they are used in various real-world applications.



Challenges and Objectives

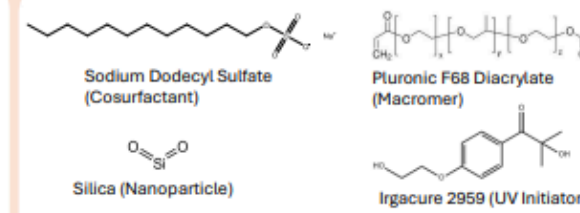
❖ **Current challenges:**

1. Creating foam-based hydrogels with small void sizes ($< 50 \mu\text{m}$)
2. Creating stable foams

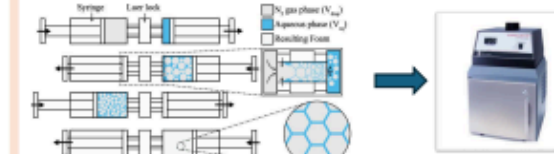
❖ **Research Goal:**

Optimize the stability of the foam and the swelling capacity of polyfoam hydrogels by comparing hydrogels made with SDS versus Silica.

Materials and Methods



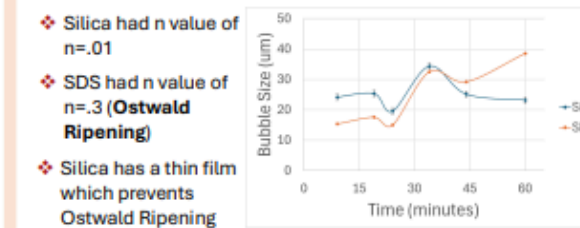
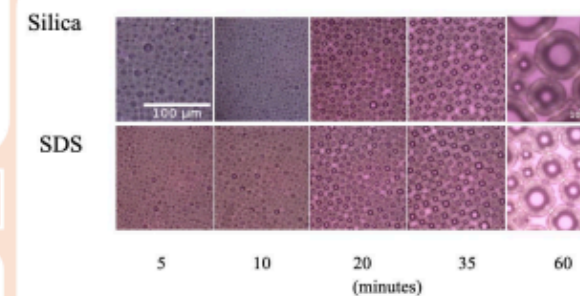
❖ Syringe method and UV chamber:



❖ **Tests:**

1. Microscope bubble images to determine the stability of each foam
2. Swelling capacity test to determine hydrogel absorbance

Results: Bubble Coarsening



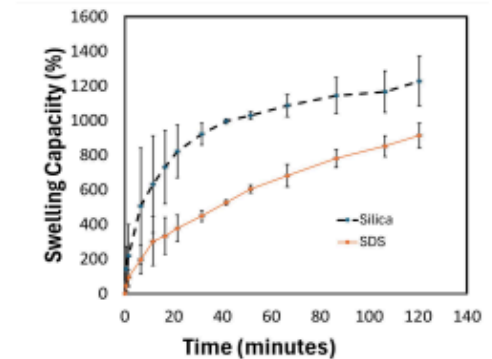
Results: Swelling Kinetics

❖ **Silica:** Highest swelling capacity: 1335%

❖ **SDS:** Highest swelling capacity: 909%

❖ Both SDS and Silica have fast swelling capacity, but overall Silica-based hydrogels swells faster.

$$\frac{(\text{Swelled mass} - \text{initial mass}) \times 100}{(\text{initial mass})}$$



Conclusion and Future Work

Conclusion:

- ❖ Silica foams are more stable than SDS because SDS undergoes Ostwald Ripening.
- ❖ Silica-based hydrogels consistently have a higher swelling capacity than SDS.

Future work:

- ❖ I will test different concentrations of Silica to optimize the hydrogel's swelling capacity and stability.

References:

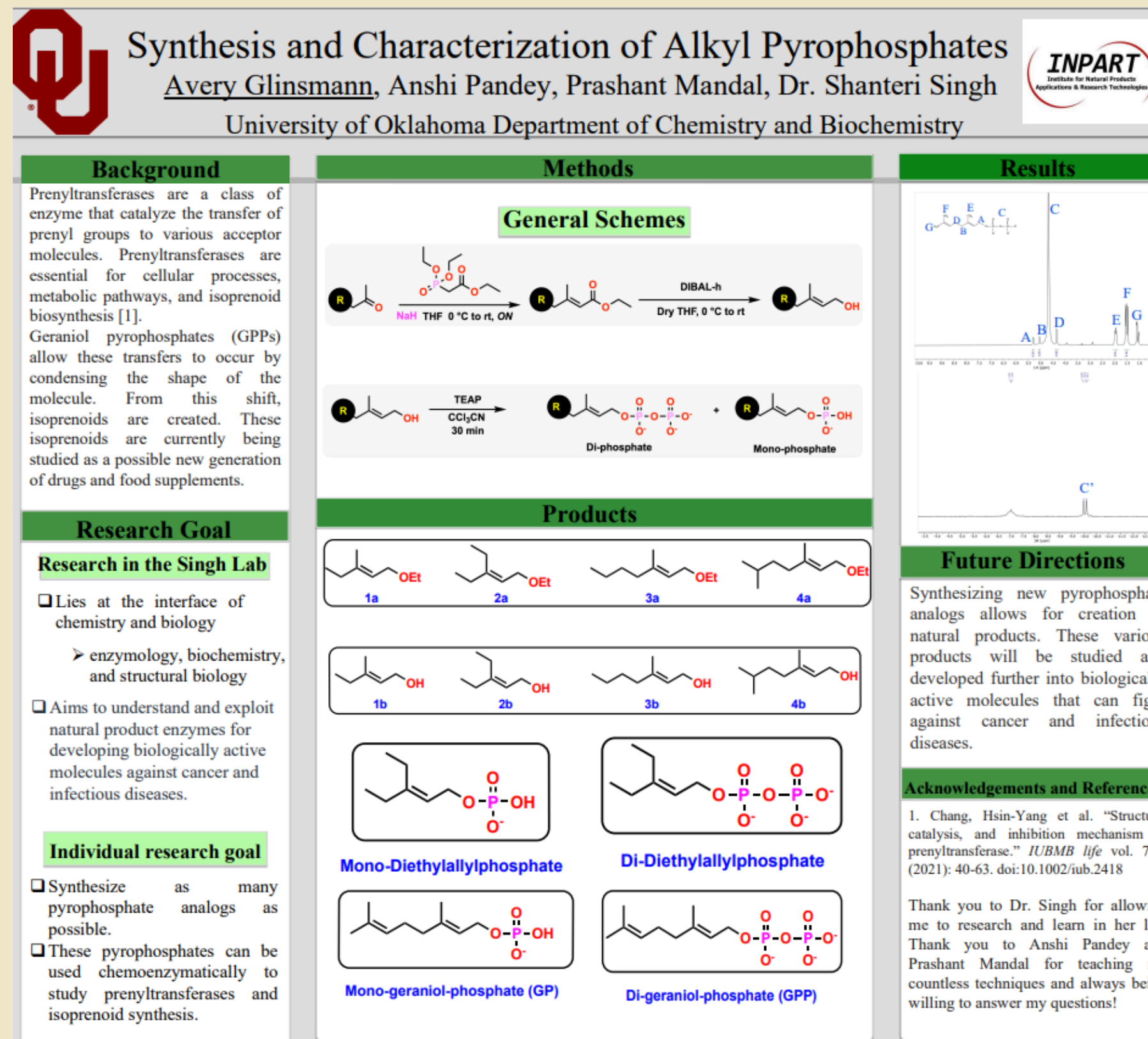
- ❖ Tripathy, D. B. (2023). *Polymer-Plastics Technology and Materials*, 62(18), 2403-2433.
- ❖ Zowada, Foudazi, Langmuir 36, 7868 (2020).

Acknowledgment: I would like to acknowledge to OU FYRE program for allowing me to participate in this research project.

Synthesis and Characterization of Alkyl Pyrophosphates

Avery Glinsmann, Anshi Pandey,
Prashant Mandal, Dr. Shanteri Singh

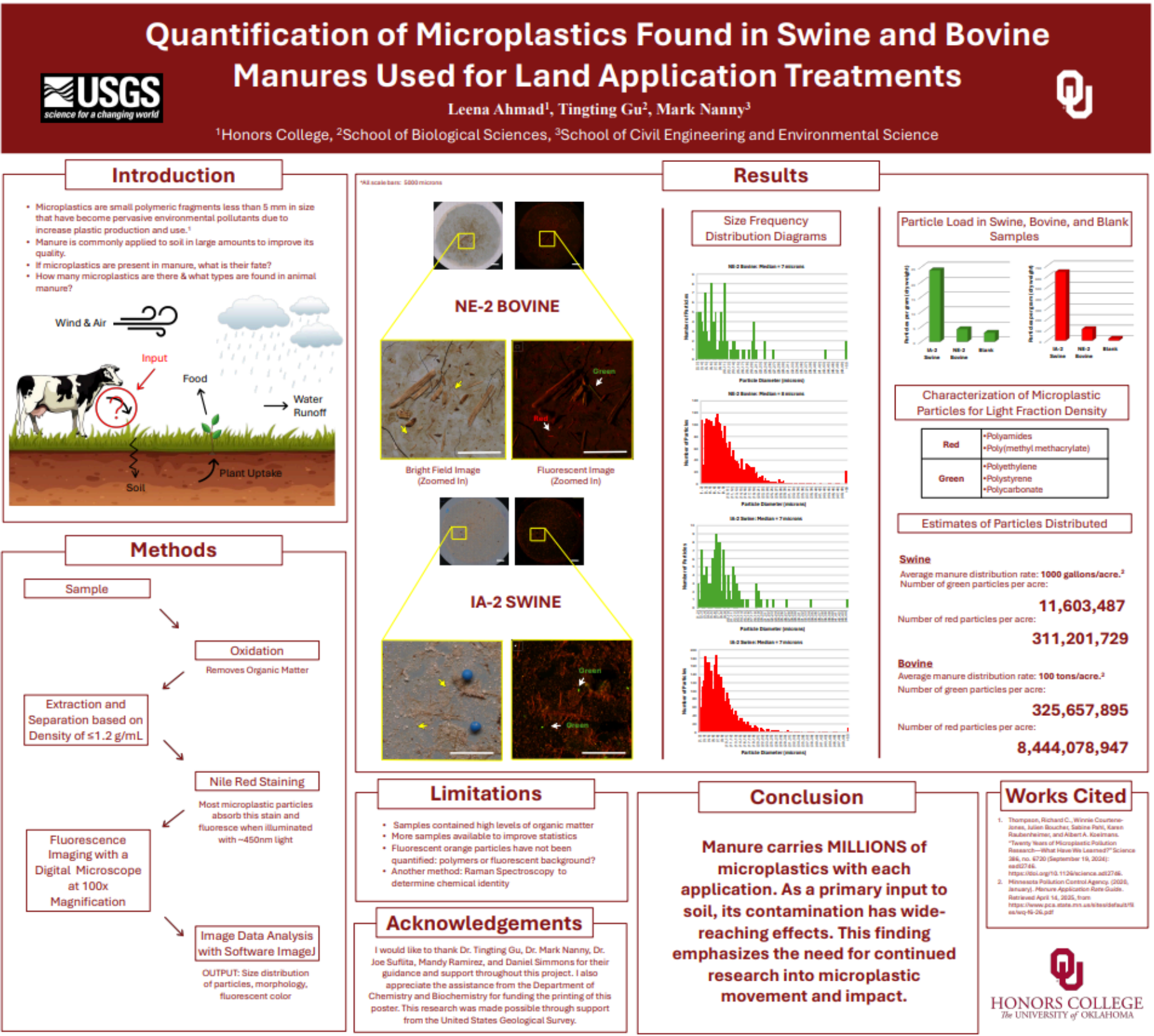
University of Oklahoma Department of
Chemistry and Biochemistry



