The UNIVERSITY of OKLAHOMA

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 complete6-10 hours of research per week. *Herearefiveeasysteps 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 (II) Biochemistry, Chemistry & Physical	(VII) Meteorology, Radar Engineering & Electrical Eng. (VIII) Native American Studies
Chemistry (III) Biology, Microbiology	(IX) Applications of Data Science & Machine Learning/Artificial Intelligence (ML/AI)
(IV) Bioengineering & Biomedical/Chemical Eng.	(X) Quantum Physics (XI) Political Science (XII) Health & Exercise Science
(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 UNIVERSITY of OKLAHOMA

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

Table of Contents

Norman, Oklahoma Main Campus

Table of Contents

Oklahoma City, Oklahoma Satellite Campus

Table of Contents - Mentor

Biological Sciences

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 amendable 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

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

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

Table of Contents - Mentor

Compendium

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

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, were finite element analysis will be used (probably ANSYS or similar program) that may allow for such simulations to be performed.

Merguizo Sanchecz, 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

Table of Contents - Mentor

Health and Exercise Science

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. 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

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 labsin 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

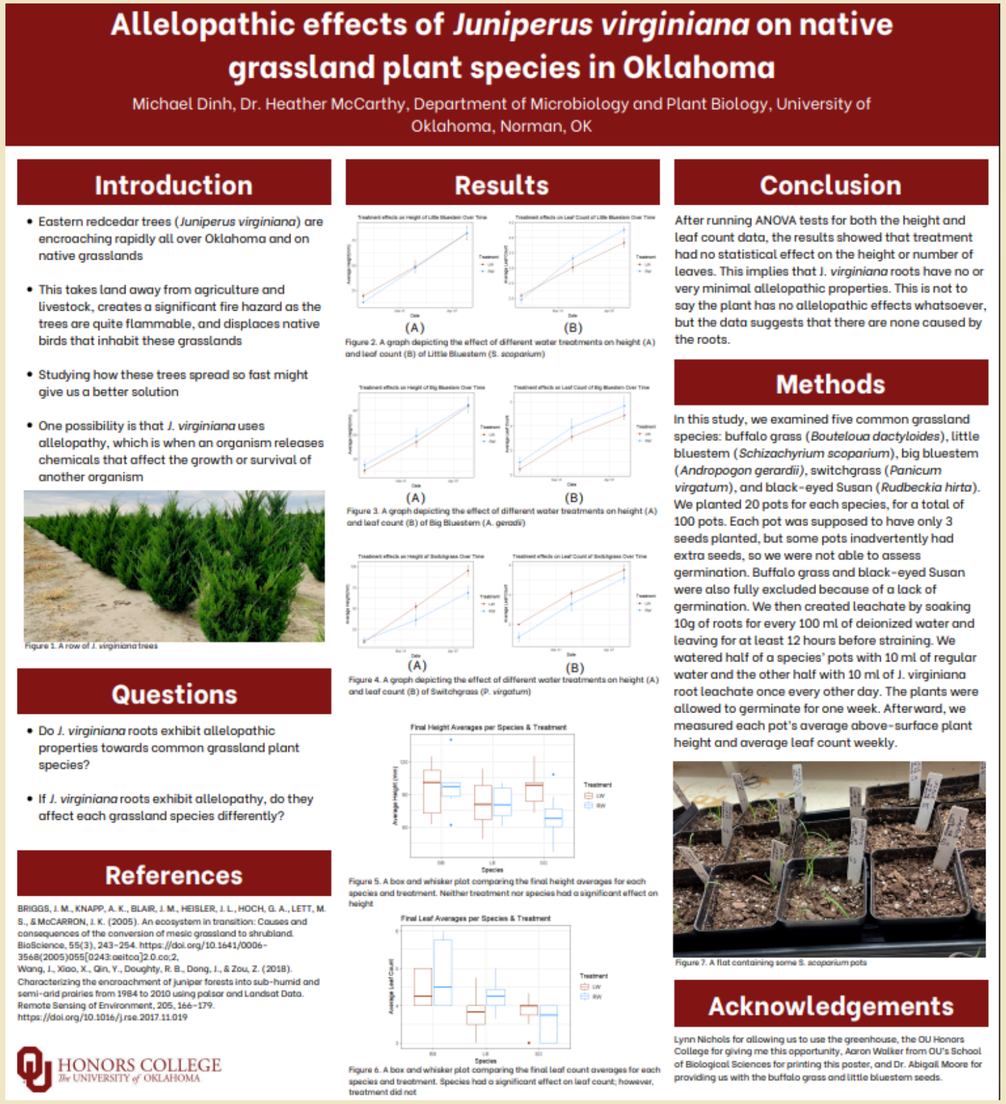
NOTE

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:aeitca]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 palsar and Landsat Data. Remote Sensing of Environment, 205, 166–179. https://doi.org/10.1016/j.rse.2017.11.019

HONORS COLLEGE The UNIVERSITY of OKLAHOMA

Results

(A) (B)

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

(A) (B)

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

(A) (B)

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.

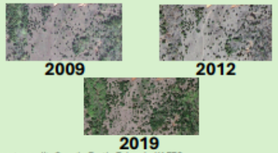


Image credit: Google Earth. Taken in KAEFS.

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

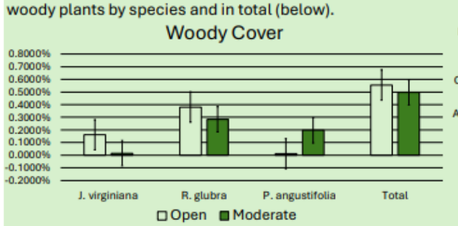
We identified 27 unique species across the 10 plots sampled, 19 to the species level and 5 to family level.

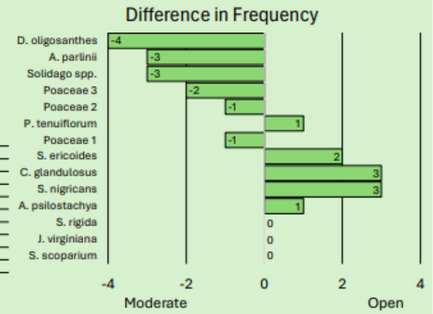
Comparing Richness: We performed a two-sample t-test to determine if there was a significant difference in species richness between open and moderate cover plots.

	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).

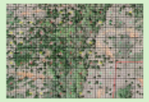




We did not find significant differences in species richness or woody cover, though these results suggest that community composition of herbaceous species may differ between open and encroached areas.

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 $5m^2$ (open) or $2.5m^2$ (moderate cover) area for sampling woody plants, and established 4 $0.5m^2$ 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 Szubryt 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

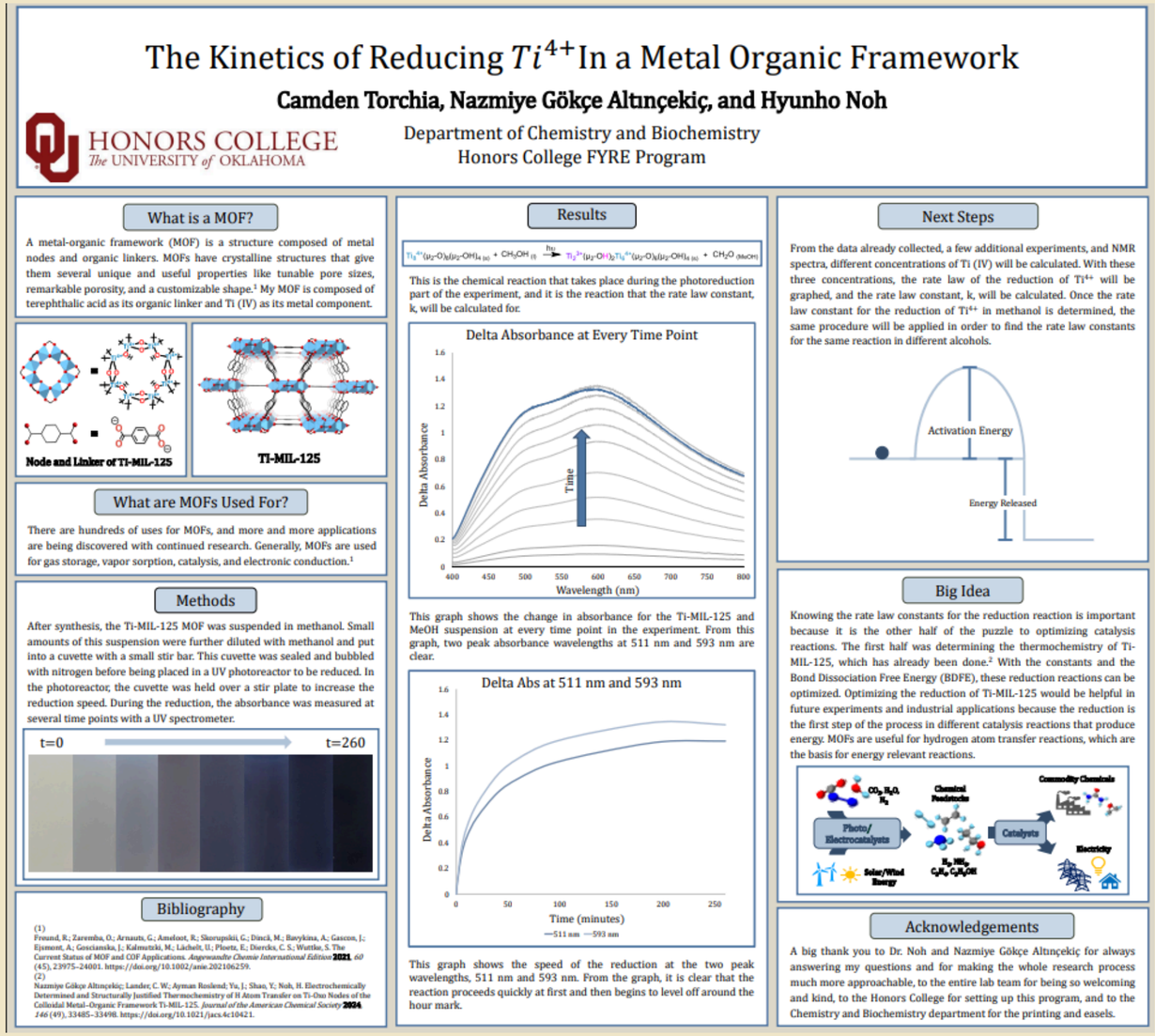
Alofs, K. M., & Fowler, N. L. (2010). Habitat fragmentation caused by woody plant encroachment inhibits the spread of an invasive grass. *The Journal of Applied Ecology*, *47*(2), 338–347. https://doi.org/10.1111/j.1365-2664.2010.01785.x

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

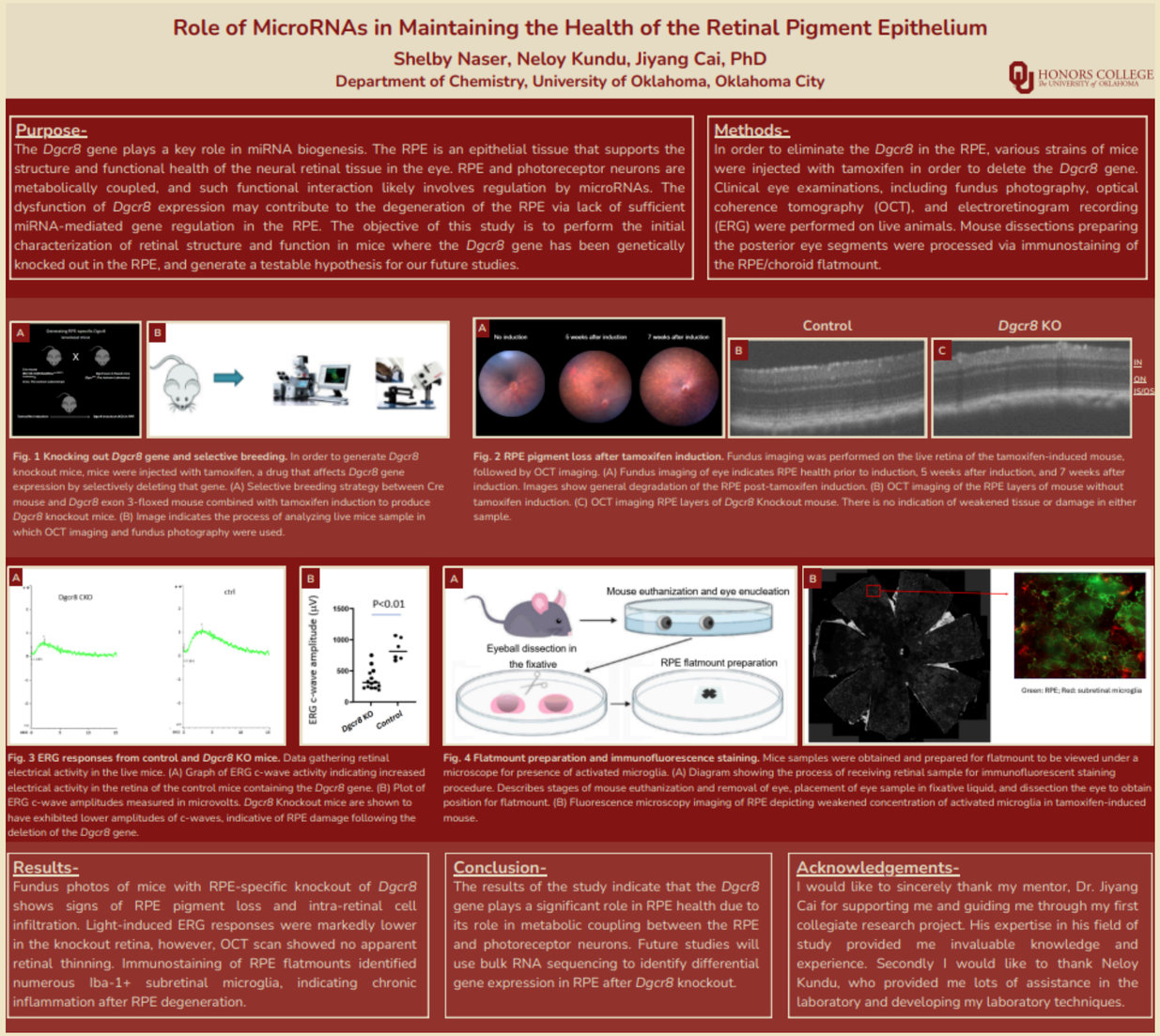
Department of Chemistry and Biochemistry Honors College FYRE Program



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

Shelby Naser, Neloy Kundu, Jiyang Cai, PhD

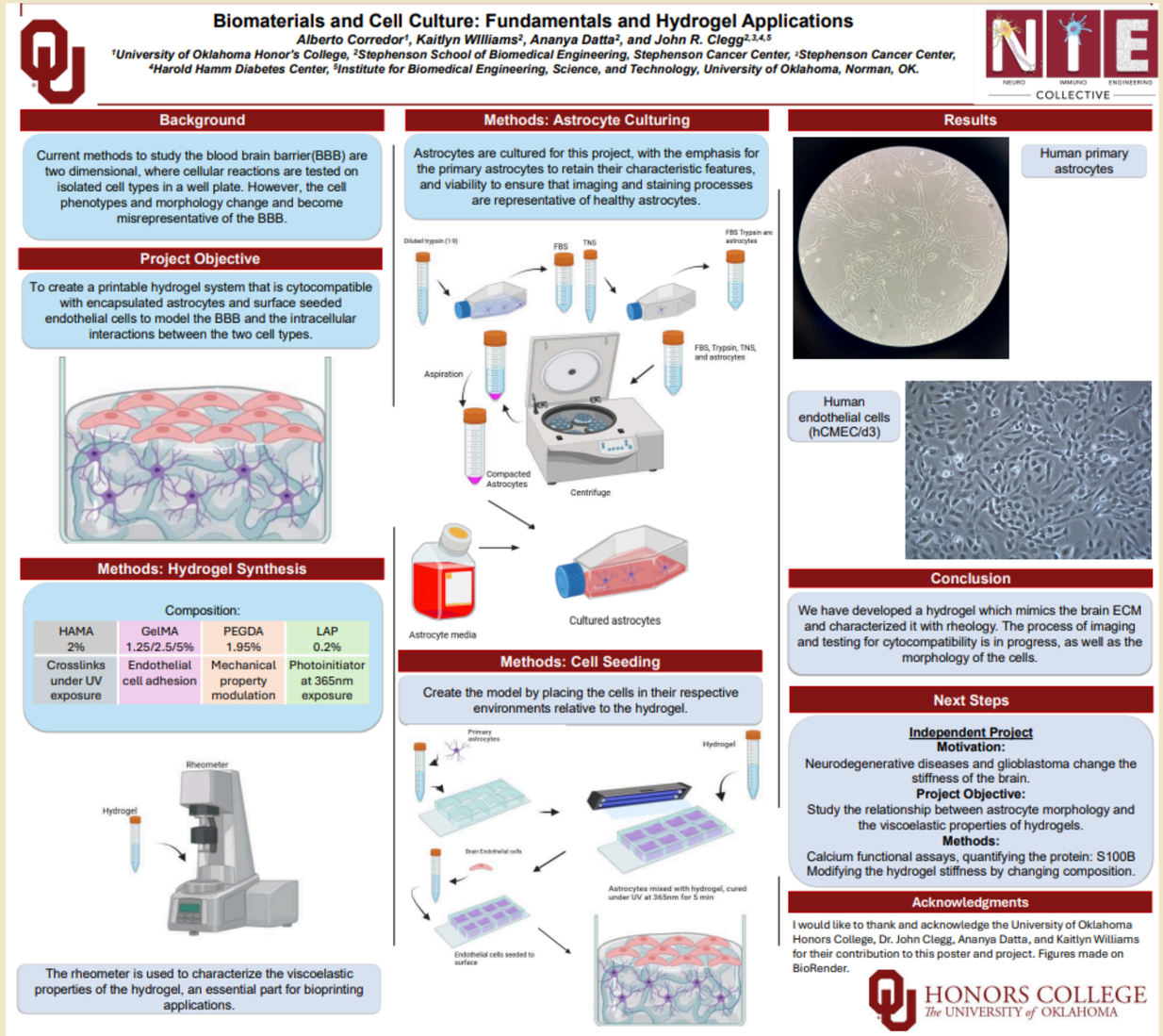
Department of Chemistry, University of Oklahoma, Oklahoma City



Biomaterials and Cell Culture: Fundamentals and Hydrogel Applications

Alberto Corredor, Kaitlyn Williams, Ananya Datta, and John R. Clegg

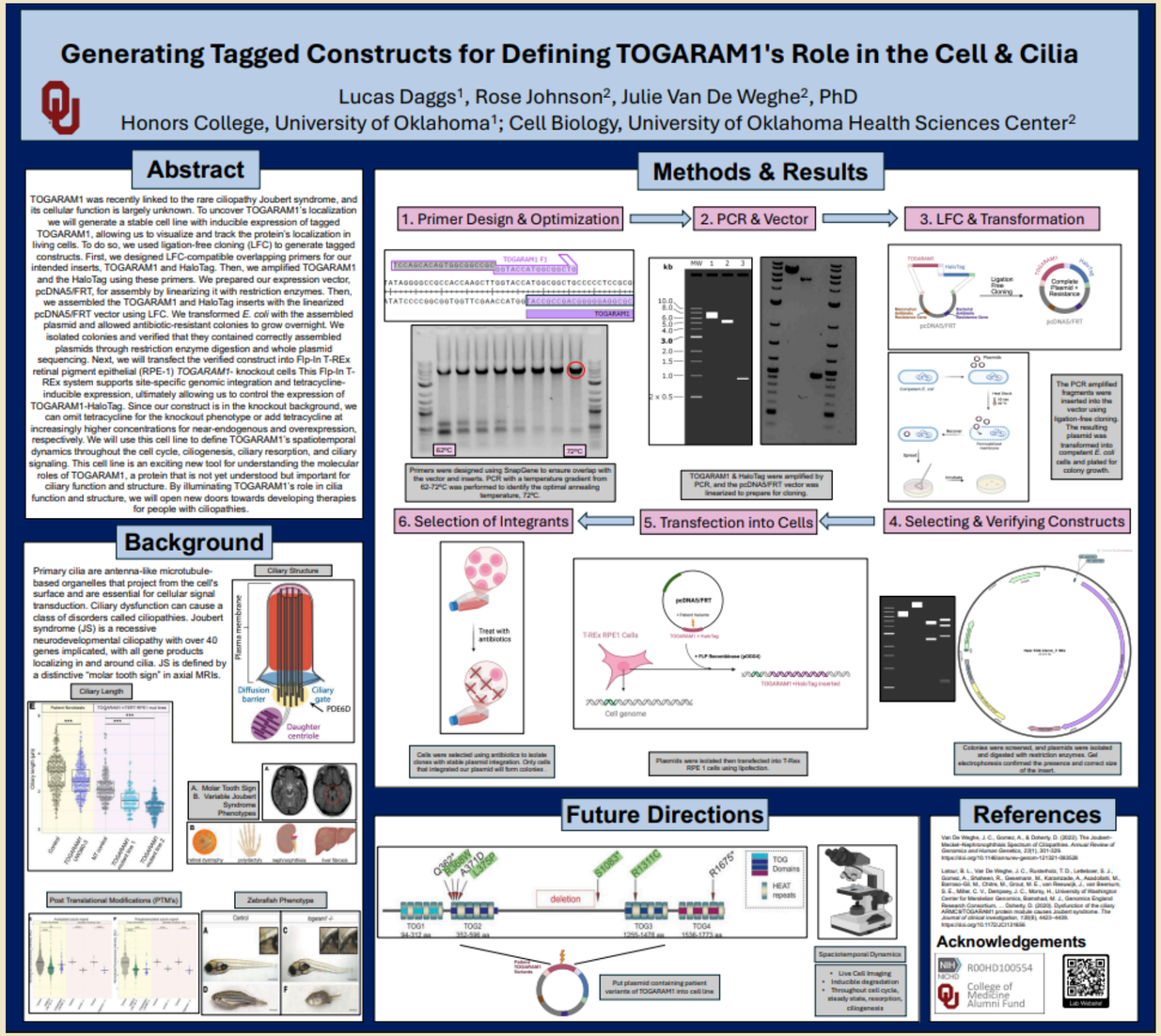
University of Oklahoma Honor's College, Stephenson School of Biomedical Engineering, Stephenson Cancer Center, Stephenson Cancer Center, Harold Hamm Diabetes Center, Institute for Biomedical Engineering, Science, and Technology, University of Oklahoma, Norman, OK.



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

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

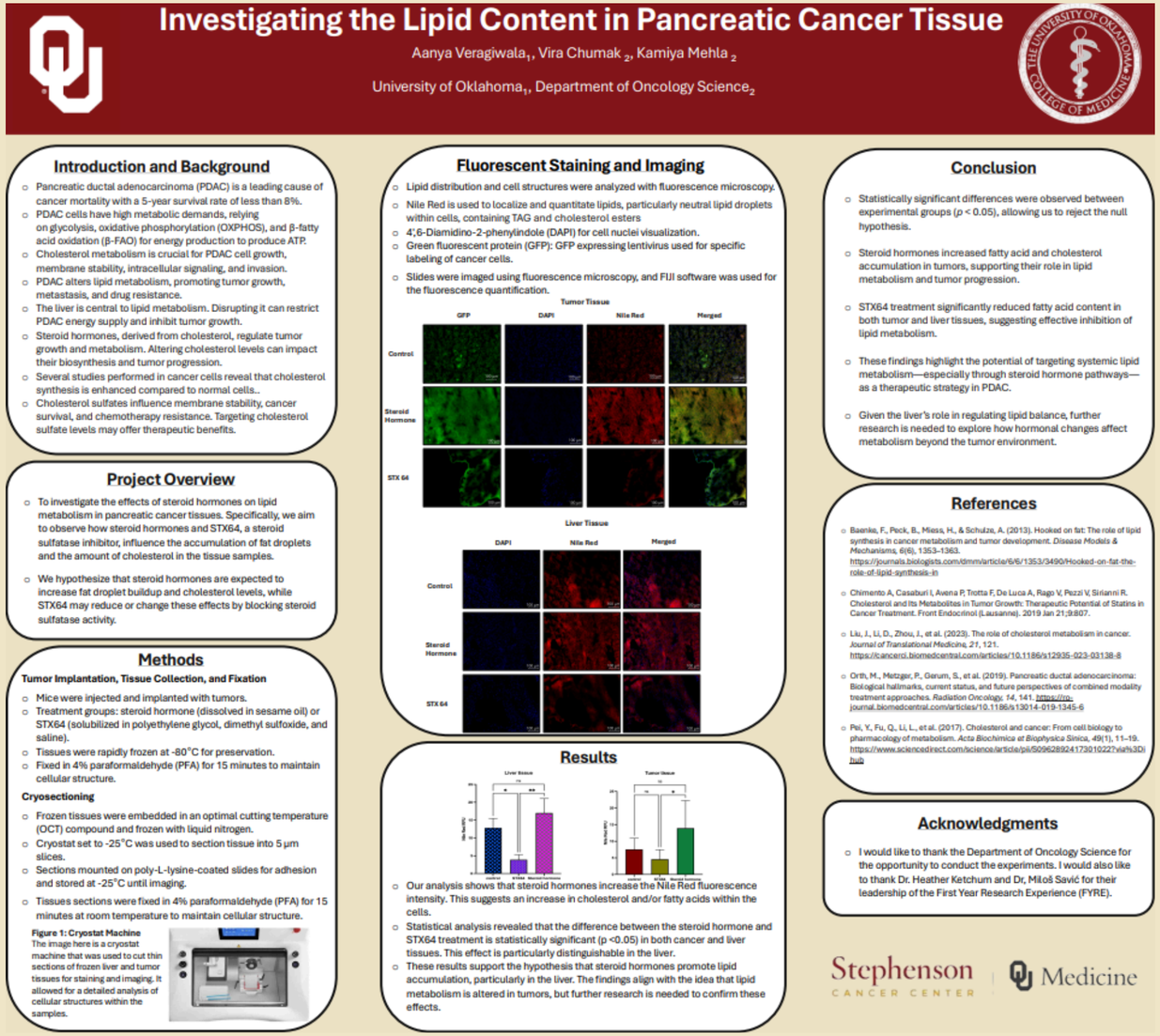
Honors College, University of Oklahoma; Cell Biology, University of Oklahoma Health Sciences Center



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 Veragiwala[1], Vira Chumak [2], Kamiya Mehla [2]

University of Oklahoma[1], Department of Oncology Science[2]

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 µm 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.

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., Miess, 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, Sirianni 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://cancerci.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://ro-journal.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%3Dihub

Acknowledgments

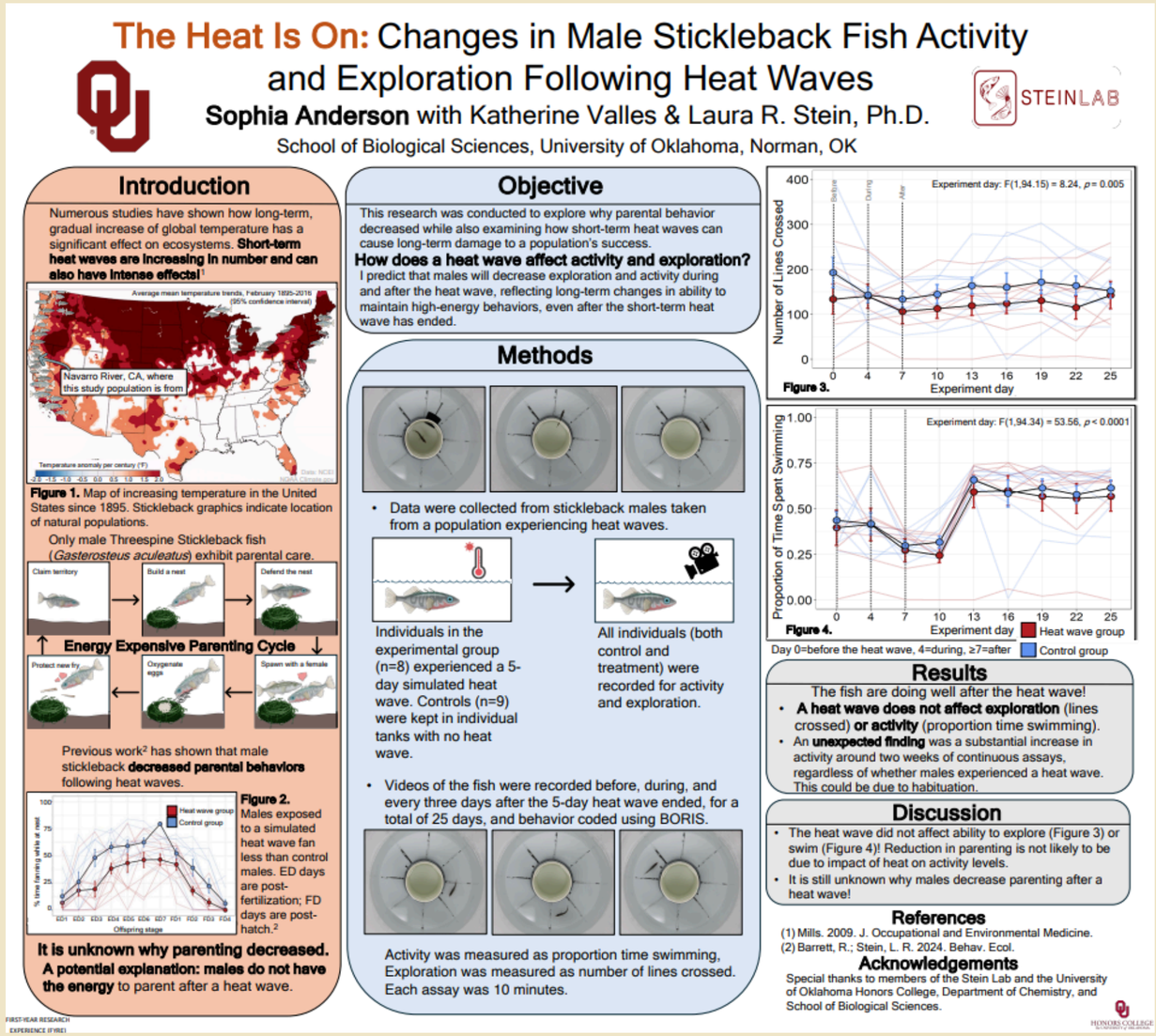
- I would like to thank the Department of Oncology Science for the opportunity to conduct the experiments. I would also like to thank Dr. Heather Ketchum and Dr, Miloš Savić for their leadership of the First Year Research Experience (FYRE).

Stephenson CANCER CENTER | Medicine

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.

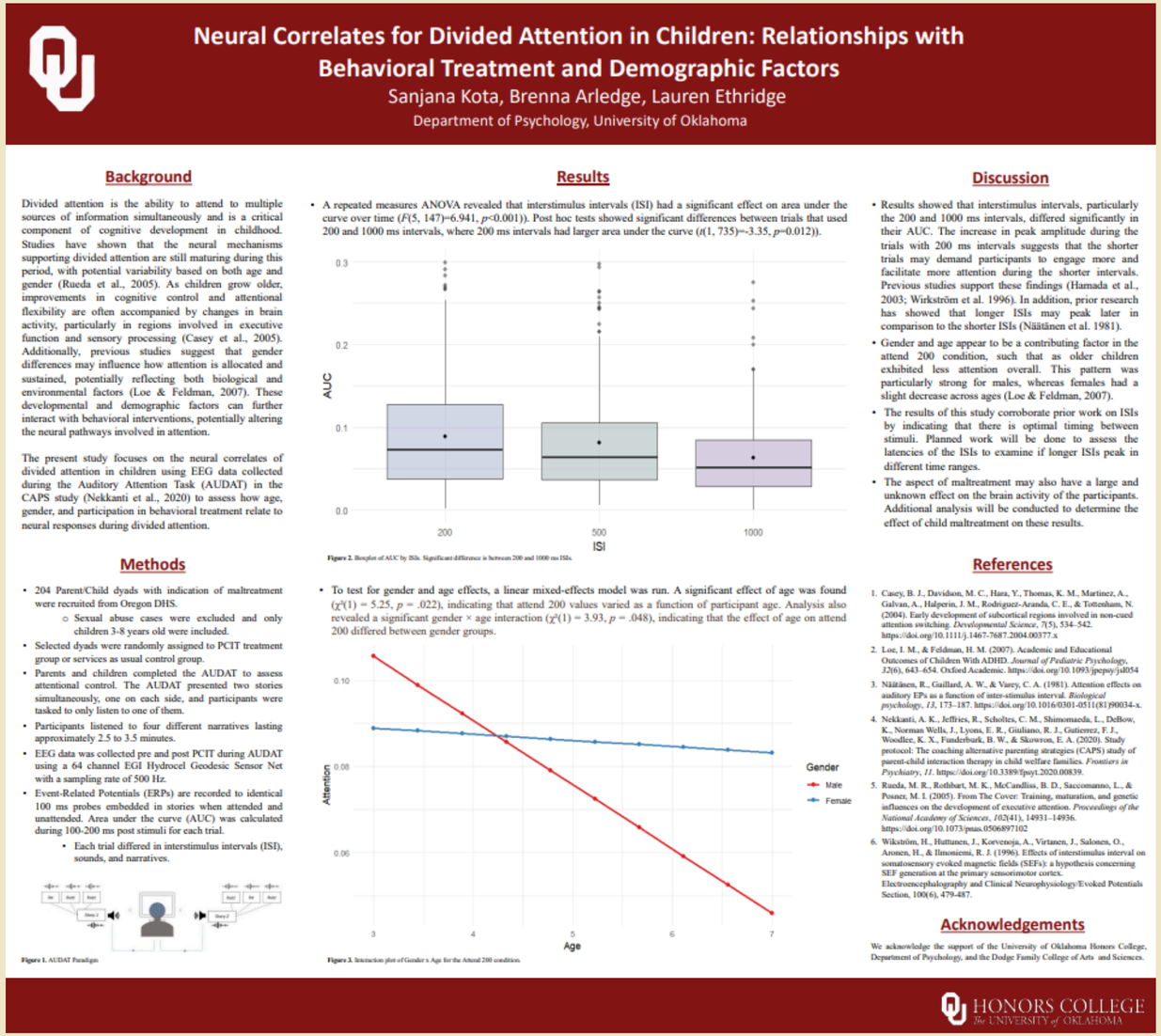
School of Biological Sciences, University of Oklahoma, Norman, OK



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 × 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/jsl054
3. Näätänen, R., Gaillard, A. W., & Varey, 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.
4. Nekkanti, A. K., Jeffries, R., Scholtes, C. M., Shimomaeda, 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/fpsyt.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. Wikström, H., Huttunen, J., Korvenoja, 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

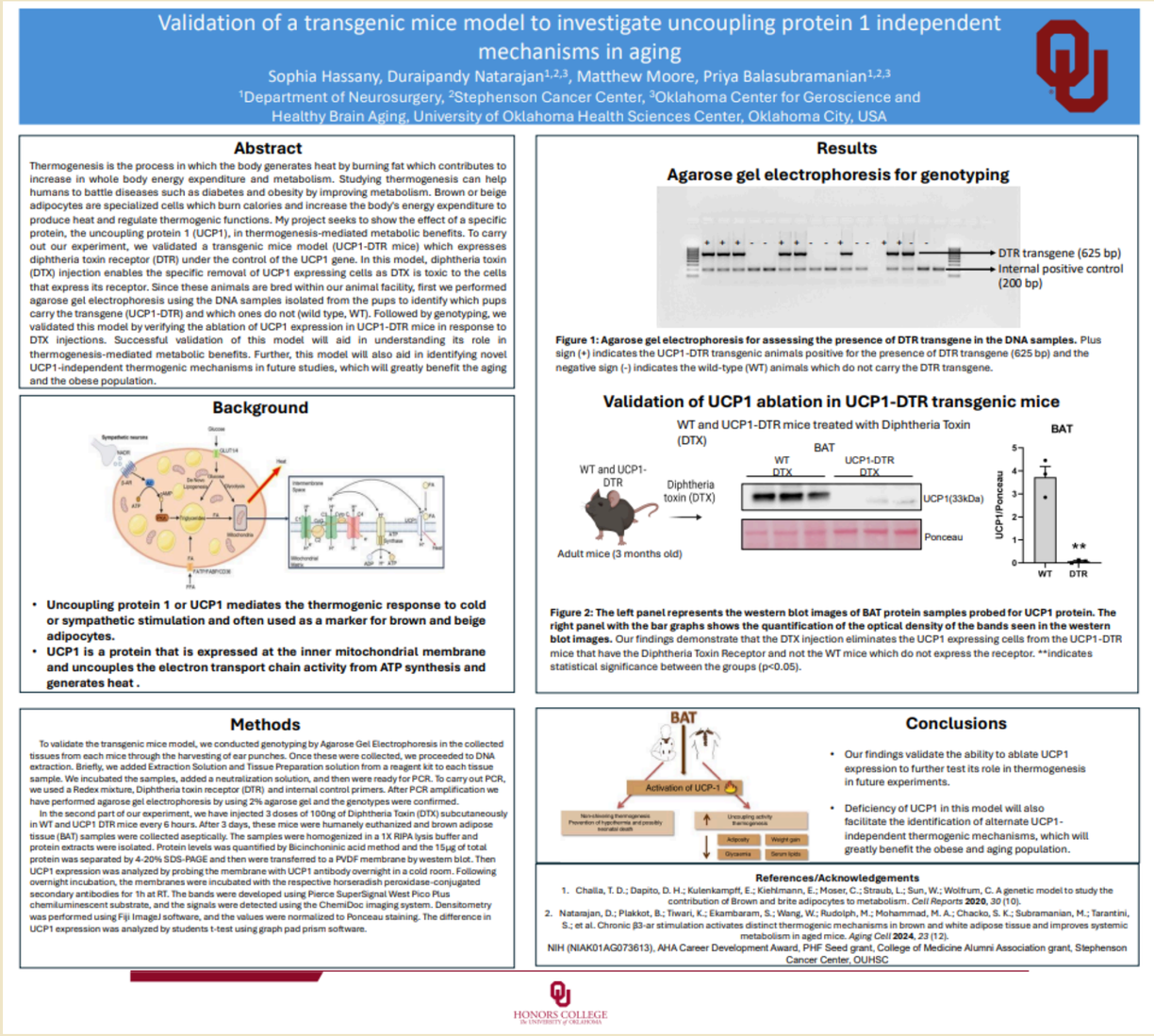
We acknowledge the support of the University of Oklahoma Honors College, Department of Psychology, and the Dodge Family College of Arts and Sciences.