Quantification of Microplastics Found in Swine and Bovine Manures Used for Land Application Treatments

Leena Ahmad, Tingting Gu, Mark Nanny

Honors College, School of Biological Sciences, School of Civil Engineering and Environmental Science



Architectural Proportion Through the Lenses of Sensory Psychophysics

Principal Investigators: Tiziana Proietti,
Ph.D., C. Gibbs College of Architecture,
Sergei Gepshtein – Collaboratory
for Adaptive Sensory Technologies

Salk Institute Collaborators: Sraboni Das
Meem – Graduate Teaching Assistant,
James Fawcett – Undergraduate
Academic Assistant , Emma Eitzen –
Graduate Research Assistant

Background

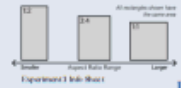
Sense|Base Laboratory is an interdisciplinary laboratory that bridges architecture and neuroscience with an emphasis on the perception of architectural proportion

Psychophysics examines the relationship between physical patterns (stimuli) that excite the observer's sensory system, and the sensations that the stimuli elicit.¹

Architectural Proportion and Aspect Ratios

Architectural Proportion: two-dimensional property of architectural objects, with a connection to the stationary observer, mobility, three-dimensionality, and perceptibility.²

i.e. The different elements of an architectural design.



This experiment tests subject's perceptibility in differing aspect ratios, which is the proportion of an object's width to its height


Experiment Objective

Just Noticeable Difference' (JND) - a term used to describe "the amount of change that is needed in order to perceive a difference between one stimulus and another."³

This experiment combines the ideas of sensory psychophysics, architectural proportion, and aspect ratios to test people's ability to perceive differences in aspect ratios, as well as determine the threshold of perceptibility.

Methodology


The experiment takes place on a computer, where we have written a program that produces combinations of varying aspect ratios. The participant is tasked with identifying the largest aspect ratio out of a set of two.



Three rounds: practice round - produces combinations with easier conditions (more perceptible differences in aspect ratios), and two "real" rounds with harder conditions (less perceptible/no differences), that take a longer amount of time. Data for the experiment is collected from these two rounds

- When the round is started, a 'fixation point' appears in the middle of the screen. The participant focuses on this point.
- After, the first rectangle appears and the participant has about one second to view it
- Then, a mock grid or 'mask' appears to separate the two rectangles
- After, the second rectangle appears
- Lastly, the response screen appears and the subject has a chance to input their choice. This continues until the round ends

The subject inputs their choice using a keyboard according to the system to the right



Architectural Proportion

Through the Lenses of Sensory Psychophysics

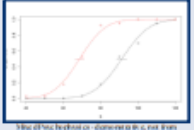
Principal Investigators: Tiziana Proietti, Ph.D. - C. Gibbs College of Architecture, Sergei Gepshtein - Collaboratory for Adaptive Sensory Technologies, Salk Institute
Collaborators: Sraboni Das Meem - Graduate Teaching Assistant, James Fawcett - Undergraduate Academic Assistant, Emma Eitzen - Graduate Research Assistant

Results

Psychometric Functions

This experiment utilizes psychometric functions to demonstrate the change in JND across aspect ratios and participants ⁴

- Y-axis: JND
- X-axis: aspect ratios



Although the research is still ongoing, we have produced many meaningful results

In total: 20 participants, 18 with new practice round implementation

- First few run-throughs: discursive data from subject to subject
- Solution: implementation of practice round, as described in methodology. Practice round allows participants to understand if they are choosing the correct option, allowing them to further understand the concept for the next two rounds
- Results: more concise data that can be analyzed with the psychometric function

As of right now, the research continues, and specific graphics are unable to be provided

Conclusion

Key Take-Aways

- The data we obtain from this experiment plays a key role in the advancement of different architectural principles
- Determining the threshold of perceptibility for aspect ratios gives further insight into the "Just Noticeable Difference" idea, which can be generalized to larger architectural concepts

Interpretation

- Although still in progress, the data that has been collected so far demonstrates how perceptibility can be quantified, specifically by psychometric means
- Not only have we tested a numerical threshold for aspect ratio perceptibility, we have also identified innate biases within individuals
 - In certain conditions, the aspect ratios are the same, yet participants input answers of confidence that one over the other is larger

References

¹ Elisabetta Canepa, *Generators of Architectural Atmosphere* (NPP eBooks, 2022), 99.
² Canepa: *Generators of Architectural Atmosphere*, 100.
³ Tiziana Proietti, *Revisiting the Plastic Number Theory from the Perspective of Perceptual Psychology* (Architectural Science Review, 2021), 5.
⁴ Proietti: *Revisiting the Plastic Number Theory from the Perspective of Perceptual Psychology*, 7

Storm Surge Surrogate Model Exploration Using MATLAB & Python

Andrew Patrick, Honors College Student, University of Oklahoma

Aikaterini Kyprioti² Ph.D, Assistant Professor, School of Civil Engineering and Environmental Science, University of Oklahoma



Storm Surge Surrogate Model Exploration Using MATLAB & Python

Andrew Patrick¹, Honors College Student, University of Oklahoma

Aikaterini Kyprioti² Ph.D, Assistant Professor, School of Civil Engineering and Environmental Science, University of Oklahoma

¹ ap6@ou.edu, ² akyriot@ou.edu



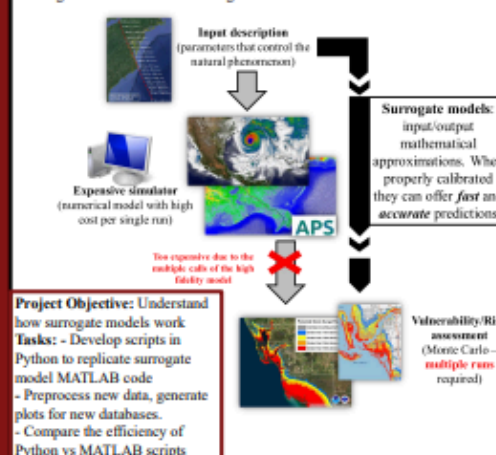
1. Introduction

A **storm surge** is a dangerous rise in sea level caused by powerful hurricane winds pushing ocean water onto land. It can flood coastal areas in minutes, making it one of the **deadliest natural hazards** for U.S. coastlines. Past storms like Katrina and Sandy show how devastating surge-driven flooding can be to lives, homes, and infrastructure



Hurricane Helene (2024) damages due to surge and high winds.

Machine learning (ML) coupled with numerical models that can capture complex natural phenomena and their interactions with the build environment is allowing for faster and accurate results that can improve long- and short-term risk management efforts.



Project Objective: Understand how surrogate models work
Tasks: - Develop scripts in Python to replicate surrogate model MATLAB code
- Preprocess new data, generate plots for new databases.
- Compare the efficiency of Python vs MATLAB scripts

2. Database Parametrization

Input definition:
Storm Features related to both the storm intensity / size / speed and to the track should be included:

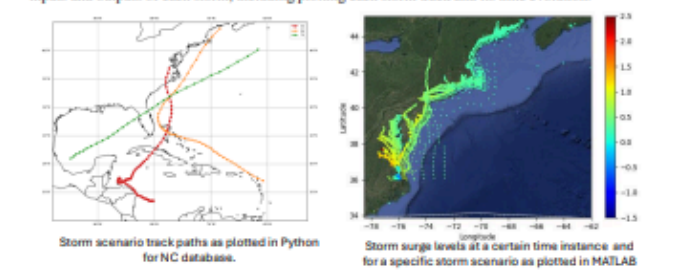
- Landfall location x_{lf} , y_{lf}
- Heading direction θ
- Central pressure deficit ΔP
- Forward speed v_f
- Radius of maximum winds R_{mw}

Output definition:
Spatial distribution of a quantity of interest (storm surge) across a large region of interest. These locations are in the order of tens of thousands and can reach a few millions. Information can be provided in two different ways:

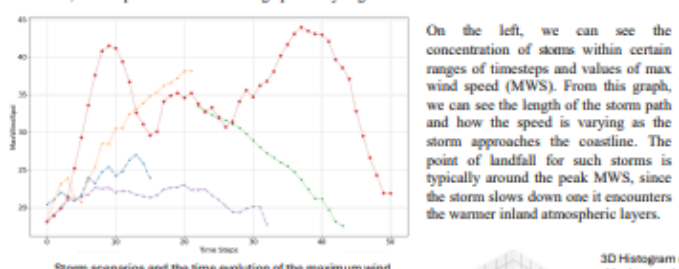
- Time series storm surge
- Peak (maximum) storm surge

3. Storm Scenario Exploration

Two different databases were explored here, one for the North Atlantic called NACCS (developed by the U.S. Army Corps of Engineers containing 535 storm scenarios), primarily looking at the states of NY and New Jersey, as well as a newly developed database on North Carolina called NC for brevity (courtesy of a large NSF CoPe grant containing 240 storm scenarios). Exploratory plots were generated for both the inputs and outputs of each storm, including plotting each storm track and its time evolution.