HONORS COLLEGE
The UNIVERSITY of OKLAHOMA

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



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

Sophia Hassany, Duraipandy Natarajan[1,2,3], Matthew Moore, Priya Balasubramanian[1,2,3]

[1]Department of Neurosurgery, [2]Stephenson Cancer Center, [3]Oklahoma Center for Geroscience and Healthy Brain Aging, University of Oklahoma Health Sciences Center, Oklahoma City, USA

Abstract

Thermogenesis is the process in which the body generates heat by burning fat which contributes to increase in whole body energy expenditure and metabolism. Studying thermogenesis can help humans to battle diseases such as diabetes and obesity by improving metabolism. Brown or beige adipocytes are specialized cells which burn calories and increase the body's energy expenditure to produce heat and regulate thermogenic functions. My project seeks to show the effect of a specific protein, the uncoupling protein 1 (UCP1), in thermogenesis-mediated metabolic benefits. To carry out our experiment, we validated a transgenic mice model (UCP1-DTR mice) which expresses diphtheria toxin receptor (DTR) under the control of the UCP1 gene. In this model, diphtheria toxin (DTX) injection enables the specific removal of UCP1 expressing cells as DTX is toxic to the cells that express its receptor. Since these animals are bred within our animal facility, first we performed agarose gel electrophoresis using the DNA samples isolated from the pups to identify which pups carry the transgene (UCP1-DTR) and which ones do not (wild type, WT). Followed by genotyping, we validated this model by verifying the ablation of UCP1 expression in UCP1-DTR mice in response to DTX injections. Successful validation of this model will aid in understanding its role in thermogenesis-mediated metabolic benefits. Further, this model will also aid in identifying novel UCP1-independent thermogenic mechanisms in future studies, which will greatly benefit the aging and the obese population.

Background

- **Uncoupling protein 1 or UCP1 mediates the thermogenic response to cold or sympathetic stimulation and often used as a marker for brown and beige adipocytes.**
- **UCP1 is a protein that is expressed at the inner mitochondrial membrane and uncouples the electron transport chain activity from ATP synthesis and generates heat .**

Results

Agarose gel electrophoresis for genotyping

Figure 1: Agarose gel electrophoresis for assessing the presence of DTR transgene in the DNA samples. Plus sign (+) indicates the UCP1-DTR transgenic animals positive for the presence of DTR transgene (625 bp) and the negative sign (-) indicates the wild-type (WT) animals which do not carry the DTR transgene.

Validation of UCP1 ablation in UCP1-DTR transgenic mice

Figure 2: The left panel represents the western blot images of BAT protein samples probed for UCP1 protein. The right panel with the bar graphs shows the quantification of the optical density of the bands seen in the western blot images. Our findings demonstrate that the DTX injection eliminates the UCP1 expressing cells from the UCP1-DTR mice that have the Diphtheria Toxin Receptor and not the WT mice which do not express the receptor. **indicates statistical significance between the groups (p<0.05).

Methods

To validate the transgenic mice model, we conducted genotyping by Agarose Gel Electrophoresis in the collected tissues from each mice through the harvesting of ear punches. Once these were collected, we proceeded to DNA extraction. Briefly, we added Extraction Solution and Tissue Preparation solution from a reagent kit to each tissue sample. We incubated the samples, added a neutralization solution, and then were ready for PCR. To carry out PCR, we used a Redex mixture, Diphtheria toxin receptor (DTR) and internal control primers. After PCR amplification we have performed agarose gel electrophoresis by using 2% agarose gel and the genotypes were confirmed.

In the second part of our experiment, we have injected 3 doses of 100ng of Diphtheria Toxin (DTX) subcutaneously in WT and UCP1 DTR mice every 6 hours. After 3 days, these mice were humanely euthanized and brown adipose tissue (BAT) samples were collected aseptically. The samples were homogenized in a 1X RIPA lysis buffer and protein extracts were isolated. Protein levels was quantified by Bicinchoninic acid method and the 15µg of total protein was separated by 4-20% SDS-PAGE and then were transferred to a PVDF membrane by western blot. Then UCP1 expression was analyzed by probing the membrane with UCP1 antibody overnight in a cold room. Following overnight incubation, the membranes were incubated with the respective horseradish peroxidase-conjugated secondary antibodies for 1h at RT. The bands were developed using Pierce SuperSignal West Pico Plus chemiluminescent substrate, and the signals were detected using the ChemiDoc imaging system. Densitometry was performed using Fiji ImageJ software, and the values were normalized to Ponceau staining. The difference in UCP1 expression was analyzed by students t-test using graph pad prism software.

Conclusions

- Our findings validate the ability to ablate UCP1 expression to further test its role in thermogenesis in future experiments.
- Deficiency of UCP1 in this model will also facilitate the identification of alternate UCP1-independent thermogenic mechanisms, which will greatly benefit the obese and aging population.

References/Acknowledgements

1. Challa, T. D.; Dapito, D. H.; Kulenkampff, E.; Kiehlmann, E.; Moser, C.; Straub, L.; Sun, W.; Wolfrum, C. A genetic model to study the contribution of Brown and brite adipocytes to metabolism. *Cell Reports* **2020**, *30* (10).
2. Natarajan, D.; Plakkot, B.; Tiwari, K.; Ekambaram, S.; Wang, W.; Rudolph, M.; Mohammad, M. A.; Chacko, S. K.; Subramanian, M.; Tarantini, S.; et al. Chronic β3-ar stimulation activates distinct thermogenic mechanisms in brown and white adipose tissue and improves systemic metabolism in aged mice. *Aging Cell* **2024**, *23* (12).

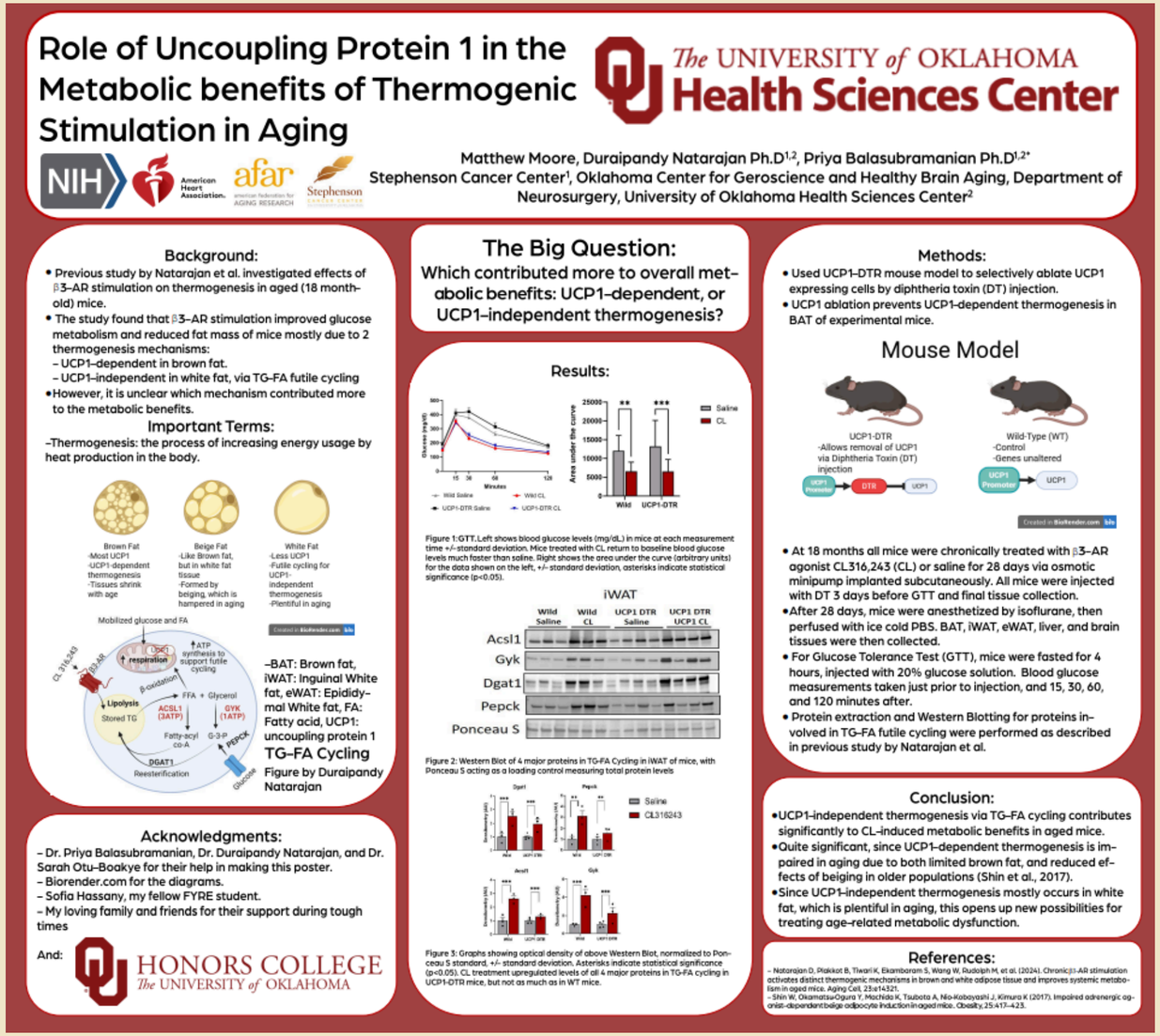
NIH (NIAK01AG073613), AHA Career Development Award, PHF Seed grant, College of Medicine Alumni Association grant, Stephenson Cancer Center, OUHSC

HONORS COLLEGE
The UNIVERSITY of OKLAHOMA

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

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

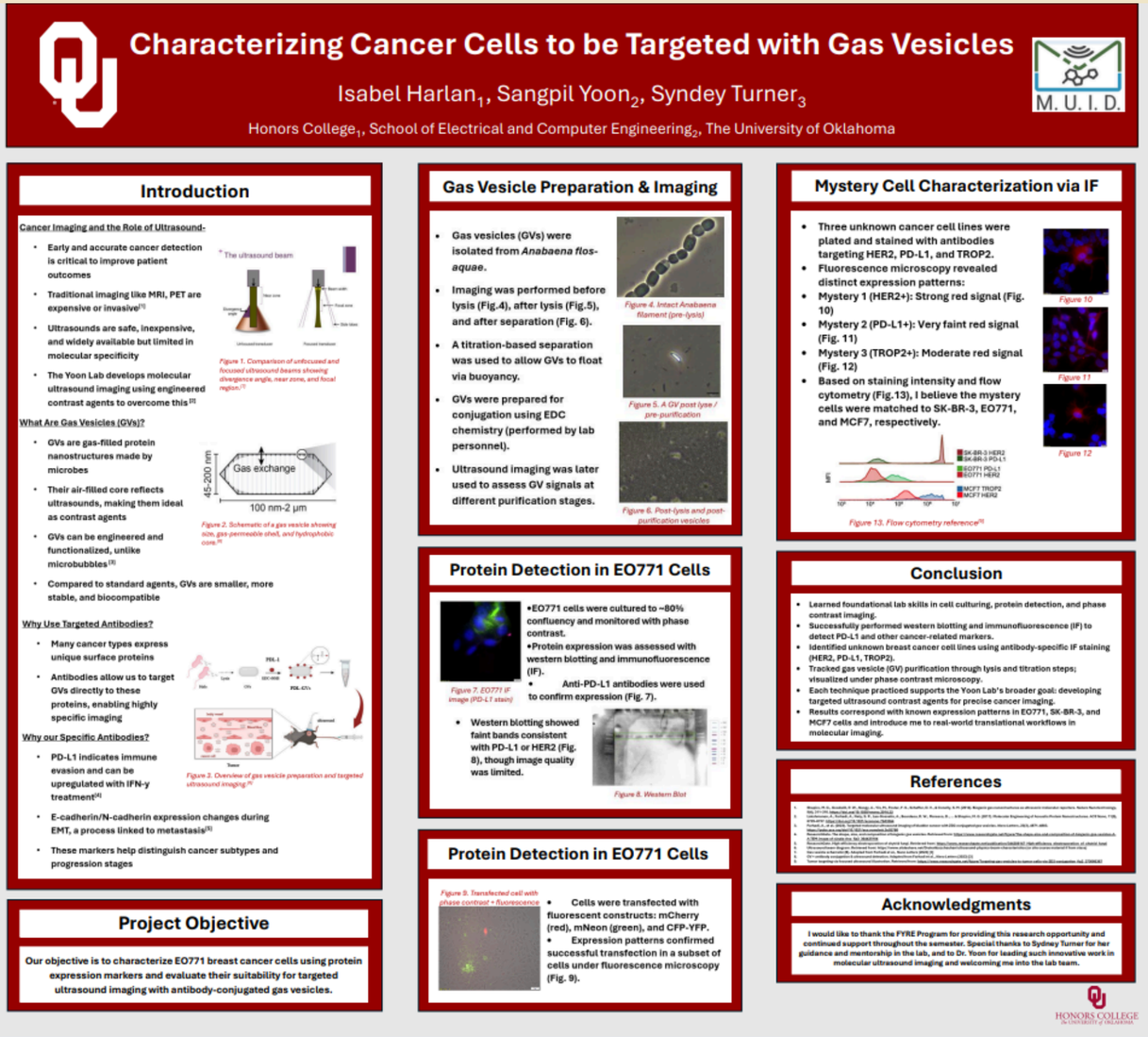
Stephenson Cancer Center, Oklahoma Center for Geroscience and Healthy Brain Aging, Department of Neurosurgery, University of Oklahoma Health Sciences Center



Characterizing Cancer Cells to be Targeted with Gas Vesicles

Isabel Harlan, Sangpil Yoon, Syndey Turner

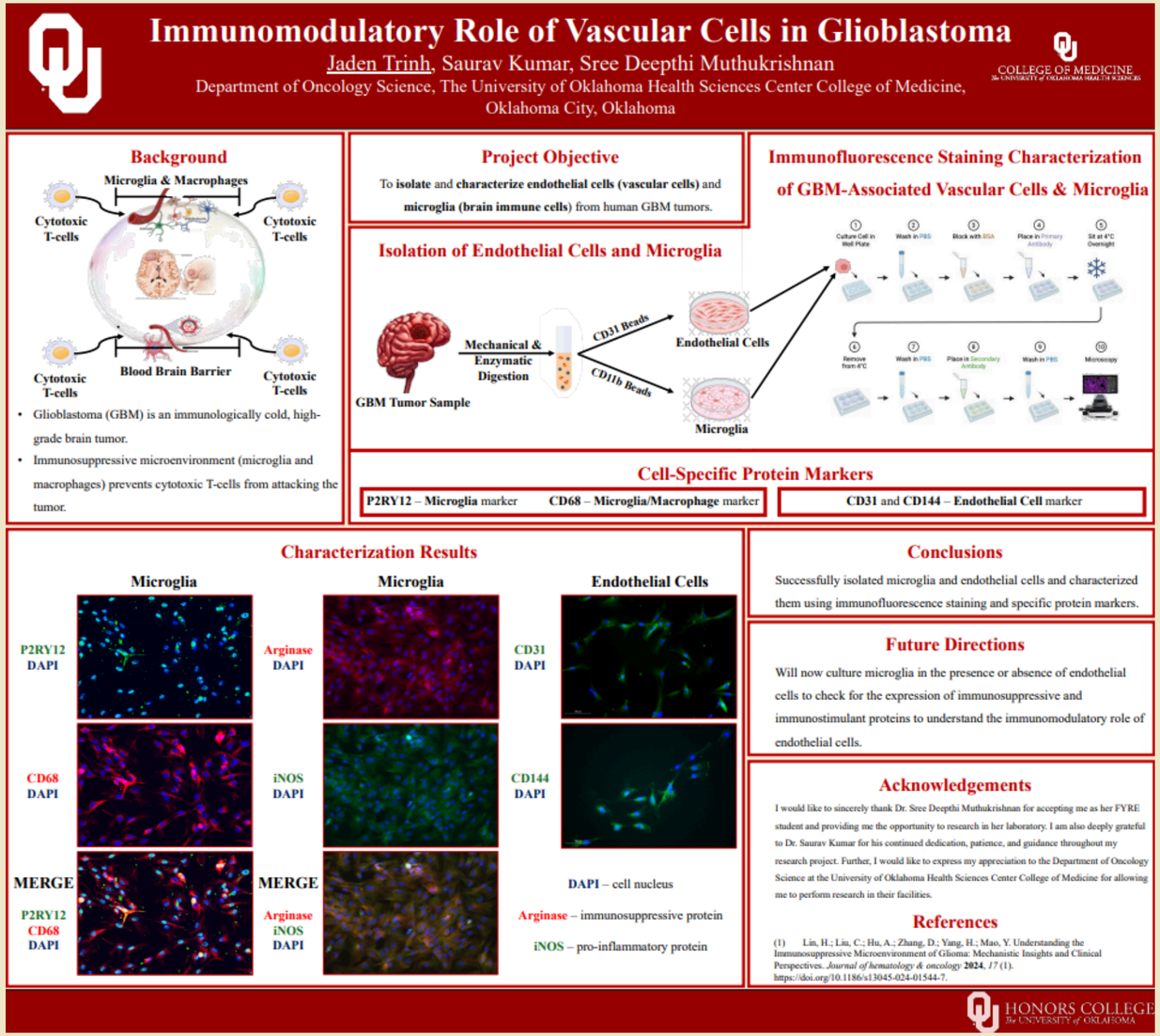
Honors College, School of Electrical and Computer Engineering, The University of Oklahoma



Immunomodulatory Role of Vascular Cells in Glioblastoma

Jaden Trinh, Saurav Kumar, Sree Deepthi Muthukrishnan

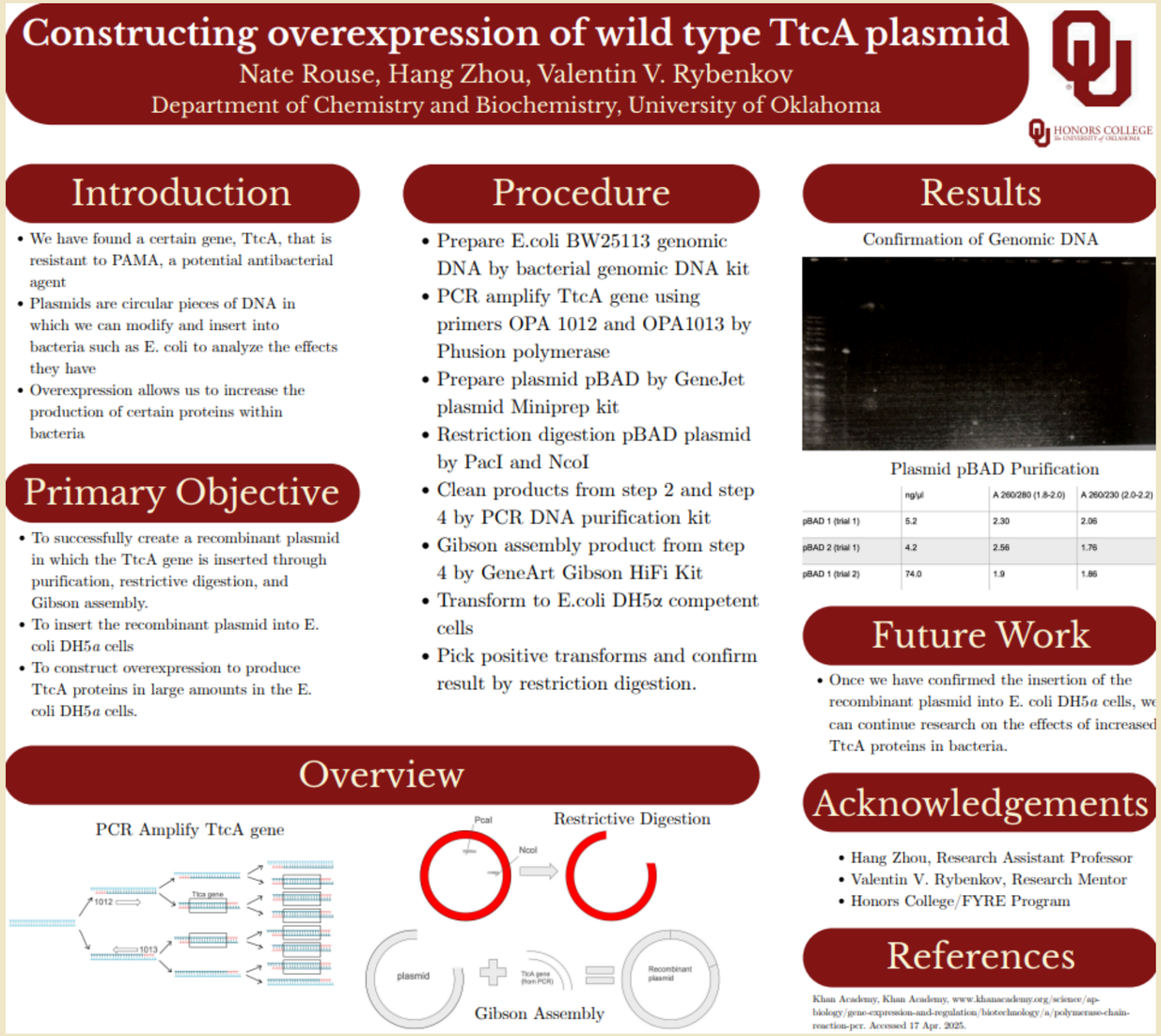
Department of Oncology Science, The University of Oklahoma Health Sciences Center College of Medicine, Oklahoma City, Oklahoma



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

HONORS COLLEGE

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 DH5α cells
- To construct overexpression to produce TtcA proteins in large amounts in the E. coli DH5α 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

Overview

PCR Amplify TtcA gene

Restrictive Digestion

Gibson Assembly

Future Work

- Once we have confirmed the insertion of the recombinant plasmid into E. coli DH5α 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

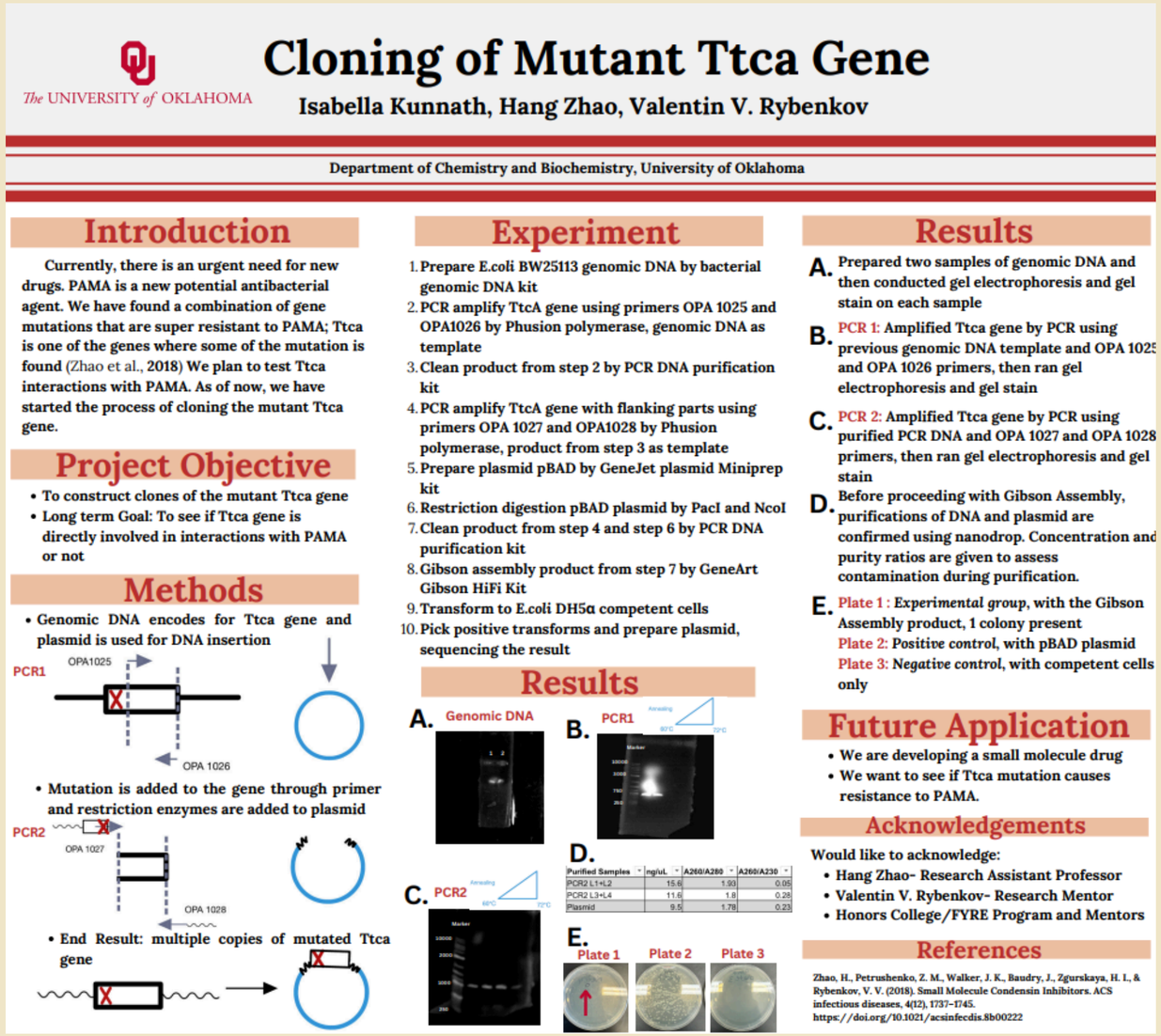
References

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

Cloning of Mutant Ttca Gene

Isabella Kunnath, Hang Zhao, Valentin V. Rybenkov

Department of Chemistry and Biochemistry, University of Oklahoma



Cloning of Mutant Ttca Gene

The UNIVERSITY of OKLAHOMA

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

PCR1 OPA1025 OPA 1026

- Mutation is added to the gene through primer and restriction enzymes are added to plasmid

PCR2 OPA 1027 OPA 1028

- End Result: multiple copies of mutated Ttca gene

Experiment

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

Results

A. Genomic DNA

B. PCR1

C. PCR2

D.

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

E. Plate 1 Plate 2 Plate 3

Results

A. Prepared two samples of genomic DNA and then conducted gel electrophoresis and gel stain on each sample

B. PCR 1: Amplified Ttca gene by PCR using previous genomic DNA template and OPA 1025 and OPA 1026 primers, then ran gel electrophoresis and gel stain

C. PCR 2: Amplified Ttca gene by PCR using purified PCR DNA and OPA 1027 and OPA 1028 primers, then ran gel electrophoresis and gel stain

D. Before proceeding with Gibson Assembly, purifications of DNA and plasmid are confirmed using nanodrop. Concentration and purity ratios are given to assess contamination during purification.

E. 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

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

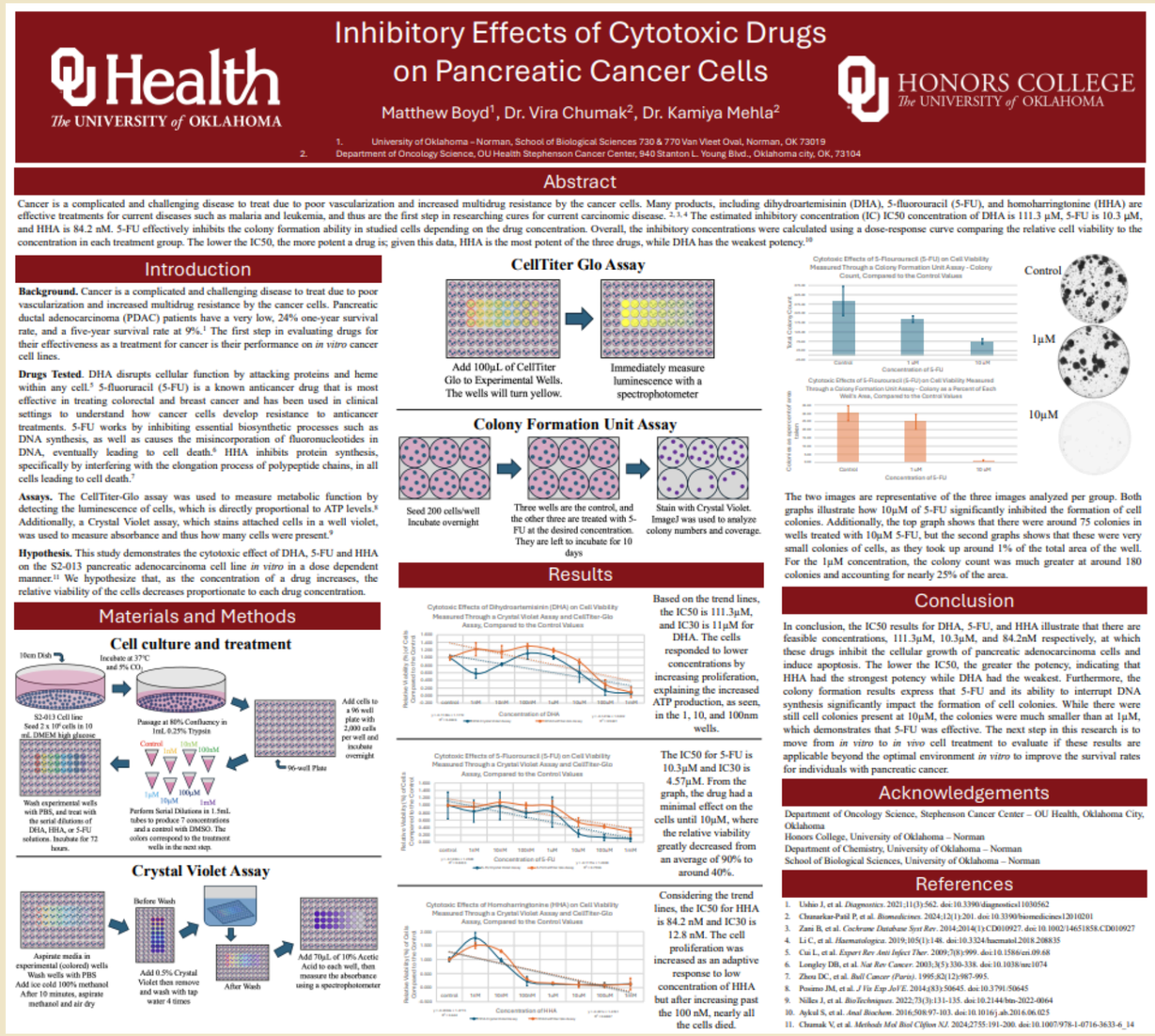
Zhao, H., Petrushenko, Z. M., Walker, J. K., Baudry, J., Zgurskaya, H. I., & Rybenkov, V. V. (2018). Small Molecule Condensin Inhibitors. ACS infectious diseases, 4(12), 1737–1745. https://doi.org/10.1021/acsinfecdis.8b00222

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



Inhibitory Effects of Cytotoxic Drugs on Pancreatic Cancer Cells

Matthew Boyd[1], Dr. Vira Chumak[2], Dr. Kamiya Mehla[2]

1. University of Oklahoma – Norman, School of Biological Sciences 730 & 770 Van Vleet Oval, Norman, OK 73019
2. Department of Oncology Science, OU Health Stephenson Cancer Center, 940 Stanton L. Young Blvd., Oklahoma city, OK, 73104

Abstract

Cancer is a complicated and challenging disease to treat due to poor vascularization and increased multidrug resistance by the cancer cells. Many products, including dihydroartemisinin (DHA), 5-fluorouracil (5-FU), and homoharringtonine (HHA) are effective treatments for current diseases such as malaria and leukemia, and thus are the first step in researching cures for current carcinomic disease. [2,3,4] The estimated inhibitory concentration (IC) IC50 concentration of DHA is 111.3 μM, 5-FU is 10.3 μM, and HHA is 84.2 nM. 5-FU effectively inhibits the colony formation ability in studied cells depending on the drug concentration. Overall, the inhibitory concentrations were calculated using a dose-response curve comparing the relative cell viability to the concentration in each treatment group. The lower the IC50, the more potent a drug is; given this data, HHA is the most potent of the three drugs, while DHA has the weakest potency.[10]

Introduction

Background. Cancer is a complicated and challenging disease to treat due to poor vascularization and increased multidrug resistance by the cancer cells. Pancreatic ductal adenocarcinoma (PDAC) patients have a very low, 24% one-year survival rate, and a five-year survival rate at 9%.[1] The first step in evaluating drugs for their effectiveness as a treatment for cancer is their performance on *in vitro* cancer cell lines.

Drugs Tested. DHA disrupts cellular function by attacking proteins and heme within any cell.[5] 5-fluoruracil (5-FU) is a known anticancer drug that is most effective in treating colorectal and breast cancer and has been used in clinical settings to understand how cancer cells develop resistance to anticancer treatments. 5-FU works by inhibiting essential biosynthetic processes such as DNA synthesis, as well as causes the misincorporation of fluoronucleotides in DNA, eventually leading to cell death.[6] HHA inhibits protein synthesis, specifically by interfering with the elongation process of polypeptide chains, in all cells leading to cell death.[7]

Assays. The CellTiter-Glo assay was used to measure metabolic function by detecting the luminescence of cells, which is directly proportional to ATP levels.[8] Additionally, a Crystal Violet assay, which stains attached cells in a well violet, was used to measure absorbance and thus how many cells were present.[9]

Hypothesis. This study demonstrates the cytotoxic effect of DHA, 5-FU and HHA on the S2-013 pancreatic adenocarcinoma cell line *in vitro* in a dose dependent manner.[11] We hypothesize that, as the concentration of a drug increases, the relative viability of the cells decreases proportionate to each drug concentration.

Materials and Methods

Cell culture and treatment

Crystal Violet Assay

CellTiter Glo Assay

Add 100μL of CellTiter Glo to Experimental Wells. The wells will turn yellow.

Immediately measure luminescence with a spectrophotometer

Colony Formation Unit Assay

Seed 200 cells/well Incubate overnight

Three wells are the control, and the other three are treated with 5-FU at the desired concentration. They are left to incubate for 10 days

Stain with Crystal Violet. ImageJ was used to analyze colony numbers and coverage.

Results

Based on the trend lines, the IC50 is 111.3μM, and IC30 is 11μM for DHA. The cells responded to lower concentrations by increasing proliferation, explaining the increased ATP production, as seen, in the 1, 10, and 100nm wells.

The IC50 for 5-FU is 10.3μM and IC30 is 4.57μM. From the graph, the drug had a minimal effect on the cells until 10μM, where the relative viability greatly decreased from an average of 90% to around 40%.

Considering the trend lines, the IC50 for HHA is 84.2 nM and IC30 is 12.8 nM. The cell proliferation was increased as an adaptive response to low concentration of HHA but after increasing past the 100 nM, nearly all the cells died.

The two images are representative of the three images analyzed per group. Both graphs illustrate how 10μM of 5-FU significantly inhibited the formation of cell colonies. Additionally, the top graph shows that there were around 75 colonies in wells treated with 10μM 5-FU, but the second graphs shows that these were very small colonies of cells, as they took up around 1% of the total area of the well. For the 1μM concentration, the colony count was much greater at around 180 colonies and accounting for nearly 25% of the area.

Conclusion

In conclusion, the IC50 results for DHA, 5-FU, and HHA illustrate that there are feasible concentrations, 111.3μM, 10.3μM, and 84.2nM respectively, at which these drugs inhibit the cellular growth of pancreatic adenocarcinoma cells and induce apoptosis. The lower the IC50, the greater the potency, indicating that HHA had the strongest potency while DHA had the weakest. Furthermore, the colony formation results express that 5-FU and its ability to interrupt DNA synthesis significantly impact the formation of cell colonies. While there were still cell colonies present at 10μM, the colonies were much smaller than at 1μM, which demonstrates that 5-FU was effective. The next step in this research is to move from *in vitro* to *in vivo* cell treatment to evaluate if these results are applicable beyond the optimal environment *in vitro* to improve the survival rates for individuals with pancreatic cancer.