NACCS has been already validated in MATLAB, and it will serve as a baseline for code comparisons against the newly developed Python scripts. The new data set (that with 240 is currently being analyzed using Python, the data being visualized using Python libraries. By taking what we need from the data matrix, we can plot different kinds of graphs analyzing one storm at a time or all of them at once.



When analyzing the new storm data set (NC), various ways to search for trends were created. With the use of feature-over-time graphs, histograms of storms per range-of-feature, and by extension 3D histograms, allowed for the identification of the landfalling parameters that will be used in the surrogate model development. Out of the 240 storms, 190 are making landfall and 50 are bypassing the area. For each of them a vector of parameters x was defined.

4. MATLAB and Python

Code was generated in Python to replicate the routines that are currently executed through a sequence of MATLAB scripts. The reason why this transition was decided had to do with the benefits that Python is offering in the implementation of AI/ML tools and potentially the extension to different surrogate modeling methods beyond Gaussian Processes which is the current selection. Translation of code was validated with the NACCS database, ensuring that precision and memory requirements were kept approximately the same.



Snippets of the same code in MATLAB (left) and Python (right).

5. Results - Conclusions

Surrogate models, since they are data driven models, are fast to compute, so it is critical to compare the algorithm's performance to ensure that the model can be trained and also provide predictions in the least amount of time possible. When comparing the calibration (currently this is the part that has been completed in both Python and MATLAB) of the Gaussian processes, which was recently proposed for these purposes [1-4], for a subset (100 storms instead of 535) of the NACCS storm in MATLAB to the calibration in Python, we saw two main differences.



When we look at the time it takes for the MATLAB code to complete, it's consistently between 25.5 and 26 seconds. The Python code consistently finished between 32 and 33 seconds. Despite this difference, Python consistently takes around 2 to 4 GB less memory to run during most points in the runtime. So, a question for future investigation arises, on whether execution time for Python can be improved, for example employing some parallel computations or even lowering the precision (accuracy) in the significant digits that are kept.

A three-task project objective was presented here related to exploring surrogate modeling for storm surge estimation, using existing synthetic storm databases. Such data-driven models are expected to inform regional hazard risk assessments for coastline communities, aiming to improve their preparedness against such disastrous events (hurricanes) but also inform engineering design standards for the construction of new infrastructure. A new database was explored (NC) and parametrized, and codes were translated into Python from MATLAB, allowing comparisons in the execution time and memory requirements.



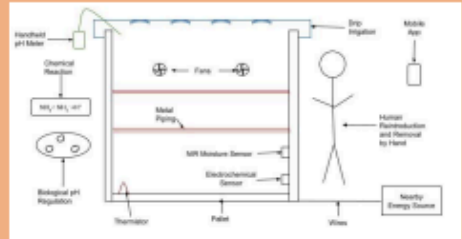
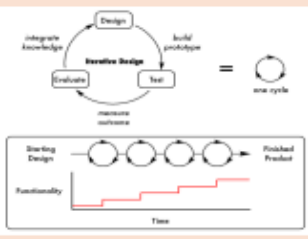

Using Python to explore storm surge surrogate models has a good chance of being more efficient than MATLAB. While analyzing the subsets, Python uses 2 to 4 GB less memory, though when analyzing the full set that gap will substantially widen, making Python favored for saving memory. Efforts will continue in translating as well as the testing and validation of the surrogate model to be able to provide more robust comparisons among the two.

6. References

- [1] A. Al Kajbaf and M. Bensi, "Application of surrogate models in estimation of storm surge: A comparative assessment," *ScienceDirect*, Jun. 2020. [Online]. Available: <https://doi.org/10.1016/j.asoc.2020.106184>
- [2] Kyprioti, Aikaterini P., Alexandros A. Taflanidis, Norberto C. Nadal-Caraballo, and Madison Campbell. "Storm hazard analysis over extended geospatial grids utilizing surrogate models." *Coastal Engineering* 168 (2021): 103855.
- [3] Kyprioti, Aikaterini P., Alexandros A. Taflanidis, Norberto C. Nadal-Caraballo, and Madison O. Campbell. "Incorporation of sea level rise in storm surge surrogate modeling." *Natural Hazards* 105 (2021): 531-563.
- [4] Kyprioti, Aikaterini P., Christopher Irwin, Alexandros A. Taflanidis, Norberto C. Nadal-Caraballo, Madison C. Yawn, and Luke A. Aucoin. "Spatio-temporal storm surge emulation using Gaussian Process techniques." *Coastal Engineering* 180 (2023): 104231.

Understanding Researching by Reflecting on Designing a Low-Cost, Smart Compost System

Jackson Clymer & Anthony Voci, and
Farrokh Mistree & Wesley Honeycutt

<div><div></div><div>TEAM MEMBERS Jackson Clymer Anthony Voci</div></div> <div><div>OU Mentors Farrokh Mistree Wesley Honeycutt</div><div></div></div>		<h1>Understanding Researching by Reflecting on Designing a Low-Cost, Smart Compost System</h1>	
PROBLEM	<h3>Background</h3> <ul style="list-style-type: none">Undergraduates with the First Year Research Experience (FYRE)Despite the engineering theme of the project, neither of us are engineering majors.	<h3>Why We Chose this Project</h3> <ul style="list-style-type: none">This project was designed to improve understanding of researchGaining an understanding early on can help us determine if research is something we want to pursue further and can put us on the right track.	<h3>Initial idea of Researching and Designing</h3> <ul style="list-style-type: none">Jackson's Initial Idea: Initially, I thought of research and design as two entirely different straightforward processes. I didn't think that each one had subsections that each focused on different aspects.Anthony's Initial Idea: When I started with FYRE, I thought research meant simply asking a question and solving it. I had not considered that it could be divided into distinct categories-or that designing and researching are different processes.
	<h3>Parallels Between Designing and Researching</h3> <ul style="list-style-type: none">Research Focuses on Gap in Knowledge<ul style="list-style-type: none">-What is not known, what knowledge are we trying to gain.Design Focuses on Gap in Capability<ul style="list-style-type: none">-What can we not do, how do we give ourselves the ability to do it. <div><div>Steps of Basic Research<ol style="list-style-type: none">Step 1: Identify Research QuestionStep 2: Gathering Background InformationStep 3: Designing the ExperimentStep 4: Running the ExperimentStep 5: Analyzing the DataStep 6: Interpreting ResultsStep 7: Forming a Conclusion</div><div>Steps of Original Design¹<ol style="list-style-type: none">Step 1: Problem statement and Requirements ListStep 2: Function StructuresStep 3: Morphological Chart and Available AssetsStep 4: Generate ConceptsStep 5: Description and Critical EvaluationStep 6: Evaluation CriteriaStep 7: Go/No Go AnalysisStep 8: Down Select</div></div>	<h3>Designing a Low-Cost, Smart Compost System</h3> <ul style="list-style-type: none">Outlined the ProblemGenerated Potential SolutionsCritically Evaluated SolutionsDown Selected to one Concept 	<h3>Takeaways Relating Designing to Researching</h3> <ul style="list-style-type: none">By going through the process of original design, we formed takeaways that influenced our larger idea of researchJackson's Takeaway: Through working on the Plus Minus Interesting and Program Decision Process Chart, I found out that I do not enjoy working on the steps associated with basic research, which will help me guide my future towards something I enjoy like applied research.Anthony's Takeaway: By understanding co-locations, I have gained deeper insight into how the aspects of designing interacts with the world and connects to basic research.
DESIGN METHOD			
DATA / OUTCOMES	<h3>What Did We Gain</h3> <p>Jackson's Value: I learned about the different aspects of research, including which aspects I liked and disliked. I gained a better understanding of research, which I can use to serve as a foundation for future research projects.</p> <p>Anthony's Value: I learned more about myself and how I process new topics. I now understand that breaking down learning into distinct phases mirrors the iterative nature of both research and design, enabling me to absorb and apply new ideas more effectively.</p>	<h3>New Idea of Researching</h3> <ul style="list-style-type: none">Research is the systematic process of creating new knowledge and procedures. Basic Research is specifically about creating new knowledge, while applied research uses knowledge to solve practical problems. 	<h3>Future with Researching</h3> <ul style="list-style-type: none">Jackson's Future Plans: I enjoyed the problem-solving aspect of the design process, so I am pursuing applied research in the field of chemistry. I have changed my major to chemical engineering to give myself more opportunities to pursue applied research.Anthony's Future Plans: I found the process of basic research incredibly engaging, and I look forward to delving even deeper into further studies. As a meteorology major, I am excited about exploring how basic research connects to my field and am now considering pursuing a PhD.
	<div><div>Images used<ol style="list-style-type: none">Nagarikoti, Neha, et al. DESIGNING a NEONATAL TRANSPORT INCUBATOR for RURAL INDIA.Blogger. (2024b, May 25). The Iterative Design Process: A Full Guide for UX Designers.</div><div>Acknowledgements: We would like to thank Dr. Farrokh Mistree and Dr. Wesley Honeycutt for mentoring us through this research experience, the Honors College for providing the opportunity to get involved in first year research, Dr. Heather Ketchum and Dr. Miloš Savić for giving us helpful advice throughout the research process, and the Department of Chemistry and Biochemistry and the School of Biology for printing out the poster.</div></div> <div><div></div><div>GALLOGLY COLLEGE OF ENGINEERING SCHOOL OF AEROSPACE AND MECHANICAL ENGINEERING THE UNIVERSITY OF OKLAHOMA</div><div>2025 Undergraduate Research Day</div></div>		

Relevance Classification A Learning Approach for Social Media

Shawn Agarwal

RELEVANCE CLASSIFICATION

A LEARNING APPROACH FOR SOCIAL MEDIA



SHAWN AGARWAL

BACKGROUND

PROBLEM:

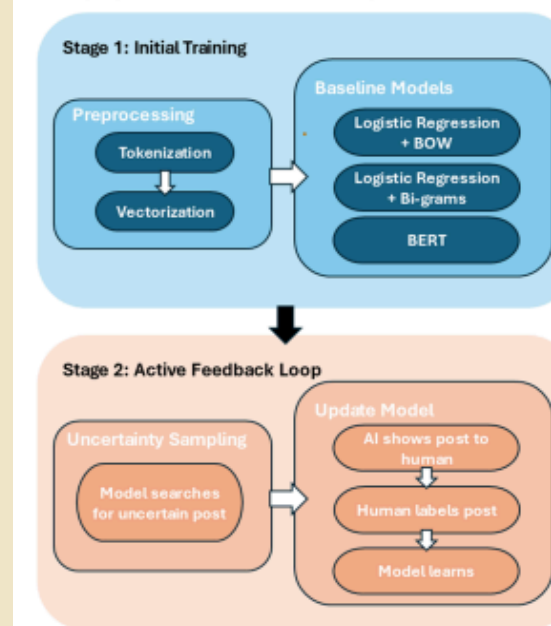
Social media classification is challenging due to sarcasm, slang, and ambiguous language.

OBJECTIVE:

Develop a model to classify social media content as relevant or not, accurately using active learning and contextual understanding.

METHODOLOGY

TWO-STAGE LEARNING:



DATASET

SENTIMENT140 DATASET WITH 1.6 MILLION TWEETS:

Contains 1.6 million tweets from 2009 collected using the Twitter API.



RESULTS

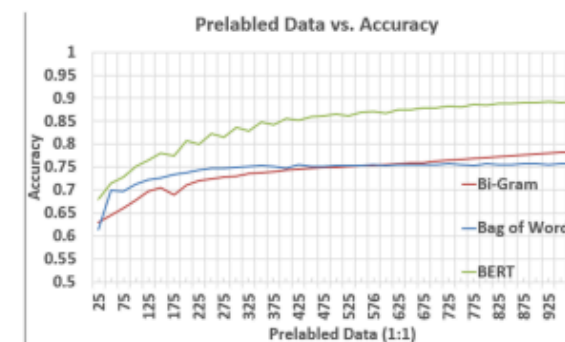
BI-GRAMS: WORD PAIR FREQUENCY

BAG OF WORDS: SINGLE WORD FREQUENCY

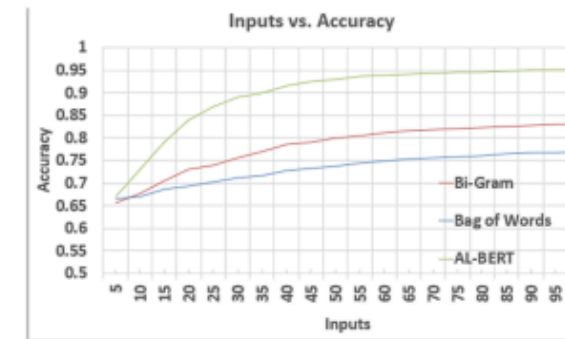
BERT: CONTEXTUAL UNDERSTANDING

AL-BERT: ACTIVE LEARNING BERT

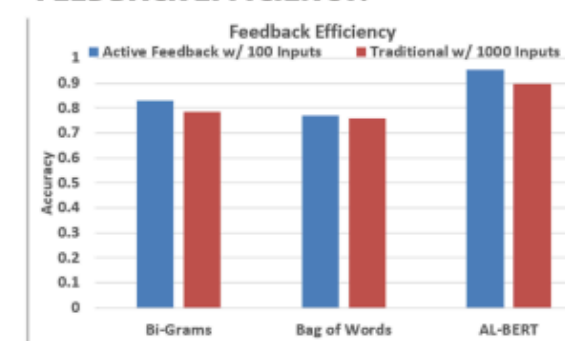
ACCURACY WITHOUT FEEDBACK :



ACCURACY WITH FEEDBACK:



FEEDBACK EFFICIENCY:



DISCUSSION

KEY INSIGHTS:

◇ ACTIVE FEEDBACK WORKS:

- Models using human feedback outperformed the traditional method by resolving slang and sarcasm

◇ CONTEXT IS KEY:

- AL-BERT beat simpler models by understanding sentences, not just words

CHALLENGES:

◇ OLD DATASET

- Missing modern slang

◇ EFFORT:

- Requires human effort but it ensures adaptability

WHY IT MATTERS:

- Improves social media moderation and personalized recommendations
- Balances AI efficiency with human intuition
- It's like a self-driving car with a human co-pilot

FUTURE STEPS:

- Use newer data
- Reduce human effort with automated feedback

CONCLUSION

Combining AI's ability to process millions of tweets with human insight into nuances yields a more accurate classifier for ambiguous domains - healthcare, education, customer service, legal, social media, and news.

ACKNOWLEDGEMENTS

This work is supported in part by the Data Institute for Societal Challenges, University of Oklahoma.

WORKS CITED

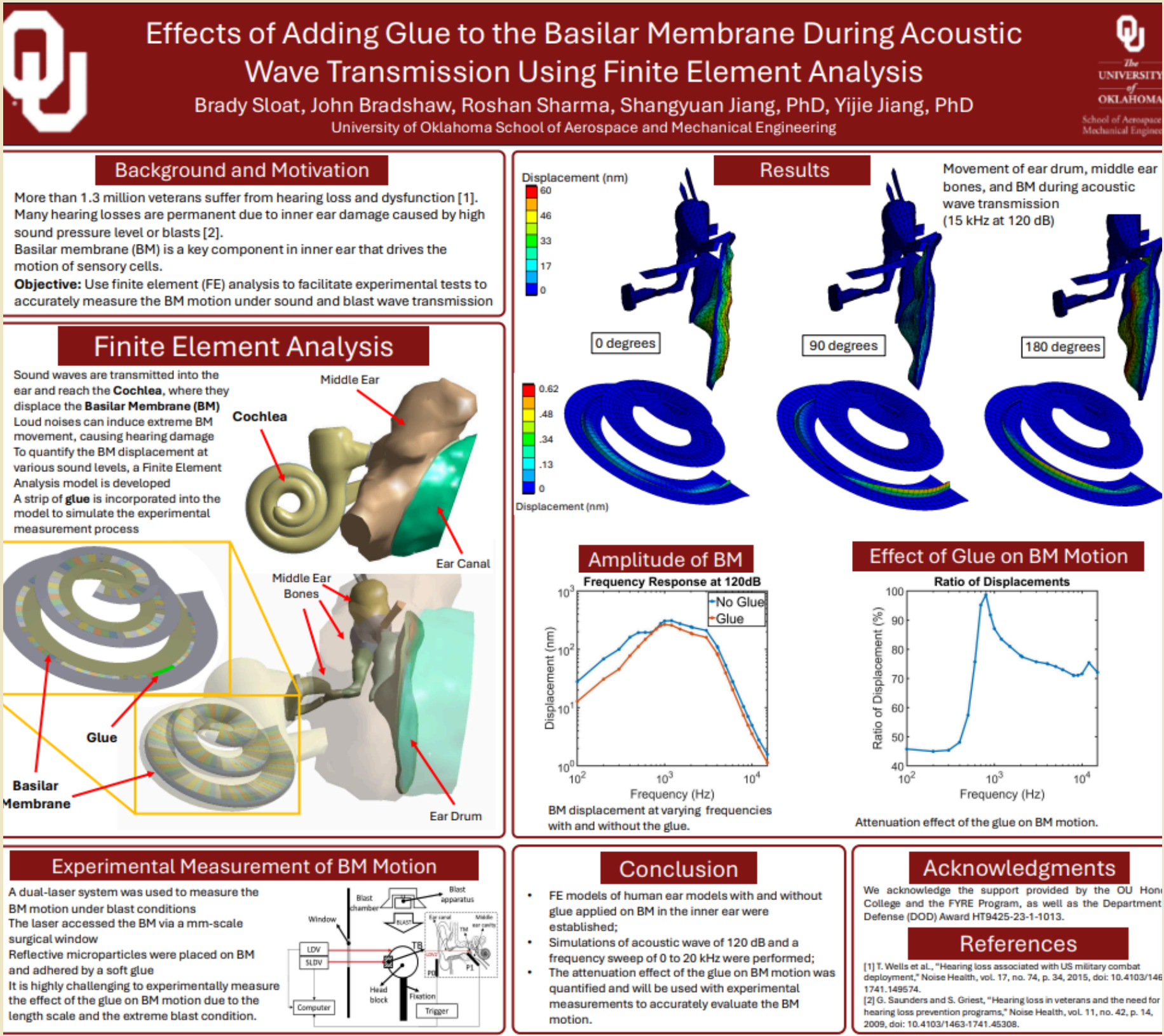
Cook, T. (2020, August 30). How BERT determines search relevance. Towards Data Science.

Sentiment 140

Baumgärtner, T., Ribeiro, L. F. R., Reimers, N., & Gurevych, I. (2022). Incorporating relevance feedback for information-seeking retrieval using few-shot document re-ranking. In Proceedings of the 2022 Conference on Empirical Methods in Natural Language Processing (EMNLP). Association for Computational Linguistics.