Acknowledgements

Department of Oncology Science, Stephenson Cancer Center – OU Health, Oklahoma City, Oklahoma
Honors College, University of Oklahoma – Norman
Department of Chemistry, University of Oklahoma – Norman
School of Biological Sciences, University of Oklahoma – Norman

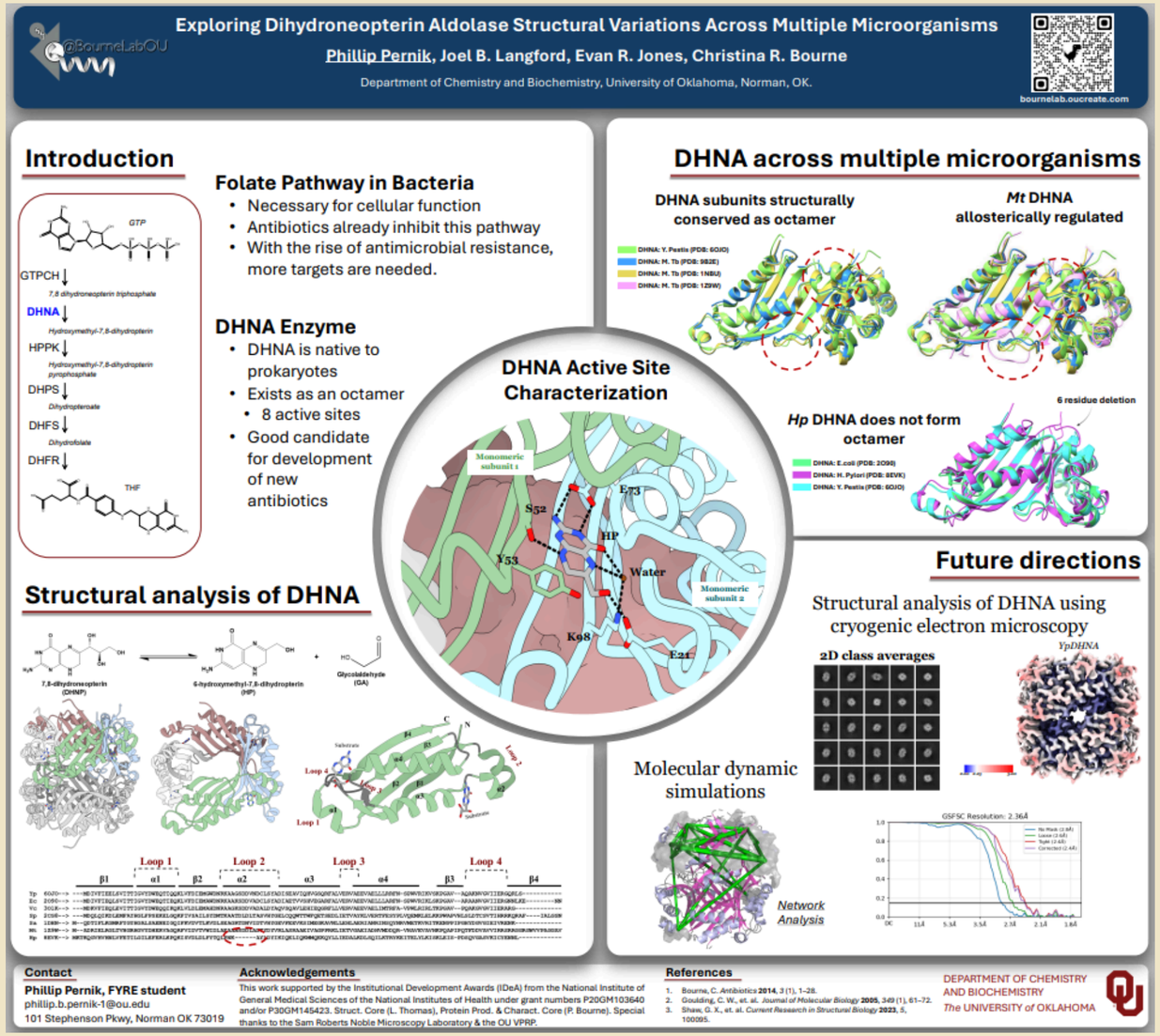
References

1. Ushio J, et al. *Diagnostics*. 2021;11(3):562. doi:10.3390/diagnostics11030562
2. Chunarkar-Patil P, et al. *Biomedicines*. 2024;12(1):201. doi:10.3390/biomedicines12010201
3. Zuni B, et al. *Cochrane Database Syst Rev*. 2014;2014(1):CD010927. doi:10.1002/14651858.CD010927
4. Li C, et al. *Haematologica*. 2019;105(1):148. doi:10.3324/haematol.2018.208835
5. Cui L, et al. *Expert Rev Anti Infect Ther*. 2009;7(8):999. doi:10.1586/eri.09.68
6. Longley DB, et al. *Nat Rev Cancer*. 2003;3(5):330-338. doi:10.1038/nrc1074
7. Zhou DC, et al. *Bull Cancer (Paris)*. 1995;82(12):987-995.
8. Posimo JM, et al. *J Vis Exp JoVE*. 2014;(83):50645. doi:10.3791/50645
9. Nilles J, et al. *BioTechniques*. 2022;73(3):131-135. doi:10.2144/btn-2022-0064
10. Aykul S, et al. *Anal Biochem*. 2016;508:97-103. doi:10.1016/j.ab.2016.06.025
11. Chumak V, et al. *Methods Mol Biol Clifton NJ*. 2024;2755:191-200. doi:10.1007/978-1-0716-3633-6_14

Exploring Dihydroneopterin Aldolase Structural Variations Across Multiple Microorganisms

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

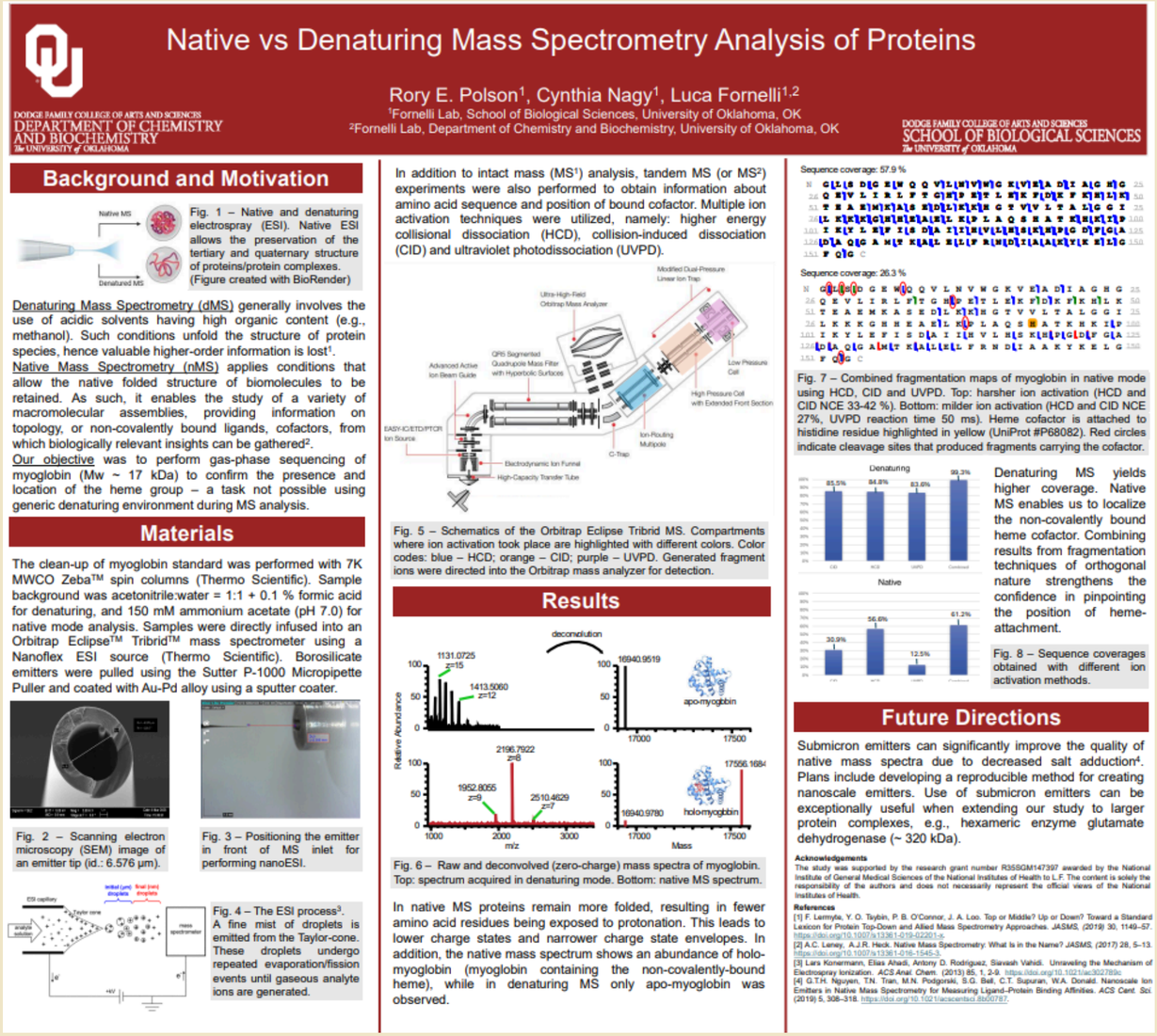
Department of Chemistry and Biochemistry, University of Oklahoma, Norman, OK



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



Native vs Denaturing Mass Spectrometry Analysis of Proteins

Rory E. Polson[1], Cynthia Nagy[1], Luca Fornelli[1,2]
[1]Fornelli Lab, School of Biological Sciences, University of Oklahoma, OK
[2]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

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

Background and Motivation

Native MS
Denatured MS

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 lost[1].
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 gathered[2].
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.

ESI capillary
Taylor cone
analyte solution
mass spectrometer
+kV

Fig. 4 – The ESI process[3]. A fine mist of droplets is emitted from the Taylor-cone. These droplets undergo repeated evaporation/fission events until gaseous analyte ions are generated.

In addition to intact mass (MS¹) analysis, tandem MS (or MS²) experiments were also performed to obtain information about amino acid sequence and position of bound cofactor. Multiple ion activation techniques were utilized, namely: higher energy collisional dissociation (HCD), collision-induced dissociation (CID) and ultraviolet photodissociation (UVPD).

Modified Dual-Pressure Linear Ion Trap
Ultra-High-Field Orbitrap Mass Analyzer
Advanced Active Ion Beam Guide
QRS Segmented Quadrupole Mass Filter with Hyperbolic Surfaces
Low Pressure Cell
High Pressure Cell with Extended Front Section
EASY-IC/ETD/PTCR Ion Source
Ion-Routing Multipole
C-Trap
Electrodynamic Ion Funnel
High-Capacity Transfer Tube

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.

Results

deconvolution
Relative Abundance
1131.0725 z=15
1413.5060 z=12
16940.9519
apo-myoglobin
2196.7922 z=8
1952.8055 z=9
2510.4629 z=7
16940.9780
17556.1684
holo-myoglobin
m/z
Mass

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

In native MS proteins remain more folded, resulting in fewer amino acid residues being exposed to protonation. This leads to lower charge states and narrower charge state envelopes. In addition, the native mass spectrum shows an abundance of holo-myoglobin (myoglobin containing the non-covalently-bound heme), while in denaturing MS only apo-myoglobin was observed.

Sequence coverage: 57.9 %
Sequence coverage: 26.3 %

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.

Denaturing
83.5%
84.8%
83.8%
99.3%
CID
HCD
UVPD
Combined
Native
30.9%
56.6%
12.5%
61.2%

Denaturing MS yields higher coverage. Native MS enables us to localize the non-covalently bound heme cofactor. Combining results from fragmentation techniques of orthogonal nature strengthens the confidence in pinpointing the position of heme-attachment.

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 adduction[4]. 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 R35SGM147397 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. Lermyte, Y. O. Tsybin, 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, 1140–57. https://doi.org/10.1007/s13361-019-02201-6.
[2] A.C. Leney, 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/ac302789c
[4] G.T.H. Nguyen, T.N. Tran, M.N. Podgorski, S.G. Bell, C.T. Supuran, 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

Introduction

Environmental pollution from heavy metals like copper (Cu) is a growing threat to ecosystems. While copper is essential in small amounts, high levels from mining, agriculture, and industrial waste can harm organisms and alter behavior. We used *Drosophila melanogaster* (fruit flies) to study how copper exposure affects decision-making behavior in females, especially their egg-laying (oviposition) and feeding choices.

By comparing flies from two populations with different histories of copper exposure and resistance, we aim to understand how environmental toxins influence behavior, and how past exposure may lead to adaptation or behavioral flexibility.

Populations Used

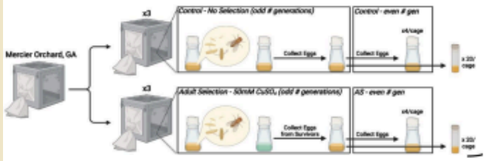
Line (BBM)

- **Location:** Ducktown, Tennessee
- **Background:** Old copper mine with a long history of contamination
- **Copper Exposure:** High, concentrated exposure
- **Resistance:** Evolved strong copper resistance
- **Why It Matters:** Represents flies adapted to intense copper in a small area

(MO)

- **Location:** Blue Ridge, Georgia
- **Background:** Fruit orchard using copper-based pesticides
- **Copper Exposure:** Lower-level, widespread exposure
- **Resistance:** Likely evolved copper resistance differently
- **Why It Matters:** Represents flies exposed to copper over a larger area

Methods



Populations & Selection

- Used *D. melanogaster* females from BBM and MO populations
- Lab-reared through multiple generations (currently gen 18)

Two selection groups

- Adult-selected (copper food during adulthood)
- Control (control food only)
- All flies returned to control food for one generation before testing

Oviposition Assay

Data Analysis

- Measured behavioral responses (egg-laying) Tested for:
- Population origin
- Copper resistance selection
- Interaction between population and selection
- Analysis conducted using ANOVA

Results

Effect of Treatment (10 mM $CuSO_4$ vs Control)

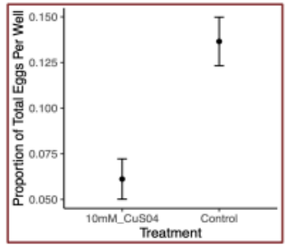


Fig 1. Treatment with 10 mM $CuSO_4$ significantly reduced the proportion of eggs laid per well compared to control (**$F = 79.10$, $p < 0.0001$**). This suggests that *D. melanogaster* females avoid laying eggs in copper-contaminated food. Bars show mean response ± 95% confidence intervals.

Interaction Between Treatment and Selection

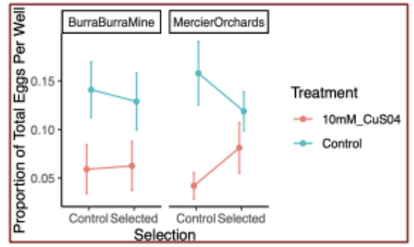


Fig 2. There was a significant interaction between Treatment and Selection (**$F = 7.59$, $p = 0.0068$**). Flies that were selected for copper resistance responded differently to copper exposure than control flies. In selected lines, oviposition behavior changed more under copper treatment.

Key Aims

- Determine how copper sulfate exposure affects oviposition behavior in *D. melanogaster* females.
- Compare behavioral responses between two fly populations with different copper exposure histories.
- Test whether past selection for copper resistance influences behavioral plasticity under stress.

Future Tests

- Continue collecting data to confirm whether population origin significantly affects behavior under copper exposure.
- Test additional generations to explore whether copper resistance continues to influence behavioral plasticity over time.
- Examine possible differences between males and females in decision-making under copper stress.
- Investigate neural or genetic pathways that may underlie behavioral responses to heavy metal exposure.

References

1. Rand, M. D.; Tennessen, J. M.; Mackay, T. F. C.; Anholt, R. R. H. Perspectives on the *Drosophila melanogaster* Model for Advances in Toxicological Science. *Curr. Protoc.* **2023**, *3*, e870.
2. Calap-Quintana, P.; González-Fernández, J.; Sebastiá-Ortega, N.; Llorens, J. V.; Moltó, M. D. *Drosophila melanogaster* Models of Metal-Related Human Diseases and Metal Toxicity. *Int. J. Mol. Sci.* **2017**, *18* (7), 1456.
3. Everman, E. R.; Cloud-Richardson, K. M.; Macdonald, S. J. Characterizing the Genetic Basis of Copper Toxicity in *Drosophila* Reveals a Complex Pattern of Allelic, Regulatory, and Behavioral Variation. *Genetics* **2021**, *217* (1), iyaa020.
4. Zamberlan, D. C.; Halmenschelager, P. T.; Silva, L. F. O.; da Rocha, J. B. T. Copper Decreases Associative Learning and Memory in *Drosophila melanogaster*. *Sci. Total Environ.* **2020**, *710*, 135306.

Conclusion

Copper exposure significantly reduces oviposition in *D. melanogaster* females. Flies selected for copper resistance show altered behavior under stress, indicating that selection history can influence behavioral plasticity. While population differences were not statistically significant, a possible trend suggests that natural origin may shape behavioral responses to copper exposure.

Acknowledgments

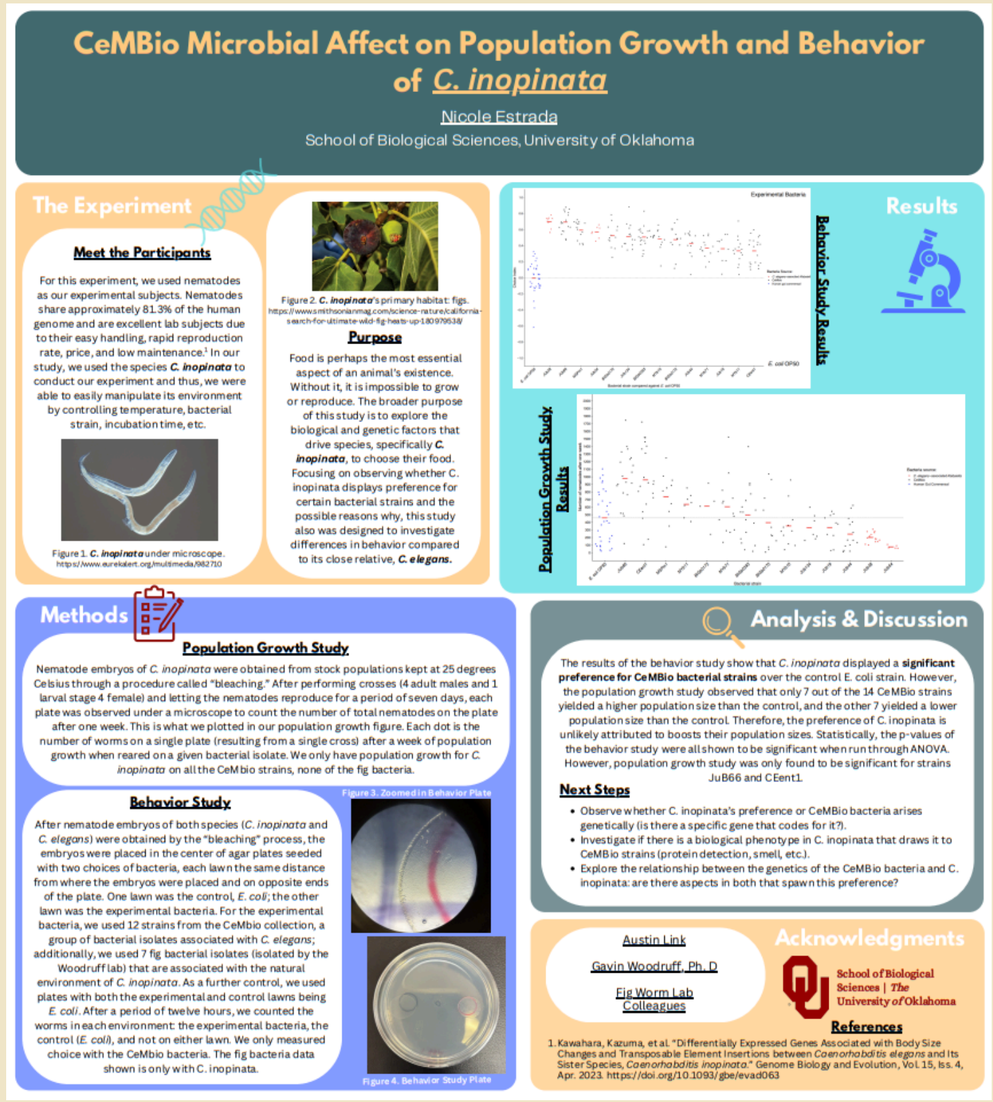
I would like to thank my mentor, Dr. Everman, for all her support throughout this project. I am also incredibly grateful to the OU FYRE Program, Dr. Heather Ketchum, Dr. Mitos Savic, and Dr. Slavik, as well as the OU Honors College, for making this opportunity possible.