Effects of Adding Glue to the Basilar Membrane During Acoustic Wave Transmission Using Finite Element Analysis

Brady Sloat, John Bradshaw, Roshan Sharma, Shangyuan Jiang, PhD, Yijie Jiang, PhD
University of Oklahoma School of Aerospace and Mechanical Engineering



Long-Term Cannabis Use and Mental Health: Evidence from 12 years of Data

Yu Lu, Isabella Perna, Jasmine Nguyen, Jeong Kyu Lee, David Joseph Regelmann, Jeff R. Temple

Department of Health and Exercise Science, University of Oklahoma, Department of Classics and Letters , University of Oklahoma, Hartford HealthCare Medical Group, School of Behavioral Health Sciences, University of Texas Health Sciences Center at Houston



Long-Term Cannabis Use and Mental Health: Evidence from 12 years of Data

Yu Lu¹, Isabella Perna², Jasmine Nguyen¹, Jeong Kyu Lee¹, David Joseph Regelmann³, Jeff R. Temple⁴

¹ Department of Health and Exercise Science, University of Oklahoma, ² Department of Classics and Letters , University of Oklahoma, ³ Hartford HealthCare Medical Group, ⁴ School of Behavioral Health Sciences, University of Texas Health Sciences Center at Houston

Study Purpose

- The prevalence of cannabis use has been increasing in the U.S.¹
- Cannabis use has been associated with a range of adverse mental health outcomes, such as depression,² anxiety,¹ substance use disorders and dependence,¹ suicide ideation and attempts.³
- However, existing research primarily rely on cross-sectional data, longitudinal relationships between cannabis use and mental health outcomes remain unclear.
- The **purpose** of the study are to:
 - Examine cannabis usage (i.e., # of years using cannabis, age of initiation, and ever daily cannabis usage) in a sample of U.S. adolescents over 12-year period.
 - Examine how cannabis use in adolescence and young adulthood associate with with depression, anxiety, mental health treatment, and suicide ideation in adulthood.

Methods

Data: Annual survey data from *Dating it Safe*, collected in 2010-2017 (Waves 1-8) and 2020-2023 (Waves 9-12).

Participants: 1,042 participants initially recruited from multiple high schools in Texas.

- Mean age = 15.1 years, SD = .79, range: 13 - 18 years at Wave 1
- 56% female, 44% male
- 31.4% Hispanic, 27.9% Black, 29.4% White, 118 other

Measures

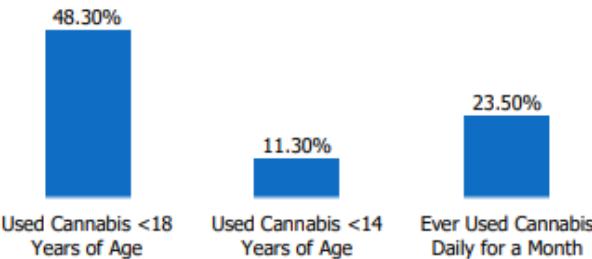
- Cannabis Use
 - "In your lifetime, have you ever used marijuana?" (W1)
 - "If yes, how old were you the first time you used?" (W1)
 - "In the past month, how many days did you use marijuana?" (W1-12)
- Mental Health
 - Depression (CES-D, W1, W12)
 - Anxiety (SCARED, W1, W12)
 - Mental Health Treatment: "Have you received mental health treatment IN THE PAST YEAR from a psychologist, psychiatrist, social worker, or counselor?" (W1, W12)
 - Suicide Ideation: "Have you thought about suicide in the PAST YEAR?" (W9, W12)

Analysis

- Multiple regression analyses were conducted in SPSS 29, controlling for age, gender, race, and prior mental health

Results

Descriptive Statistics of Cannabis Use



of Years Used Cannabis

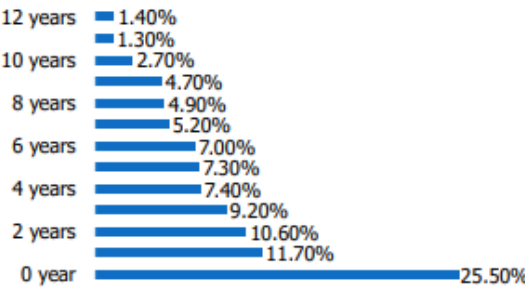


Table 1. Multiple Regression Results of Cannabis Use and Mental Health Outcomes (N = 1,042)

	W12 Depression	W12 Anxiety	W12 Mental Health Treatment	W12 Suicide Ideation
	β	β	AOR (95% CI)	AOR (95% CI)
Used Cannabis <18 Years of Age	-.03	-.06	.79 (.50, 1.26)	1.08 (.60, 1.97)
# of Years Used Cannabis	.10*	.13**	1.15*** (1.06, 1.24)	1.17** (1.06, 1.29)
Ever Used Cannabis Daily for a Month	.12**	.01	.69 (.42, 1.15)	.95 (.51, 1.75)
Age	-.02	-.08*	.83 (.63, 1.11)	.85 (.60, 1.22)
Gender (ref.: female)	-.03	-.19***	.30*** (.19, .49)	.66 (.38, 1.14)
Race (ref.: White)				
Hispanic	-.04	-.07	.54* (.32, .94)	.84 (.45, 1.58)
Black	-.05	-.19***	.61 (.36, 1.04)	.57 (.29, 1.11)
Other	-.05	.01	.77 (.39, 1.51)	.45 (.17, 1.15)
Prior Mental Health	.22***	.27***	1.37 (.83, 2.25)	9.29*** (5.50, 15.69)

Note. * $p < .05$, ** $p < .01$, *** $p < .001$. β = standardized coefficients, AOR = adjusted odds ratio, CI = confidence interval, ref. = reference group.

References

- Guttmannova, K., Kosterman, R., White, H. R., Bailey, J. A., Lee, J. O., Epstein, M., Jones, T. M. & Hawkins, J. D. (2017). The association between regular marijuana use and adult mental health outcomes. *Drug and Alcohol Dependence*, 179, 109-116.
- Bahorik, A. L., Sterling, S. A., Campbell, C. I., Weisner, C., Ramo, D., & Satre, D. D. (2018). Medical and non-medical marijuana use in depression: longitudinal associations with suicidal ideation, everyday functioning, and psychiatry service utilization. *Journal of Affective Disorders*, 241, 8-14.
- Kahn G. D., & Wilcox, H. C. (2022). Marijuana use is associated with suicidal ideation and behavior among US adolescents at rates similar to tobacco and alcohol. *Archives of suicide research*, 26(2), 520-533.

Acknowledgements

We acknowledge the support provided by the OU Honors College and the FYRE Program. Additionally, this research was supported by Award Number K23HD059916 (PI: Temple) from the Eunice Kennedy Shriver National Institute of Child Health and Human Development (NICHD) and 2012-WG-BX-0005 (PI: Temple) from the National Institute of Justice (NIJ). The content is solely the responsibility of the authors and does not necessarily represent the official views of NICHD or NIJ.

Conclusions

- Findings suggest long-term cannabis use during adolescence and young adulthood can lead to mental health problems in adulthood.
- Intervention and preventions are needed, especially for adolescents and young adults.
- Future research should examine mode of usage (e.g., smoked, vaped, ingested) and occasions of usage (e.g., social use).



Optical Properties of Perovskite Nanoplatelets

Ethan Leehan, Matthew Atteberry, and Yitong Dong

Department of Chemistry and Biochemistry, University of Oklahoma, Norman, OK, USA



Optical Properties of Perovskite Nanoplatelets

Ethan Leehan, Matthew Atteberry, and Yitong Dong
Department of Chemistry and Biochemistry, University of Oklahoma, Norman, OK, USA

Background

Nanoplatelets (NPLs) are semiconductor perovskite nanocrystals with an anisotropic shape, confined to two dimensions. The optical properties of nanocrystals are found to be defined by their size and morphology¹.

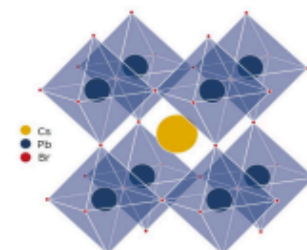


Fig. 1: Perovskite crystal structure²

Semiconductor NPLs exhibit related yet distinct properties with isotropic, or zero-dimensional, quantum dots. Dimensions of CsPbBr₃ nanocrystals can be morphologically manipulated during synthesis. Specifically, their confined dimension, or their thickness, can be enlarged via manipulation of bromide concentration³. It is hypothesized that reducing bromide in the synthesis of NPLs will increase their thickness in a similar manner.

Further, the brightness of excited NPLs can be increased by the addition of zinc (II) bromide solution, which makes the sample more pristine or uniform⁴.

Objective

- To predictably control the thickness and brightness of NPLs.
- Confirm the dimensional enlargement via reduction of available bromide
- Confirm the brightening of NPLs using zinc (II) bromide

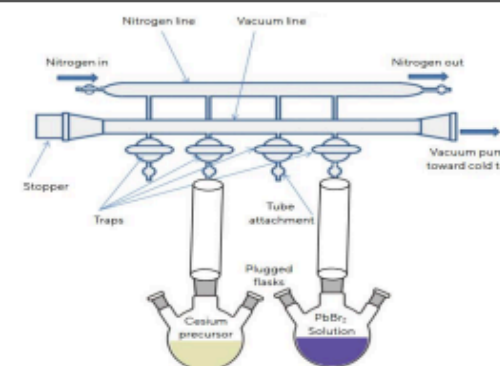


Fig. 3: Schlenk line synthesis set-up

Methodology

Synthesis was performed on a Schlenk line to introduce either nitrogen or a vacuum without oxygen exposure. The concentration of copper (II) bromide and cobalt (II) bromide was lowered by 15 and 25% to increase NPL thickness.

Cesium Precursor

- Cs₂CO₃ was triple pumped onto the line, mixed with Octadecene (ODE) and Oleic Acid (OA) in a three-neck flask
- Flask was vacuumed for 10 minutes at room temperature, then refilled with nitrogen
- Flask was heated to and maintained at 150 °C

Nanoplatelet Synthesis

- PbBr₂, CuBr₂, and CoBr₂ were triple pumped onto the line, mixed with ODE, OA, and Oleylamine (OAm) in a three-neck flask
- Flask was vacuumed for 10 minutes while heating to 120 °C
- Flask was refilled with nitrogen and heated further to 200 °C
- Flask was immediately placed in an ice bath until it reached room temperature
- 0.4 mL of Cesium Precursor were simultaneously cooled to room temperature and injected into the flask
- Contents of flask were transferred to a vial and mixed with 10 mL of acetone, allowing time to react
- Solution was centrifuged for 3 minutes, and the precipitate was redispersed in 2 mL of hexane

Purification of Nanoplatelets

- Dispersed NPLs were centrifuged for 3 minutes, and the supernatant was transferred to a new vial
- 2 mL of methyl acetate were added, allowing time to react
- Solution was centrifuged for 3 minutes, and the precipitate was again redispersed in 2 mL of hexane
- Dispersed NPLs were centrifuged for 3 minutes and transferred to a new vial

Brightening Nanoplatelets

- ZnBr₂ was dispersed in hexane and trace OAm
- 10 µL of ZnBr₂ solution was added to each mL of nanoplatelet solution

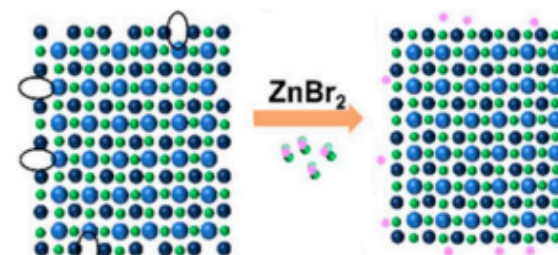


Fig. 4: ZnBr₂ brightening process⁴

Results

Absorbance and photoluminescence wavelengths recorded 'spikes' at wavelengths consistent with nanoplatelets. For photoluminescence, wavelengths were uniformly 435±1nm, with absorbance at 430±1nm. Since previous work with nanoribbons and nanowires characterize increased thickness with an increase in absorbance and photoluminescence wavelengths³, it is inconclusive whether the samples grew in that dimension. Further, brightened samples were consistently more photoluminescent and absorptive.

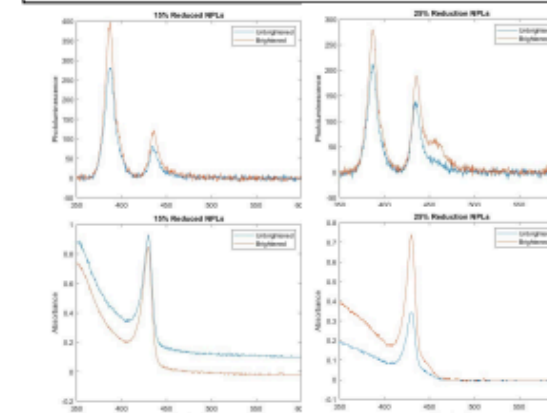


Fig. 5: Absorbance and photoluminescence data

Conclusion

The data does not support morphological control of NPLs, failing to increase thickness through bromide manipulation; further, the brightness of the samples are significantly increased when zinc (II) bromide is introduced. More work into controlling the anisotropy of NPLs is required to confirm whether such dimensional manipulation is feasible.

References

- Hu, J.; Li, L.-S.; Yang, W.; Manne, L.; Wang, L.-W.; Alivisatos, A. P. Linearly Polarized Emission from Colloidal Semiconductor Quantum Rods. *Science* 2001, 292 (5534), 2560-2563. <https://doi.org/10.1126/science.1060810>.
- Ron, M.; Roni, P. An introduction to perovskites. *Perovskite-info.com*. <https://www.perovskite-info.com/introduction> (accessed 2022-04-14).
- Dong, Y.; Qiao, T.; Kim, D.; Rossi, D.; Ahn, S. I.; Sen, D. H. Controlling Anisotropy of Quantum-Confinement CsPbBr₃ Nanocrystals by Combined Use of Equilibrium and Kinetic Anisotropy. *Chem. Mater.* 2019, 31 (15), 5655-5662. <https://doi.org/10.1021/acs.chemmater.9b01515>.
- Zhang, X.; Zhou, Y.; Peng, L.; Lin, Z.; Chang, Y.; Zhou, Z.; Li, Y. Stable Blue-Emitting CsPbBr₃ Nanoplatelets for Lighting and Display Applications. *ACS Appl. Nano Mater.* 2022, 5 (11), 17013-17021. <https://doi.org/10.1021/acsnanm.2c03940>.

Adverse Childhood Experiences (ACEs) and the noise level in CAPs data

Kushagra Rawal, Brenna Arledge, Emma Auger, Elizabeth Skowron, David Bard, and Lauren Ethridge

University of Oklahoma, Department of
Psychology University of Oregon,
Department of Psychology

Adverse Childhood Experiences (ACEs) and the noise level in CAPs data.



Kushagra Rawal¹, Brenna Arledge¹, Emma Auger¹, Elizabeth Skowron², David Bard³, and Lauren Ethridge¹

¹University of Oklahoma, Department of Psychology

²University of Oregon, Department of Psychology

Introduction

Child-Maltreatment

- Affects nearly one million children each year.
- Can lead to trauma, dysregulation, and even changes in internal neural function¹.
- Difficult to treat and causes developmental delays in children.

Parent-Child Interaction Therapy

- An intervention system that has been proven to successfully reduce harsh and aversive parenting².
- Decreases rates of CM recidivism from 50% to 19% while fostering higher quality relationships between parent and child.
- Uses goal-driven sessions and in-the-moment coaching from the therapist to guide parents through interactions with their child.
- Limited information about how PCIT exactly helps and through what functions it improves family dynamics.

Adverse Childhood Experiences (ACEs)

- Including abuse, neglect, and family dysfunction, could have an impact on brain development, emotional regulation, and health outcomes.

Effects on Electroencephalogram (EEG) Data

- This analysis looks at the effects of adverse childhood experiences have on EEG data cleanliness, measured by percentage of components removed from the data.
- Artifact contamination (e.g., movement, muscle tension) is common in pediatric and high-stress populations.

Methods

- **Participants**

- 204 parent-child dyads with indication of maltreatment were recruited from Oregon DHS.
- Selected dyads were randomly assigned to PCIT treatment group or services as usual control group.

- Resting EEG

- 64-channel Electroencephalogram for children.
- 256-channel Electroencephalogram for adults.
- 4 minutes alternating eyes open (fixated on blank screen) and eyes closed.
- Messiness of data was operationalized by the percentage of component removed from their data, with higher percentages indicating messier data.

- Adverse Childhood Experiences Scale (ACES)

- Parents reported their own and their child's exposure to adverse childhood experiences.
- Total scores were summed out of a total of 10, with higher scores indicating more experience with childhood trauma.

Results

- A paired t-test was run to examine the differences in parent-child dyads experiences with childhood trauma. There was a significant difference between parent and child ACE scores ($t(1,47)=4.27, p<0.001$). This shows that the parent and child ACE scores are different, with the parent scores being higher overall.
- Pearson's correlations were run to further explore these relationships. Parent and child ACE scores are significantly positively correlated ($r(46)=.41, p=0.004$). This suggests that as parent ACE scores increase so does their child's ACE score, suggesting an intergenerational association in ACE scores.

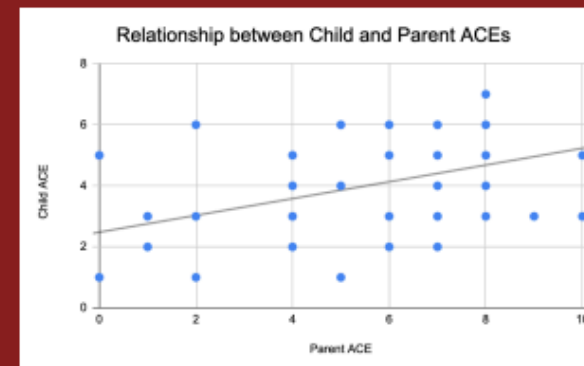


Figure 1. Scatterplot showing each family's Parent ACE score (x-axis) and Child ACE score (y-axis). There is a positive trend, illustrating that parents with higher ACE scores have children with higher scores.

- A Paired t-test were run to explore the relationship between parent and child EEG data, measured by percentage of components removed from the data. The t-test was significant ($t(1,47) = -9.43, p < 0.001$), suggesting that children and parent data differ overall in the messiness of the data.

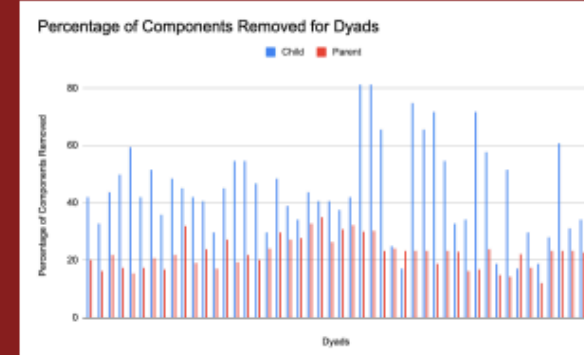
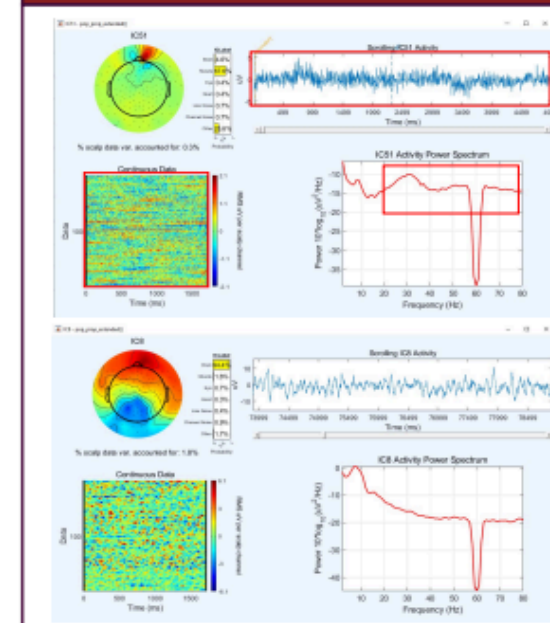


Figure 2. Bar graph comparing the percentage of components removed during EEG cleaning for parents (red) and children (blue) in each dyad. Children consistently required a higher percentage of components to be removed, indicating noisier or more artifact-laden EEG data.