HONORS COLLEGE
The UNIVERSITY of OKLAHOMA

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

Nicole Estrada

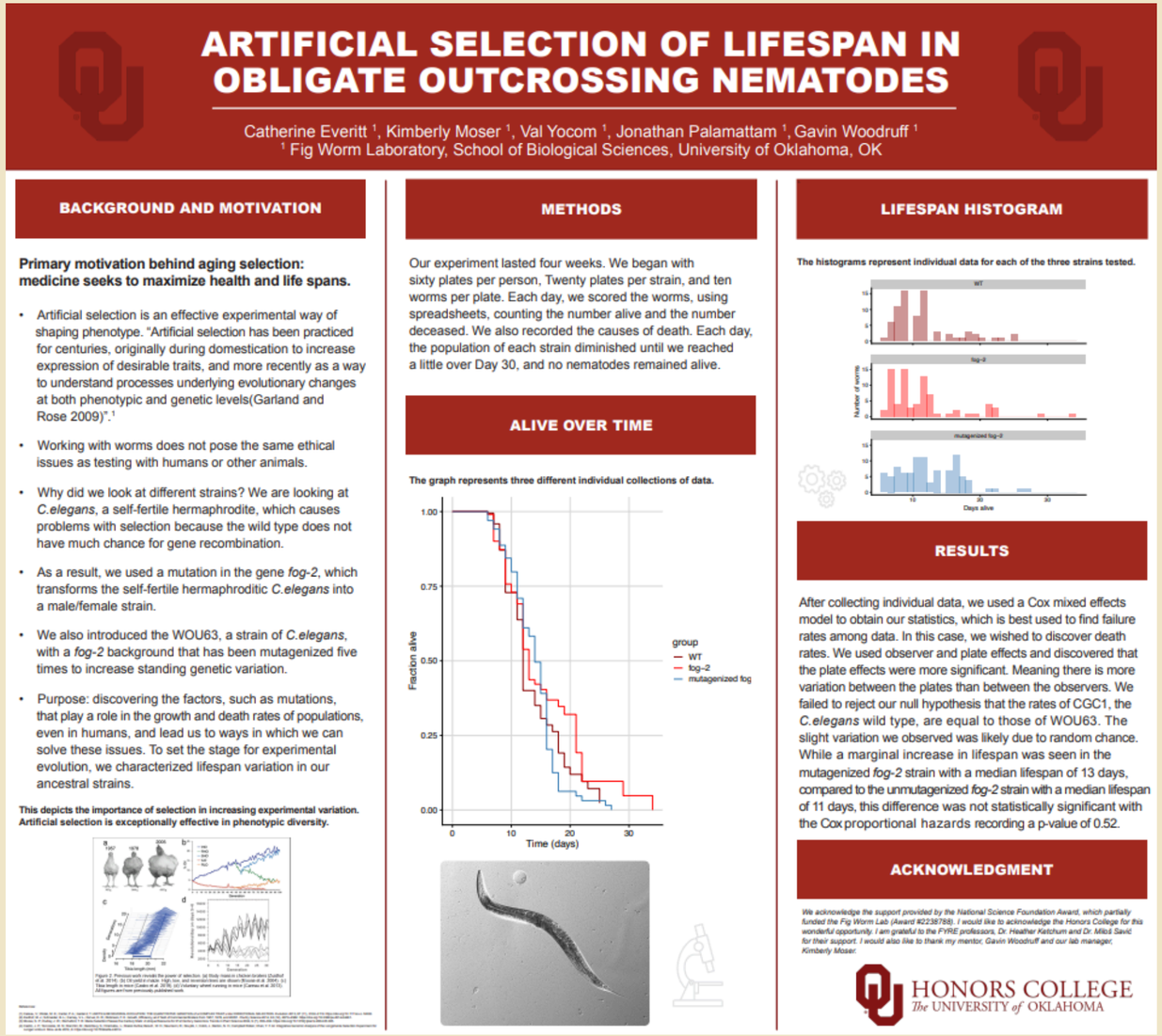
School of Biological Sciences, University of Oklahoma



Artificial Selection of Lifespan in Obligate Outcrossing Nematodes

Catherine Everitt, Kimberly Moser, Val Yocom, Jonathan Palamattam, Gavin Woodruff

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



ARTIFICIAL SELECTION OF LIFESPAN IN OBLIGATE OUTCROSSING NEMATODES

Catherine Everitt [1], Kimberly Moser [1], Val Yocom [1], Jonathan Palamattam [1], Gavin Woodruff [1]
[1] Fig Worm Laboratory, School of Biological Sciences, University of Oklahoma, OK

BACKGROUND AND MOTIVATION

Primary motivation behind aging selection: medicine seeks to maximize health and life spans.

- Artificial selection is an effective experimental way of shaping phenotype. "Artificial selection has been practiced for centuries, originally during domestication to increase expression of desirable traits, and more recently as a way to understand processes underlying evolutionary changes at both phenotypic and genetic levels(Garland and Rose 2009)".[1]
- Working with worms does not pose the same ethical issues as testing with humans or other animals.
- Why did we look at different strains? We are looking at *C.elegans*, a self-fertile hermaphrodite, which causes problems with selection because the wild type does not have much chance for gene recombination.
- As a result, we used a mutation in the gene *fog-2*, which transforms the self-fertile hermaphroditic *C.elegans* into a male/female strain.
- We also introduced the WOU63, a strain of *C.elegans*, with a *fog-2* background that has been mutagenized five times to increase standing genetic variation.
- Purpose: discovering the factors, such as mutations, that play a role in the growth and death rates of populations, even in humans, and lead us to ways in which we can solve these issues. To set the stage for experimental evolution, we characterized lifespan variation in our ancestral strains.

This depicts the importance of selection in increasing experimental variation. Artificial selection is exceptionally effective in phenotypic diversity.

METHODS

Our experiment lasted four weeks. We began with sixty plates per person, Twenty plates per strain, and ten worms per plate. Each day, we scored the worms, using spreadsheets, counting the number alive and the number deceased. We also recorded the causes of death. Each day, the population of each strain diminished until we reached a little over Day 30, and no nematodes remained alive.

ALIVE OVER TIME

The graph represents three different individual collections of data.

LIFESPAN HISTOGRAM

The histograms represent individual data for each of the three strains tested.

RESULTS

After collecting individual data, we used a Cox mixed effects model to obtain our statistics, which is best used to find failure rates among data. In this case, we wished to discover death rates. We used observer and plate effects and discovered that the plate effects were more significant. Meaning there is more variation between the plates than between the observers. We failed to reject our null hypothesis that the rates of CGC1, the *C.elegans* wild type, are equal to those of WOU63. The slight variation we observed was likely due to random chance. While a marginal increase in lifespan was seen in the mutagenized *fog-2* strain with a median lifespan of 13 days, compared to the unmutagenized *fog-2* strain with a median lifespan of 11 days, this difference was not statistically significant with the Cox proportional hazards recording a p-value of 0.52.

ACKNOWLEDGMENT

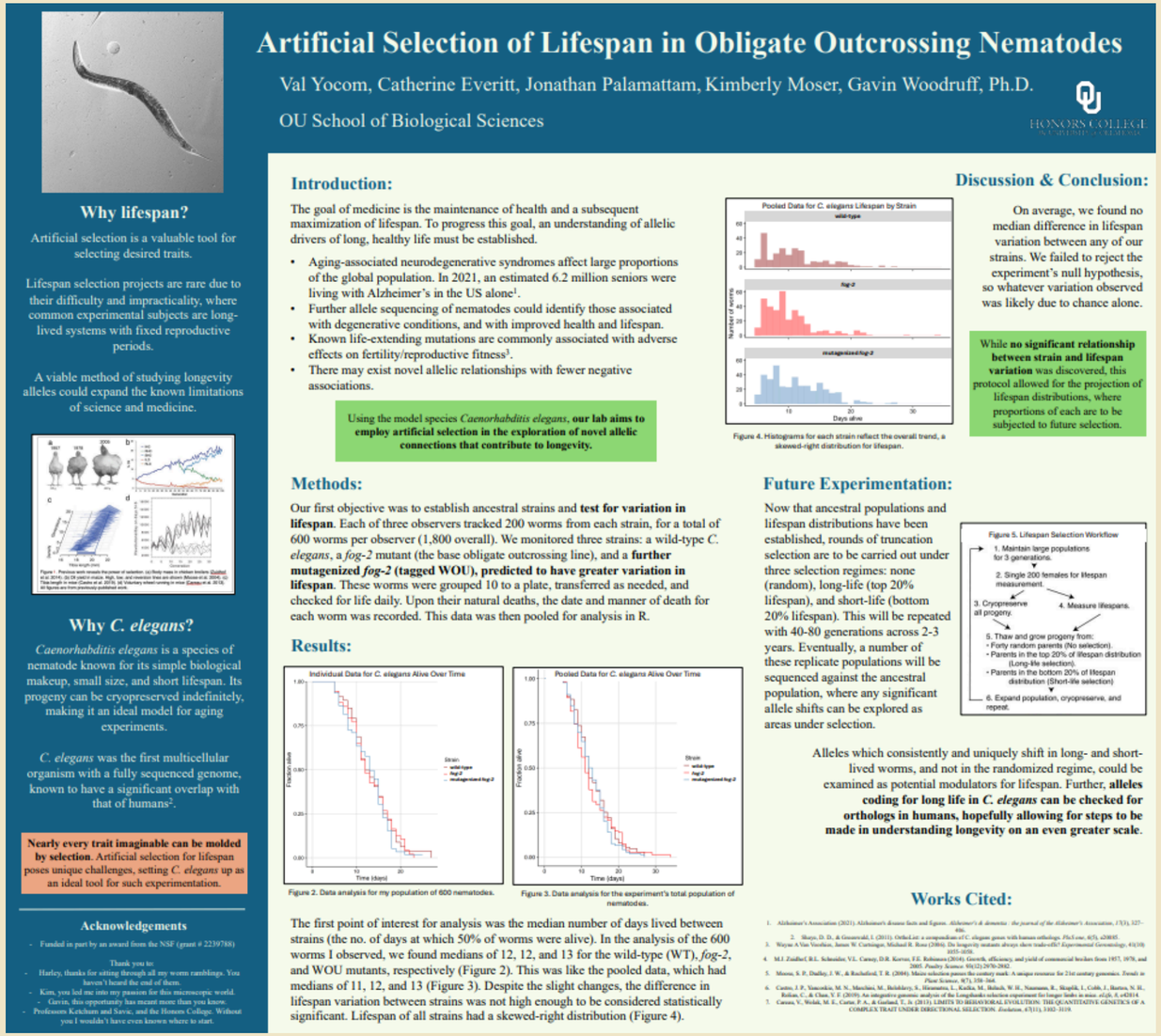
We acknowledge the support provided by the National Science Foundation Award, which partially funded the Fig Worm Lab (Award #2238788). I would like to acknowledge the Honors College for this wonderful opportunity. I am grateful to the FYRE professors, Dr. Heather Ketchum and Dr. Miloš Savić for their support. I would also like to thank my mentor, Gavin Woodruff and our lab manager, Kimberly Moser.

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



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

HONORS COLLEGE

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 humans[2].

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 Ketchum and Savic, and the Honors College. Without you I wouldn't have even known where to start.

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 alone[1].
- 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 fitness[3].
- 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.

Figure 5. Lifespan Selection Workflow

1. Maintain large populations for 3 generations.
2. Single 200 females for lifespan measurement.
3. Cryopreserve all progeny.
4. Measure lifespans.
5. Thaw and grow progeny from:
   - Forty random parents (No selection).
   - Parents in the top 20% of lifespan distribution (Long-life selection).
   - Parents in the bottom 20% of lifespan distribution (Short-life selection)
6. Expand population, cryopreserve, and repeat.

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.**

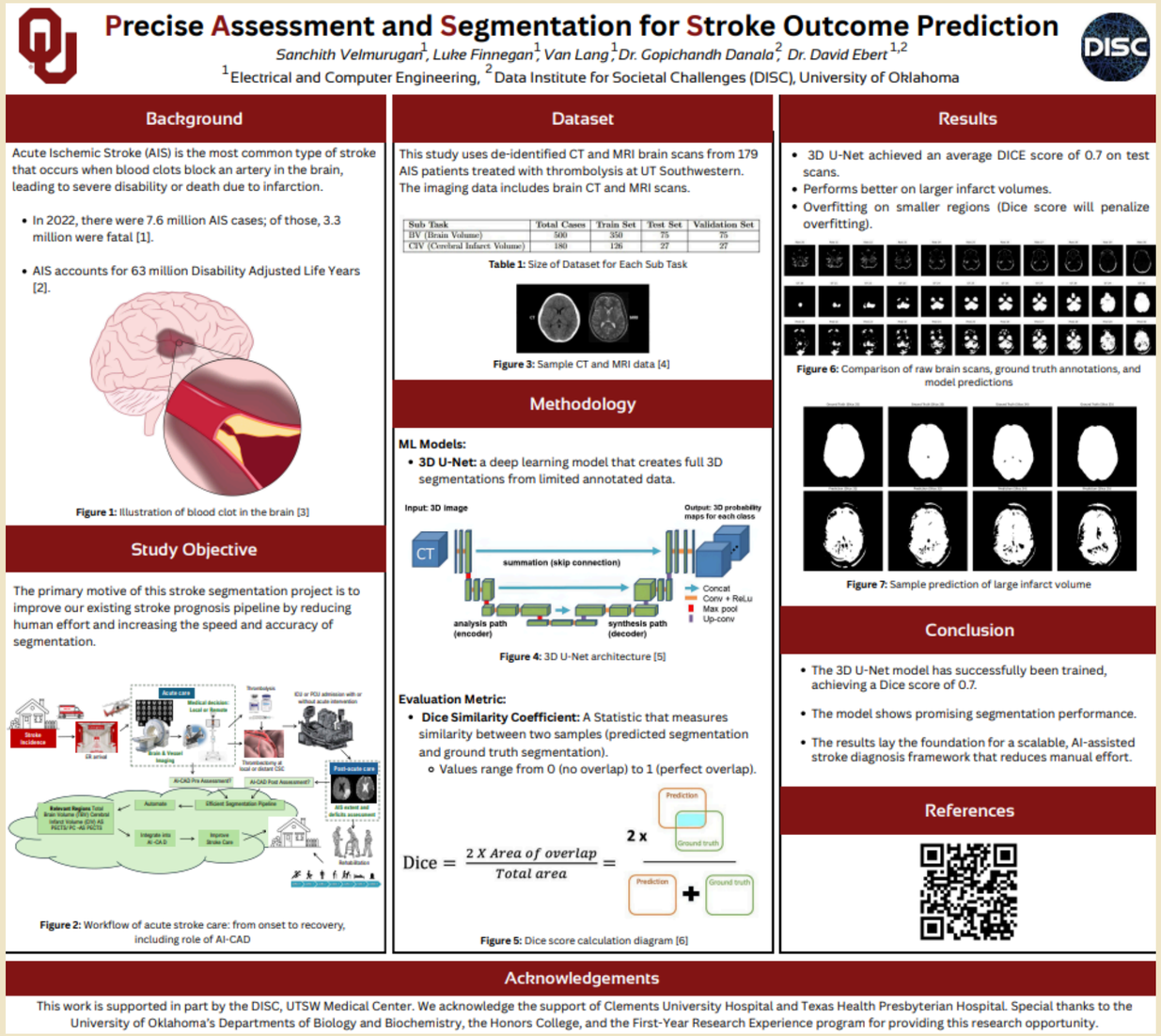
Works Cited:

1. Alzheimer's Association (2021). Alzheimer's disease facts and figures. *Alzheimer's & dementia : the journal of the Alzheimer's Association*, *17*(3), 327–406.
2. Shaye, D. D., & Greenwald, I. (2011). OrthoList: a compendium of C. elegans genes with human orthologs. *PloS one*, *6*(5), e20085.
3. Wayne A Van Voorhies, James W. Curtsinger, Michael R. Rose (2006). Do longevity mutants always show trade-offs? *Experimental Gerontology*, 41(10) 1035–1038.
4. M.J. Zuidhof, B.L. Schneider, V.L. Carney, D.R. Korver, F.E. Robinson (2014). Growth, efficiency, and yield of commercial broilers from 1957, 1978, and 2005. *Poultry Science* 93(12):2970-2982.
5. Moose, S. P., Dudley, J. W., & Rocheford, T. R. (2004). Maize selection passes the century mark: A unique resource for 21st century genomics. *Trends in Plant Science*, *9*(7), 358–364.
6. Castro, J. P., Yancoskie, M. N., Marchini, M., Belohlavy, S., Hiramatsu, L., Kučka, M., Beluch, W. H., Naumann, R., Skopalík, I., Cobb, J., Barton, N. H., Rolian, C., & Chan, Y. F. (2019). An integrative genomic analysis of the Longshanks selection experiment for longer limbs in mice. *eLife*, *8*, e42014.
7. Cassara, V., Wolak, M. E., Carter, P. A., & Garland, T., Jr. (2013). LIMITS TO BEHAVIORAL EVOLUTION: THE QUANTITATIVE GENETICS OF A COMPLEX TRAIT UNDER DIRECTIONAL SELECTION. *Evolution*, *67*(11), 3102–3119.

Precise Assessment and Segmentation for Stroke Outcome Prediction

Sanchith Velmurugan, Luke Finnegan, Van Lang, Dr. Gopichandh Danala, Dr. David Ebert

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



Precise Assessment and Segmentation for Stroke Outcome Prediction

Sanchith Velmurugan[1], *Luke Finnegan*[1], *Van Lang*[1], *Dr. Gopichandh Danala*[2], *Dr. David Ebert*[1,2]

[1] Electrical and Computer Engineering, [2] Data Institute for Societal Challenges (DISC), University of Oklahoma

Background

Acute Ischemic Stroke (AIS) is the most common type of stroke that occurs when blood clots block an artery in the brain, leading to severe disability or death due to infarction.

- In 2022, there were 7.6 million AIS cases; of those, 3.3 million were fatal [1].
- AIS accounts for 63 million Disability Adjusted Life Years [2].

Figure 1: Illustration of blood clot in the brain [3]

Study Objective

The primary motive of this stroke segmentation project is to improve our existing stroke prognosis pipeline by reducing human effort and increasing the speed and accuracy of segmentation.

Figure 2: Workflow of acute stroke care: from onset to recovery, including role of AI-CAD

Dataset

This study uses de-identified CT and MRI brain scans from 179 AIS patients treated with thrombolysis at UT Southwestern. The imaging data includes brain CT and MRI scans.

Sub Task	Total Cases	Train Set	Test Set	Validation Set
BV (Brain Volume)	500	350	75	75
CBV (Cerebral Infarct Volume)	180	126	27	27

Table 1: Size of Dataset for Each Sub Task

Figure 3: Sample CT and MRI data [4]

Methodology

ML Models:

- **3D U-Net:** a deep learning model that creates full 3D segmentations from limited annotated data.

Input: 3D Image — Output: 3D probability maps for each class; CT; summation (skip connection); analysis path (encoder); synthesis path (decoder); Concat; Conv + ReLu; Max pool; Up-conv

Figure 4: 3D U-Net architecture [5]

Evaluation Metric:

- **Dice Similarity Coefficient:** A Statistic that measures similarity between two samples (predicted segmentation and ground truth segmentation).
  - Values range from 0 (no overlap) to 1 (perfect overlap).

$$\text{Dice} = \frac{2\,X\,Area\ of\ overlap}{Total\ area} = \frac{2 \times}{\text{Prediction} + \text{Ground truth}}$$

Figure 5: Dice score calculation diagram [6]

Results

- 3D U-Net achieved an average DICE score of 0.7 on test scans.
- Performs better on larger infarct volumes.
- Overfitting on smaller regions (Dice score will penalize overfitting).