Component Examples



Conclusion

- Intergenerational trauma refers to the psychological and biological transmission of trauma from parents to children, as shown in studies like Yehuda et al. (2005), which found altered stress hormone levels in children of Holocaust survivors, suggesting trauma can be passed down even without direct exposure.
- The observed differences in EEG data quality across developmental stages and highlights the importance of careful artifact removal, especially in pediatric neurophysiological studies
- Importantly, ACE score did not impact data quality in our sample. This suggests that although childhood trauma impacts manifest in a multitude of ways, it does not appear to diminish data quality.
- The next steps would be processing the same data for non-resting tasks to see if there are any impacts compared to the REST data.

Works Cited

1. Harnett, P. F., De A., & Clark, C. (2005). A comparison of the developmental and social adjustment of children and adolescents in residential care facilities in Australia. *Journal of Child Psychology and Psychiatry*, 46, 1227-1238. <https://doi.org/10.1111/j.1469-7610.2004.01372.x>

2. Harnett, P., & Donner-Bennett, S. (2014). Assessing Evidence for Parent-Child Interaction in the Prevention of Child Maltreatment. *Child Development*, 85(1), 175-186. <https://doi.org/10.1111/cdev.12188>

3. Thomas, A., Gould, M. B., & McMahon, S. C. (2019). *Screening, Diagnosis, and Treatment of Child and Adolescent Depression*. In P. A. Jellinek, R. W. Ge, & A. C. H. Williams (Eds.), *Introduction to DSM-5 and Special-Needs Assessment: Recognition, Impact, and Treatment*. San Antonio, Texas: Springer.

4. Harnett, A. J. (2012). *The Role of Parent-Child Interaction Therapy in Helping Children's Neural Profiles in a Broad Study of Children's Responses to Parenting*. Unpublished doctoral dissertation, University of North Carolina at Chapel Hill.

5. Finkelhor, D., & Browne, A. (1985). The traumatic impact of child sexual abuse: A conceptualization. *Psychological Bulletin*, 98, 66-107. <https://doi.org/10.1037/0033-2909.98.2.66>

6. Finkelhor, D., & Browne, A. (1985). The traumatic impact of child sexual abuse: A conceptualization. *Psychological Bulletin*, 98, 66-107. <https://doi.org/10.1037/0033-2909.98.2.66>

7. Finkelhor, D., & Browne, A. (1985). The traumatic impact of child sexual abuse: A conceptualization. *Psychological Bulletin*, 98, 66-107. <https://doi.org/10.1037/0033-2909.98.2.66>

8. Finkelhor, D., & Browne, A. (1985). The traumatic impact of child sexual abuse: A conceptualization. *Psychological Bulletin*, 98, 66-107. <https://doi.org/10.1037/0033-2909.98.2.66>

9. Finkelhor, D., & Browne, A. (1985). The traumatic impact of child sexual abuse: A conceptualization. *Psychological Bulletin*, 98, 66-107. <https://doi.org/10.1037/0033-2909.98.2.66>

10. Finkelhor, D., & Browne, A. (1985). The traumatic impact of child sexual abuse: A conceptualization. *Psychological Bulletin*, 98, 66-107. <https://doi.org/10.1037/0033-2909.98.2.66>

11. Finkelhor, D., & Browne, A. (1985). The traumatic impact of child sexual abuse: A conceptualization. *Psychological Bulletin*, 98, 66-107. <https://doi.org/10.1037/0033-2909.98.2.66>

12. Finkelhor, D., & Browne, A. (1985). The traumatic impact of child sexual abuse: A conceptualization. *Psychological Bulletin*, 98, 66-107. <https://doi.org/10.1037/0033-2909.98.2.66>

13. Finkelhor, D., & Browne, A. (1985). The traumatic impact of child sexual abuse: A conceptualization. *Psychological Bulletin*, 98, 66-107. <https://doi.org/10.1037/0033-2909.98.2.66>

14. Finkelhor, D., & Browne, A. (1985). The traumatic impact of child sexual abuse: A conceptualization. *Psychological Bulletin*, 98, 66-107. <https://doi.org/10.1037/0033-2909.98.2.66>

15. Finkelhor, D., & Browne, A. (1985). The traumatic impact of child sexual abuse: A conceptualization. *Psychological Bulletin*, 98, 66-107. <https://doi.org/10.1037/0033-2909.98.2.66>

16. Finkelhor, D., & Browne, A. (1985). The traumatic impact of child sexual abuse: A conceptualization. *Psychological Bulletin*, 98, 66-107. <https://doi.org/10.1037/0033-2909.98.2.66>

17. Finkelhor, D., & Browne, A. (1985). The traumatic impact of child sexual abuse: A conceptualization. *Psychological Bulletin*, 98, 66-107. <https://doi.org/10.1037/0033-2909.98.2.66>

18. Finkelhor, D., & Browne, A. (1985). The traumatic impact of child sexual abuse: A conceptualization. *Psychological Bulletin*, 98, 66-107. <https://doi.org/10.1037/0033-2909.98.2.66>

19. Finkelhor, D., & Browne, A. (1985). The traumatic impact of child sexual abuse: A conceptualization. *Psychological Bulletin*, 98, 66-107. <https://doi.org/10.1037/0033-2909.98.2.66>

20. Finkelhor, D., & Browne, A. (1985). The traumatic impact of child sexual abuse: A conceptualization. *Psychological Bulletin*, 98, 66-107. <https://doi.org/10.1037/0033-2909.98.2.66>

21. Finkelhor, D., & Browne, A. (1985). The traumatic impact of child sexual abuse: A conceptualization. *Psychological Bulletin*, 98, 66-107. <https://doi.org/10.1037/0033-2909.98.2.66>

22. Finkelhor, D., & Browne, A. (1985). The traumatic impact of child sexual abuse: A conceptualization. *Psychological Bulletin*, 98, 66-107. <https://doi.org/10.1037/0033-2909.98.2.66>

23. Finkelhor, D., & Browne, A. (1985). The traumatic impact of child sexual abuse: A conceptualization. *Psychological Bulletin*, 98, 66-107. <https://doi.org/10.1037/0033-2909.98.2.66>

24. Finkelhor, D., & Browne, A. (1985). The traumatic impact of child sexual abuse: A conceptualization. *Psychological Bulletin*, 98, 66-107. <https://doi.org/10.1037/0033-2909.98.2.66>

25. Finkelhor, D., & Browne, A. (1985). The traumatic impact of child sexual abuse: A conceptualization. *Psychological Bulletin*, 98, 66-107. <https://doi.org/10.1037/0033-2909.98.2.66>

26. Finkelhor, D., & Browne, A. (1985). The traumatic impact of child sexual abuse: A conceptualization. *Psychological Bulletin*, 98, 66-107. <https://doi.org/10.1037/0033-2909.98.2.66>

27. Finkelhor, D., & Browne, A. (1985). The traumatic impact of child sexual abuse: A conceptualization. *Psychological Bulletin*, 98, 66-107. <https://doi.org/10.1037/0033-2909.98.2.66>

28. Finkelhor, D., & Browne, A. (1985). The traumatic impact of child sexual abuse: A conceptualization. *Psychological Bulletin*, 98, 66-107. <https://doi.org/10.1037/0033-2909.98.2.66>

29. Finkelhor, D., & Browne, A. (1985). The traumatic impact of child sexual abuse: A conceptualization. *Psychological Bulletin*, 98, 66-107. <https://doi.org/10.1037/0033-2909.98.2.66>

30. Finkelhor, D., & Browne, A. (1985). The traumatic impact of child sexual abuse: A conceptualization. *Psychological Bulletin*, 98, 66-107. <https://doi.org/10.1037/0033-2909.98.2.66>

31. Finkelhor, D., & Browne, A. (1985). The traumatic impact of child sexual abuse: A conceptualization. *Psychological Bulletin*, 98, 66-107. <https://doi.org/10.1037/0033-2909.98.2.66>

32. Finkelhor, D., & Browne, A. (1985). The traumatic impact of child sexual abuse: A conceptualization. *Psychological Bulletin*, 98, 66-107. <https://doi.org/10.1037/0033-2909.98.2.66>

33. Finkelhor, D., & Browne, A. (1985). The traumatic impact of child sexual abuse: A conceptualization. *Psychological Bulletin*, 98, 66-107.

Faculty advisor: Dr. Justin Metcalf

Faculty advisor: Dr. Justin Metcalf

Citations -
 "Introduction — PySDR: A Guide to SDR and DSP Using Python." *PySDR*. 2024. pydr.org/content/intro.html.
 "GNU Radio." *Wiki.gnuradio.org*. wiki.gnuradio.org/index.php/Main_Page.
 [1] Sanders, Frank H. Measurements of 5g new radio spectral and spatial power emissions for radar altimeter interference analysis. Institute for Telecommunication Sciences, 2022.
 [4] <https://gnuradio.gadgets.com/web/>

Evaluating the Efficiency of the Heat of Immersion Method Compared to the Washburn Method: A Wettability Study

Ansh Chouhan

University of Oklahoma

Evaluating the Efficiency of the Heat of Immersion Method Compared to the Washburn Method: A Wettability Study

Ansh Chouhan

University of Oklahoma

Introduction

The recent rise in demand for products with a highly specific wettability in materials science, with products such as the Carpe® antiperspirant line requiring a type of hydrophobic fumed silica to stop sweat more effectively, has resulted in increased demand for accurate measurements¹. Furthermore, the wettability of materials is important in the biomedical field as well, because while hydrophobic surfaces tend to prevent microbial growth, hydrophilic surfaces help facilitate healing. Lastly, wettability studies have proven important in the field of tissue engineering, where current methods are not as effective when measuring wettability of polyurethane scaffolds used in bioengineering².