Figure 6: Comparison of raw brain scans, ground truth annotations, and model predictions

Figure 7: Sample prediction of large infarct volume

Conclusion

- The 3D U-Net model has successfully been trained, achieving a Dice score of 0.7.
- The model shows promising segmentation performance.
- The results lay the foundation for a scalable, AI-assisted stroke diagnosis framework that reduces manual effort.

References

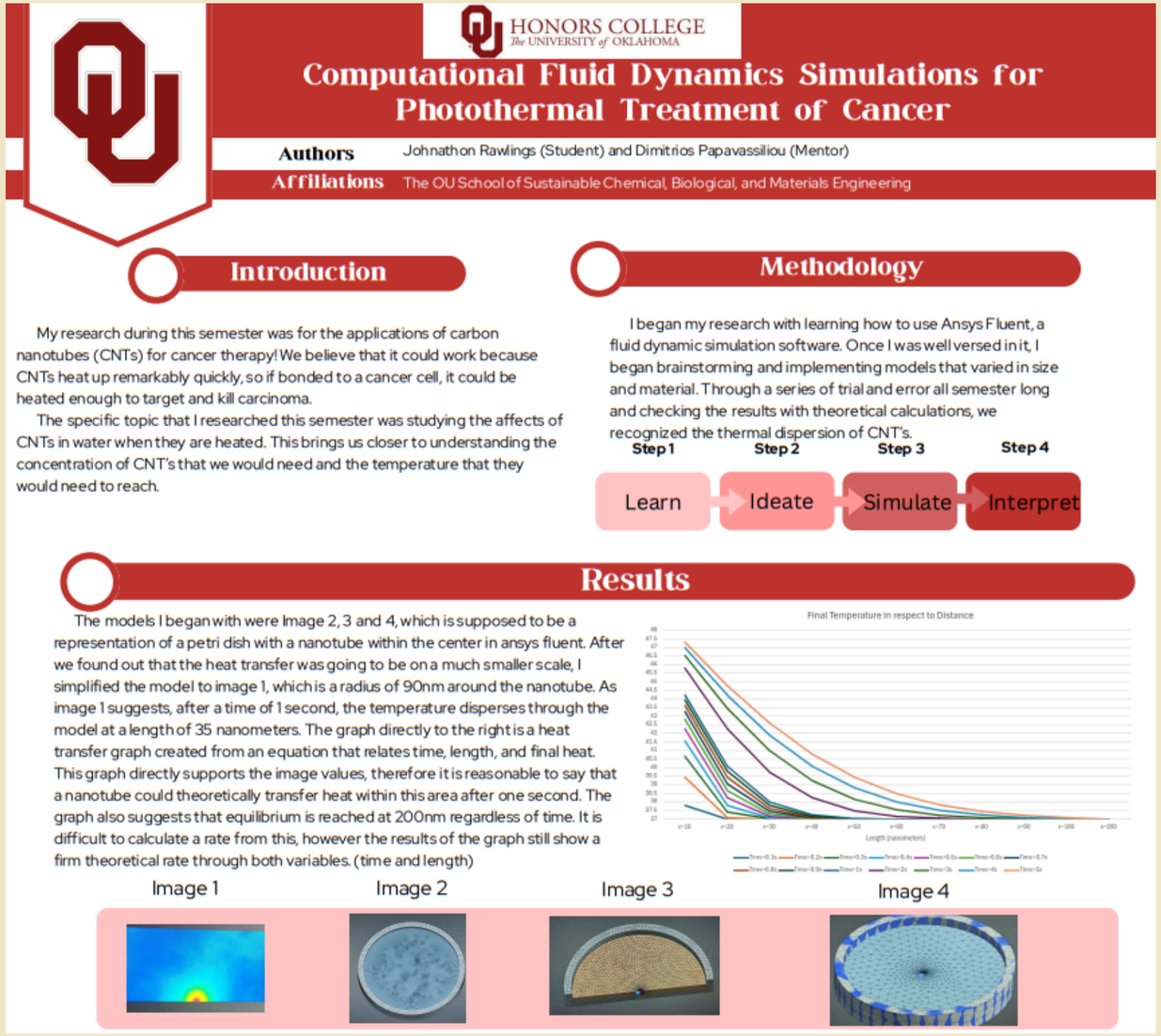
Acknowledgements

This work is supported in part by the DISC, UTSW Medical Center. We acknowledge the support of Clements University Hospital and Texas Health Presbyterian Hospital. Special thanks to the University of Oklahoma's Departments of Biology and Biochemistry, the Honors College, and the First-Year Research Experience program for providing this research opportunity.

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



HONORS COLLEGE
The UNIVERSITY of OKLAHOMA

Computational Fluid Dynamics Simulations for Photothermal Treatment of Cancer

Authors Johnathon Rawlings (Student) and Dimitrios Papavassiliou (Mentor)

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

Introduction

My research during this semester was for the applications of carbon nanotubes (CNTs) for cancer therapy! We believe that it could work because CNTs heat up remarkably quickly, so if bonded to a cancer cell, it could be heated enough to target and kill carcinoma.

The specific topic that I researched this semester was studying the affects of CNTs in water when they are heated. This brings us closer to understanding the concentration of CNT's that we would need and the temperature that they would need to reach.

Methodology

I began my research with learning how to use Ansys Fluent, a fluid dynamic simulation software. Once I was well versed in it, I began brainstorming and implementing models that varied in size and material. Through a series of trial and error all semester long and checking the results with theoretical calculations, we recognized the thermal dispersion of CNT's.

Step 1 Learn → Step 2 Ideate → Step 3 Simulate → Step 4 Interpret

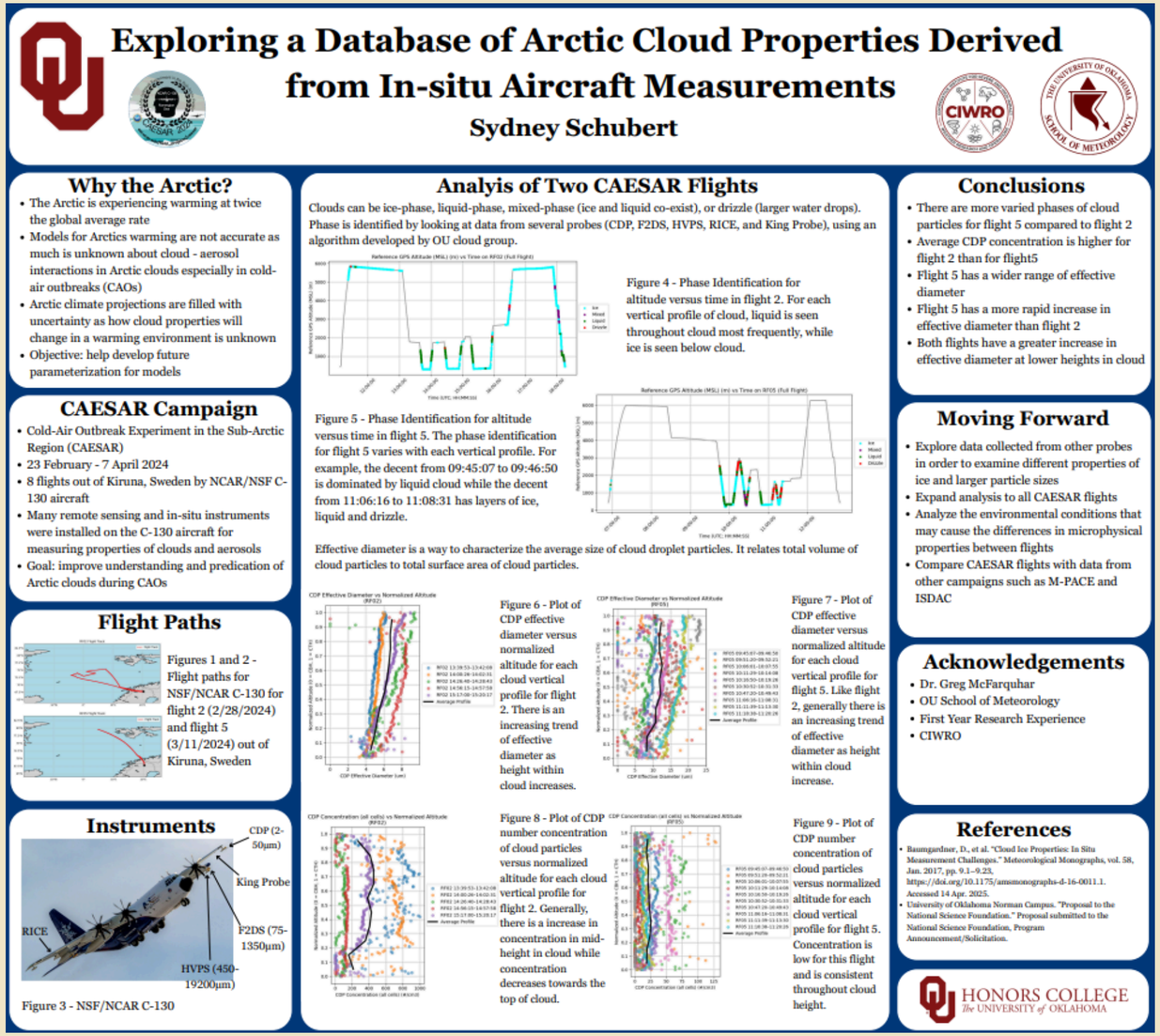
Results

The models I began with were Image 2, 3 and 4, which is supposed to be a representation of a petri dish with a nanotube within the center in ansys fluent. After we found out that the heat transfer was going to be on a much smaller scale, I simplified the model to image 1, which is a radius of 90nm around the nanotube. As image 1 suggests, after a time of 1 second, the temperature disperses through the model at a length of 35 nanometers. The graph directly to the right is a heat transfer graph created from an equation that relates time, length, and final heat. This graph directly supports the image values, therefore it is reasonable to say that a nanotube could theoretically transfer heat within this area after one second. The graph also suggests that equilibrium is reached at 200nm regardless of time. It is difficult to calculate a rate from this, however the results of the graph still show a firm theoretical rate through both variables. (time and length)

Image 1 Image 2 Image 3 Image 4

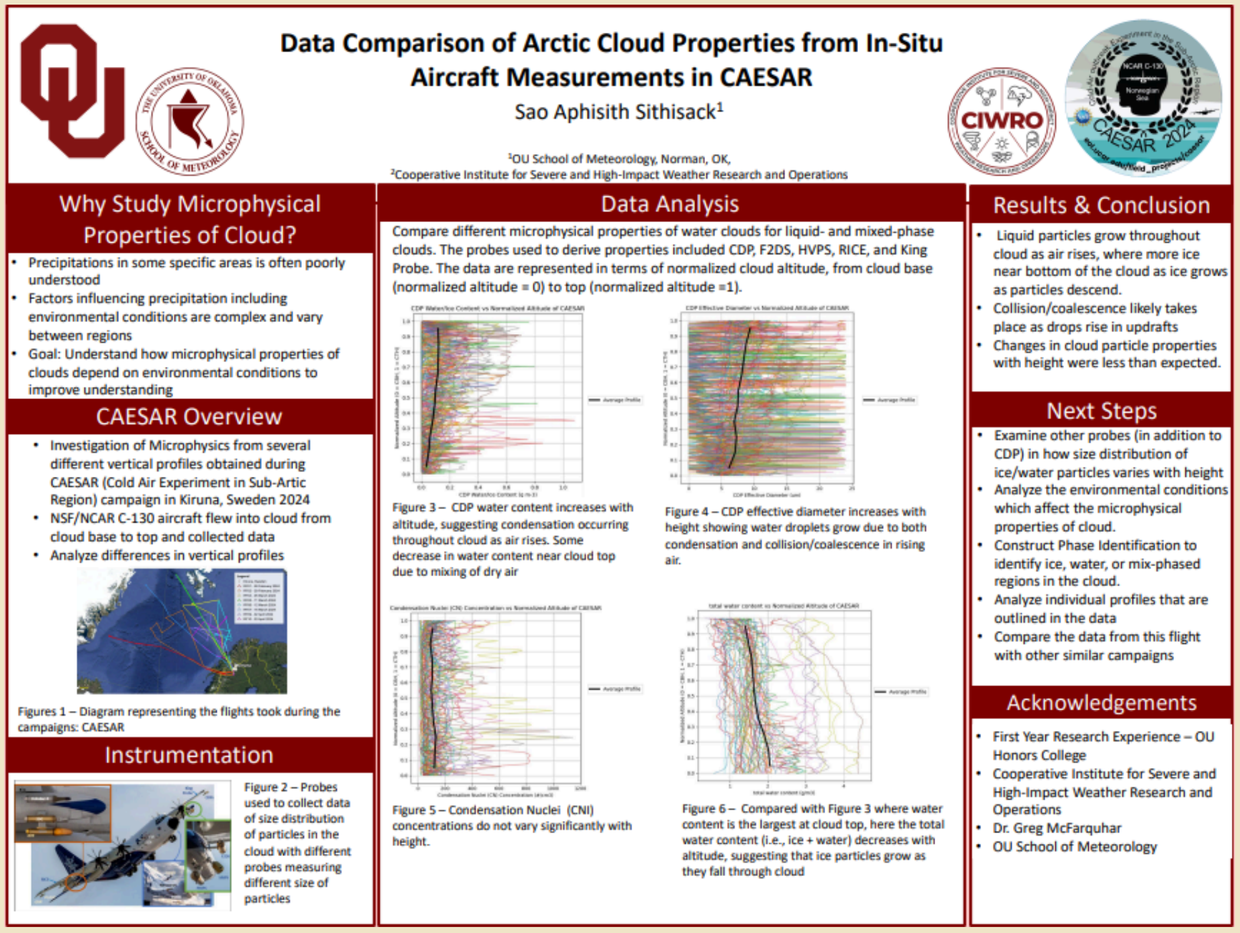
Exploring a Database of Arctic Cloud Properties Derived from In-situ Aircraft Measurements

Sydney Schubert



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 Sithisack[1]

[1]OU School of Meteorology, Norman, OK,
[2]Cooperative 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-Artic 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

Figures 1 – Diagram representing the flights took during the campaigns: CAESAR

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 (CNI) 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

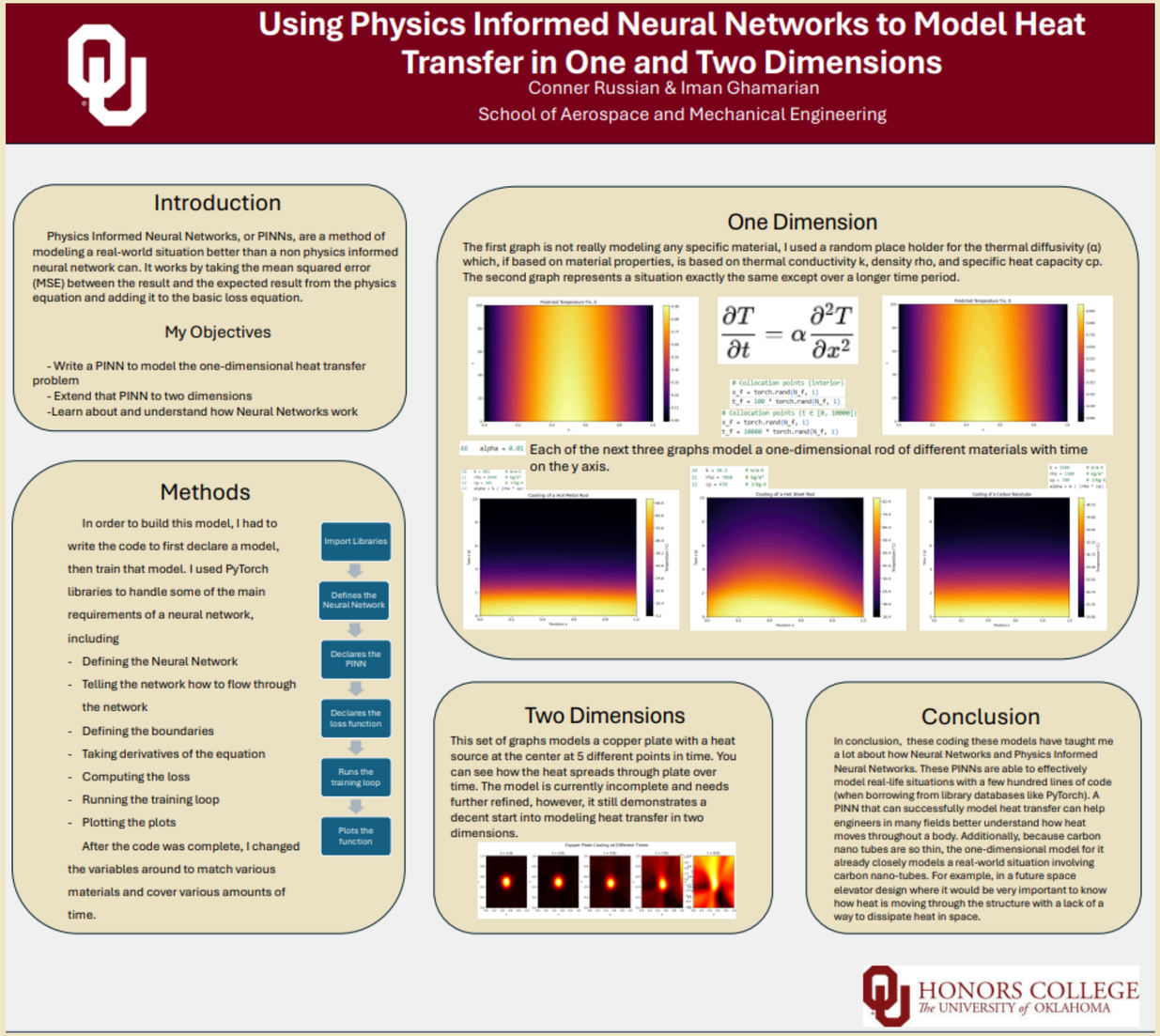
Acknowledgements

- 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

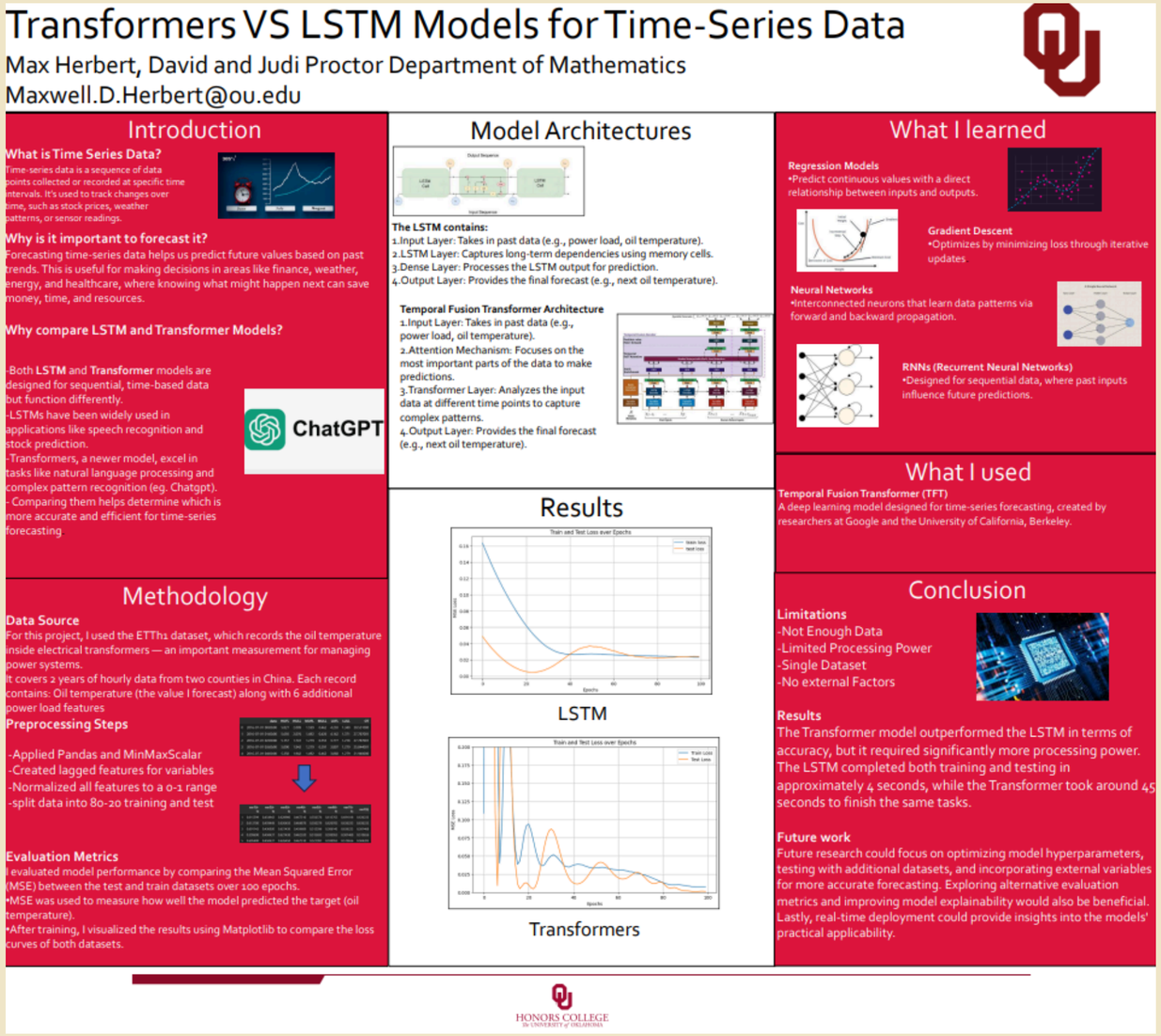
School of Aerospace and Mechanical Engineering