This demand for an accurate way to measure wettability has led researchers away from the existing Washburn method to find an alternative that can be more useful in different industries. For example, the novel heat of immersion method, which uses a high-sensitivity calorimeter to measure the heat energy generated by the uptake of a liquid, has shown to be not only more accurate than the Washburn method, but also more able to preserve the mathematical relationships at higher temperatures³.

Objectives

This experiment aims to compare the existing Washburn method to the novel heat of immersion method with three different particles (R-974, R-380, and R-300, all supplied by Evonik) at three different temperatures (40 °C, 55 °C, and 70 °C), by:

- Using a Dynamic Contact Angle Tensiometer (DCAT) to measure capillary intake of water over time of all three particles, in g²/sec, at 40 °C, 55 °C, and 70 °C.
- Using the DCAT to measure capillary intake of hexane/decano over time of all three particles, in g²/sec, at 40 °C, 55 °C, and 70 °C.
- Calculating the contact angle of all three particles at the three temperatures using a modified Washburn equation.
- Using a high-sensitivity bomb calorimeter, namely the Setaram C80, to determine the enthalpies of immersion in water of all three particles at 40 °C, 55 °C, and 70 °C.
- Calculating the predicted contact angle of all three particles at all three temperatures using equations published in Langmuir by Boshen Xu and Brian Grady⁴.
- Comparing the values of both methods for accuracy through error measurements and variability.



Fundamental Equations

- Washburn Equation

$$\frac{m^2}{t} = \frac{c + \rho^2 \cdot \sigma \cdot \cos(\theta)}{\eta}$$

where m = mass [kg], t = flow time [s], σ = surface tension of liquid [N/m], c = capillary constant of the powder, ρ = density of the liquid [kg/m³], θ = contact angle, and η = viscosity of the liquid [Pa·s]⁷

- Heat of Immersion Equation

$$\cos(\theta) = \frac{-h_1 - 0.000077}{\gamma_{LV}} \text{ (low energy surfaces)}$$

$$\cos(\theta) = \frac{-h_1 - 0.00045157}{\gamma_{LV}} \text{ (hydrophilic silica)}$$

where h_1 = heat of immersion [J/m²], θ = contact angle, and γ_{LV} = liquid-vapor interfacial tension, or surface tension [N/m]²

Data

Water			
	Temperature	Average Slope (kg ² /h)	Standard Deviation
R-974	40°	5.86433E-12	2.0107E-12
	55°	1.62763E-07	1.16749E-07
	70°	1.53274E-07	6.44372E-08
	40°	1.05334E-08	6.959E-09
	55°	2.99111E-08	1.56493E-08
	70°	5.12316E-08	3.09967E-08
R-380	40°	2.04873E-08	8.93297E-09
	55°	3.80383E-08	1.73803E-08
	70°	3.55887E-08	1.74517E-08

Table 1. Average slopes derived from the Washburn trials in water for all three compounds at all three temperatures. Note: Trials for R-974 at 55° and 70° are still in progress.

Hexane (for 40° and 55°)/Decane (for 70°)			
	Temperature	Average Slope (kg ² /h)	Standard Deviation
R-974	40°	4.6363E-10	3.07456E-11
	55°	5.53536E-10	5.53319E-11
	70°		
	40°	1.6322E-09	1.06739E-09
	55°	5.24266E-09	3.83656E-09
	70°		
R-380	40°		
	55°		
	70°		
R-300	40°		
	55°		
	70°		

Table 2. Average slopes derived from the Washburn trials in hexane/decano for all three compounds at all three temperatures. Note: Trials for R-380 at 55° are still in progress, as well as everything that is blank.

	Temperature	Contact Angle (Degrees)
R-974	40°	89.817°
	55°	
	70°	
	40°	0° (clipped)
	55°	
	70°	
R-380	40°	
	55°	
	70°	
R-300	40°	
	55°	
	70°	

Table 3. Contact angles determined from the data and the Washburn equation.

Calculations

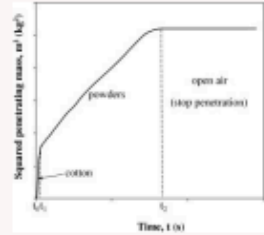


Figure 1. A visual representation of an expected Washburn trial graph, showing capillary uptake.⁹

The figure above, used from a journal entry, shows how a powder absorbs a liquid over the course of time using the Washburn method. In the graph, there are three distinct slopes which change at t_1 and t_2 . From this graph, it can be concluded that the powder is absorbing the liquid at a constant rate between t_1 and t_2 , and therefore this is the slope that should be measured after the conclusion of the trial⁹.

After measuring the slope five times of a trial in water for each temperature in kg²/s², the average is taken to account for minor variation. This average slope is then used in later calculations.

This process is then repeated, but with hexane or decane as the liquid, to calculate c, the capillary constant. This is because unlike water, these organic solvents are readily absorbed by most particles and are the best estimate for a 0° contact angle. Once again, five trials are taken to ensure replicability.

To calculate the capillary constant in the Washburn equation, $\cos(\theta)$ is replaced with 1, which is equivalent to $\cos(0^\circ)$, and the $[m^2/t]$ expression is replaced with the average slope from the Washburn trials that were done using hexane. All constants that are used to calculate c refer to hexane.

Lastly, the calculated capillary constant is plugged into the Washburn equation, and the contact angle in water is calculated by replacing the $[m^2/t]$ expression with average slope of the Washburn trials that were done in water. In this calculation, all constants that are used to calculate θ refer to water.

Unfortunately, due to the scant data currently available for calculations, only two particles' contact angles in water have been determined: R-974 and R-380 (only at 40 °C). However, these values correspond with the expected values, as R-974 is a hydrophobic particle and would have a high contact angle, whereas R-380 is a hydrophilic particle and would have a lower contact angle, as shown below¹.

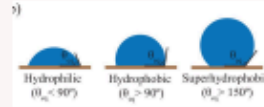


Figure 2. Contact angles and how they relate to absorption of water.¹

Conclusions and Future Steps

This project is in progress and the expected deadline is the end of December 2025; however, the data presented right now shows that the Washburn method fails to analyze highly hydrophilic substances, as the calculated $\cos(\theta)$ begins to exceed 1. These substances are typically classified as highly hydrophilic and are given 0° for the contact angle; however, there still is a spectrum within these particles. Through the heat of immersion method, these highly hydrophilic particles will be distinguishable from one another, paving the way for more accurate measurements in many fields.

As of right now, the future steps are to finish taking all of the Washburn trials in hexane or decane and then using the Setaram C80 to determine heat of immersion at the three temperatures for all three compounds. From there, the contact angle for each particle at each temperature can be determined by both methods, and comparisons can be made regarding the efficacy of both measurements. If the results are significant, a peer-reviewed lab report will be sent to Langmuir.

References

- Jaisukla, T.; Kumar Malia, L.; Thomas, T. M.; Kalichevsky, S. S.; Sinha Mahapatra, P.; Pattanmalla, A. Fundamentals and Applications of Surface Wetting. *Langmuir* **2024**, *40* (16), 8293–8326. <https://doi.org/10.1021/acs.langmuir.3c01782>.
- Xu, B.; Grady, B. P. Further Exploration of Heat of Immersion as a Method to Quantify Wettability for Particulates: Effect of Temperature. *Langmuir* **2024**, *40* (13), 6675–6684. <https://doi.org/10.1021/acs.langmuir.3c01782>.
- How It Works [Antiperspirant], Carpe. <https://mycarpe.com/pages/how-it-works> (accessed 2025-04-11).
- Amicangelo, J. H.; Noller, M. U. Human Amniotic Membrane: A Versatile Scaffold for Tissue Engineering. *ACS Biomater Sci Eng* **2018**, *4* (7), 2226–2236. <https://doi.org/10.1021/acsbiomater.8b00015>.
- Jackson, P. V.; Hunt, J. A.; Doherty, P. J.; Cannon, A.; Gilson, P. Hydrophilicity of 3-D Biomaterials: The Washburn Equation. *J Mater Sci Mater Med* **2004**, *15* (4), 507–511. <https://doi.org/10.1023/b:jmem.0000021129.60818.ca>.
- Structure and Wettability of Various Silica Surfaces. Evaluation in Nano and Macro Levels. CoLab. <https://colab.ws/articles/10.4146/colab.36.528> (accessed 2025-04-11).
- Washburn method. KRD Scientific. <https://www.krdscientific.com/en-us/faq/how-to-use-washburn-method> (accessed 2025-04-11).
- Wettability - an overview | ScienceDirect Topics. <https://www.sciencedirect.com/topics/material-science/wettability> (accessed 2025-04-11).
- Kindrapattana, S.; Phisalaphong, M.; Hewley, B. Z. Applicability of Washburn Capillary Rise for Determining Contact Angles of Powder/Porous Materials. *Journal of Colloid and Interface Science* **2013**, *397*, 168–176. <https://doi.org/10.1016/j.jcis.2013.01.033>.

Acknowledgments

I would like to thank Dr. Brian Grady for his endless support, ChatGPT for helping me understand formulas, the Honors College for providing me a gateway to research, the Chemistry Department for printing this poster, and the Chemical Engineering department for guiding me through this journey in research.

Questions?

Please email Ellen Claassen, the Graduate
Research/Teaching Assistant for FYRE,
@ellen.j.claassen@ou.edu.