Transformers VS LSTM Models for Time-Series Data

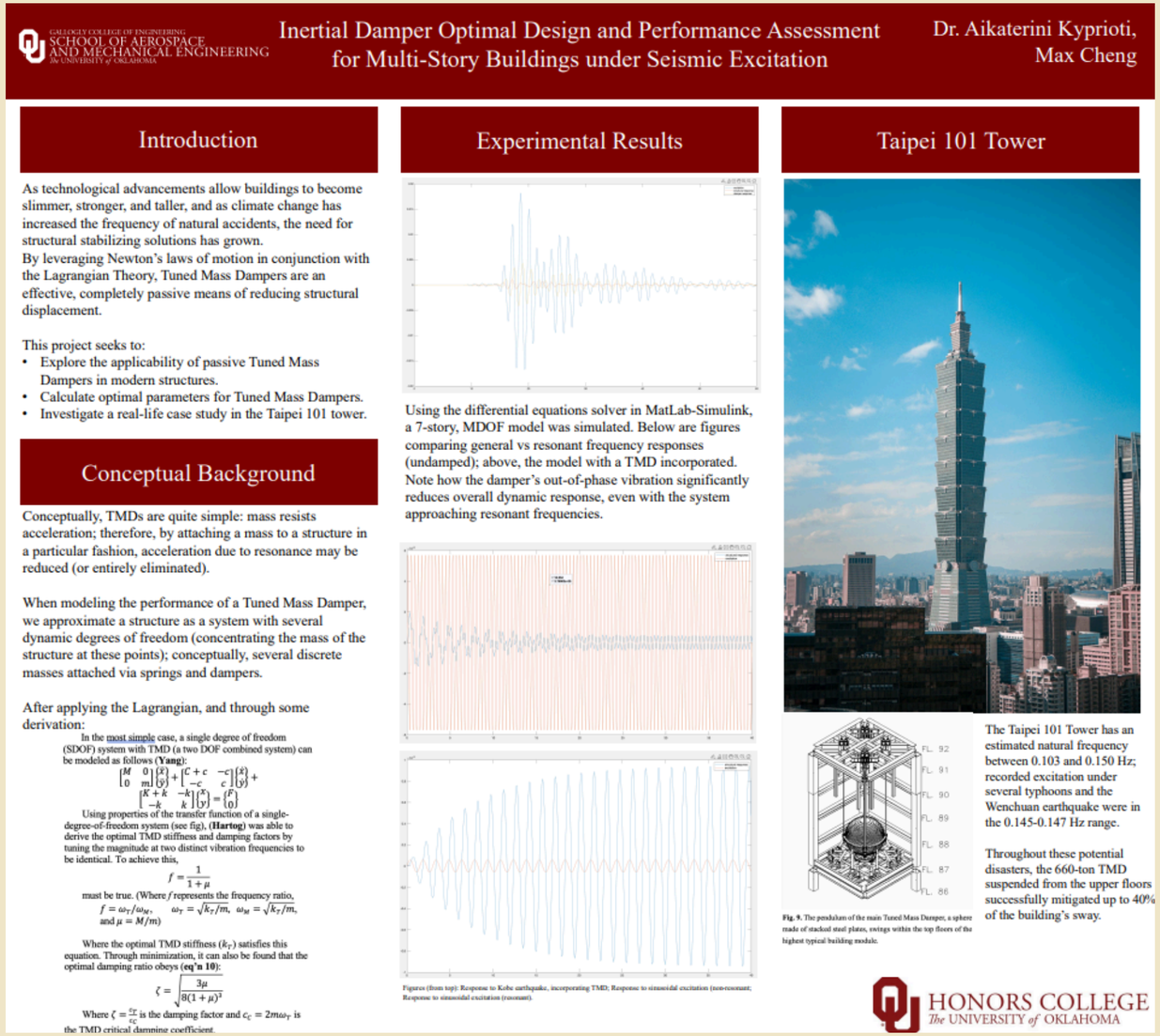
Max Herbert, David and Judi Proctor

Department of Mathematics



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

Dr. Aikaterini Kyprioti, Max Cheng



GALLOGLY 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 damping 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

Fig. 9. The pendulum of the main Tuned Mass Damper, a sphere made of stacked steel plates, swings within the top floors of the highest typical building module.

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.

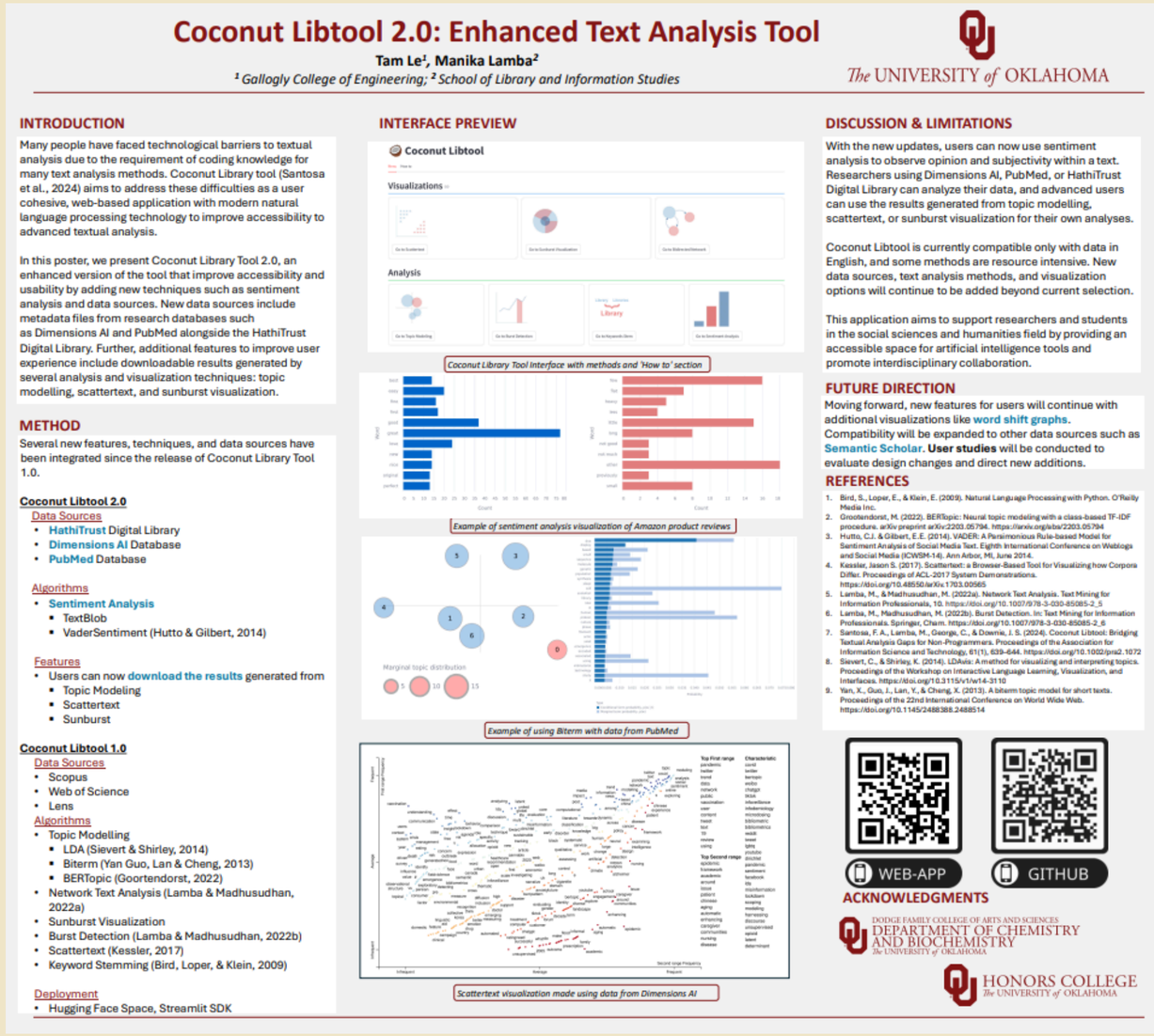
Throughout these potential disasters, the 660-ton TMD suspended from the upper floors successfully mitigated up to 40% of the building's sway.

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 Le[1], Manika Lamba[2]

[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 (Sievert & 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

1. Bird, S., Loper, E., & Klein, E. (2009). Natural Language Processing with Python. O'Reilly Media Inc.
2. 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
3. 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.
4. 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
5. 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
6. 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
7. 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/pra2.1072
8. Sievert, C., & Shirley, K. (2014). LDAvis: A method for visualizing and interpreting topics. Proceedings of the Workshop on Interactive Language Learning, Visualization, and Interfaces. https://doi.org/10.3115/v1/w14-3110
9. 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

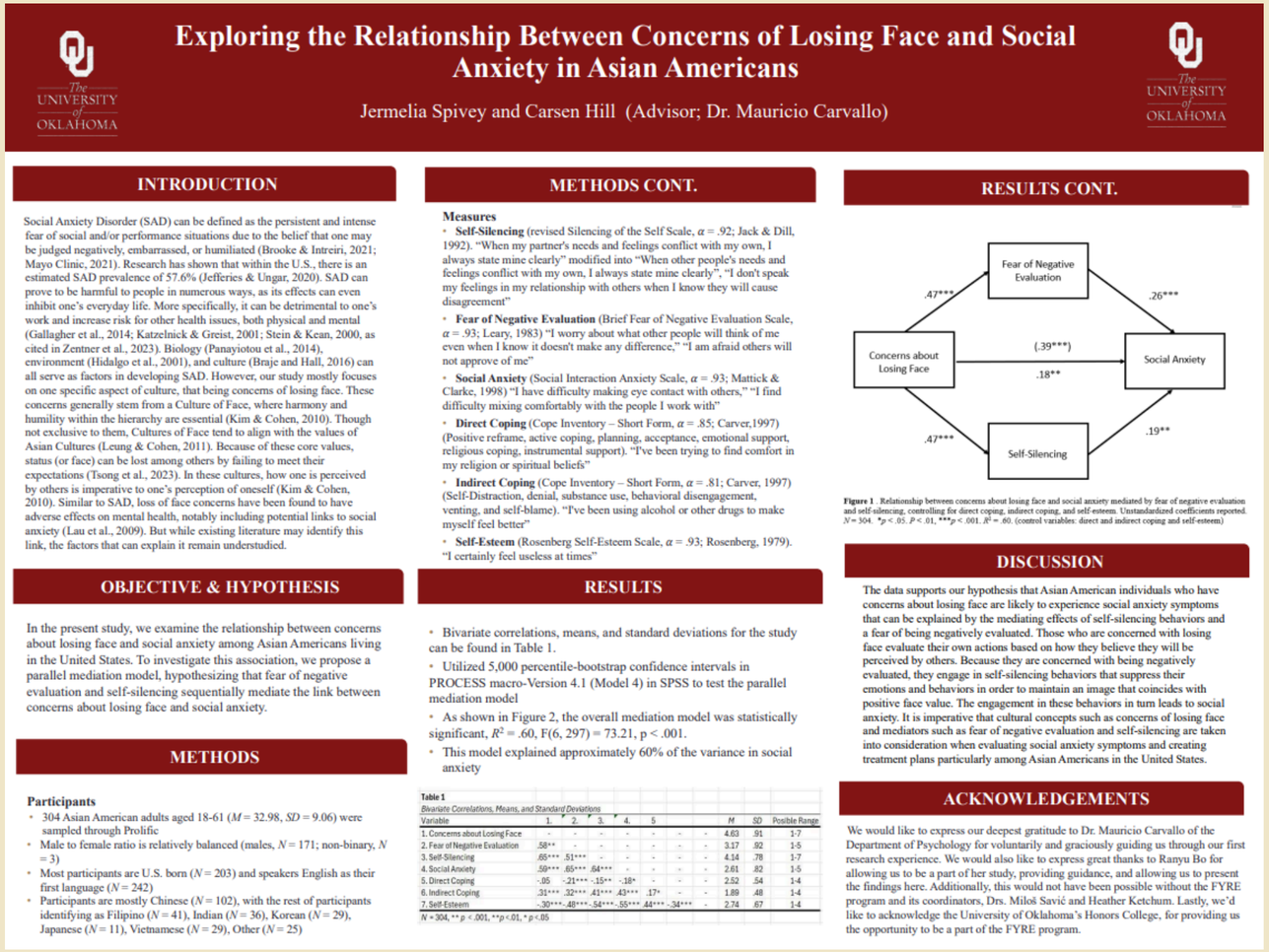
ACKNOWLEDGMENTS

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 (Brajc 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, α = .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, α = .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, α = .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, α = .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, α = .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, α = .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	Posible 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* < .001, **p <.01, * *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.

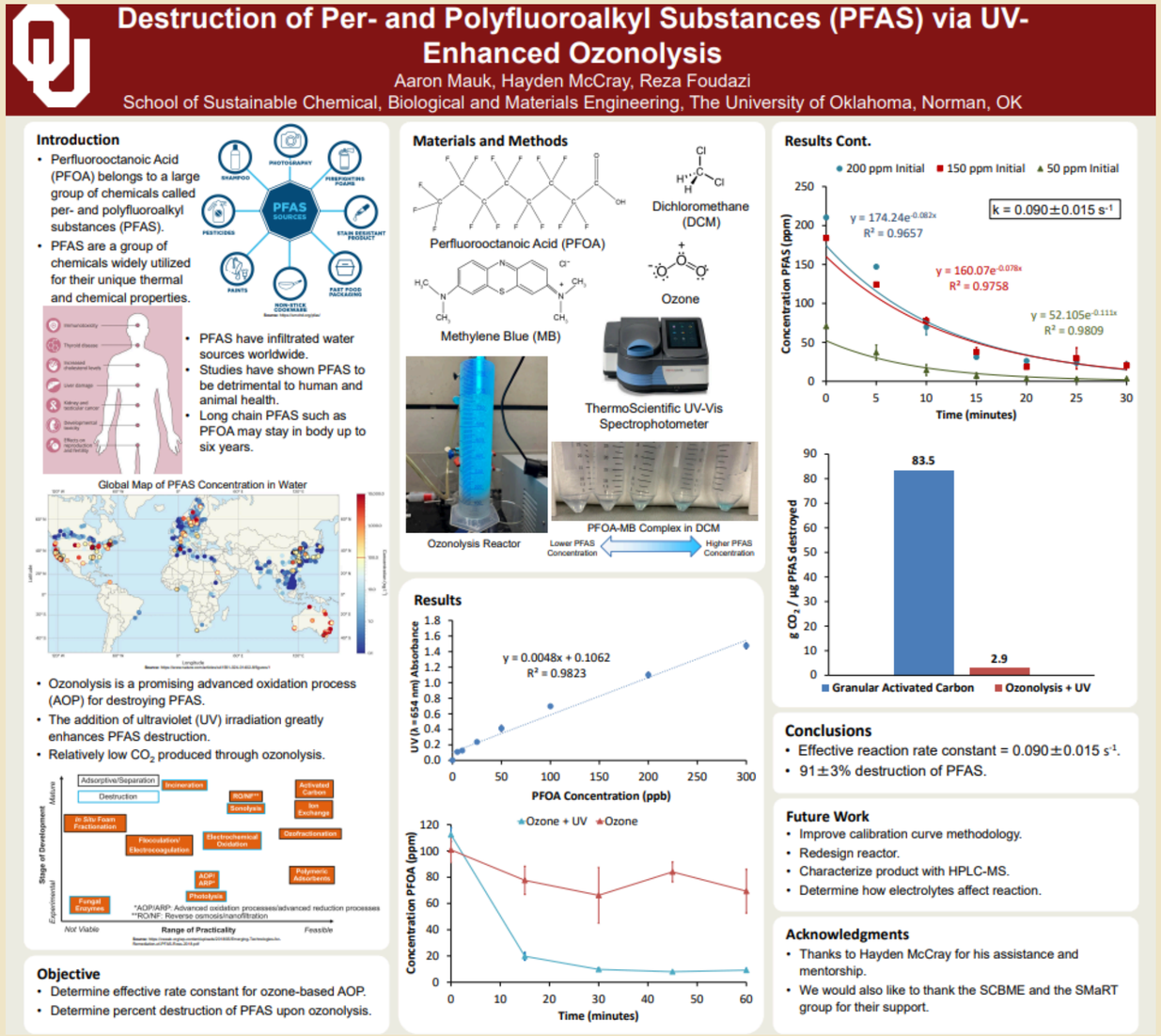
ACKNOWLEDGEMENTS

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 UVEnhanced Ozonolysis

Aaron Mauk, Hayden McCray, Reza Foudazi

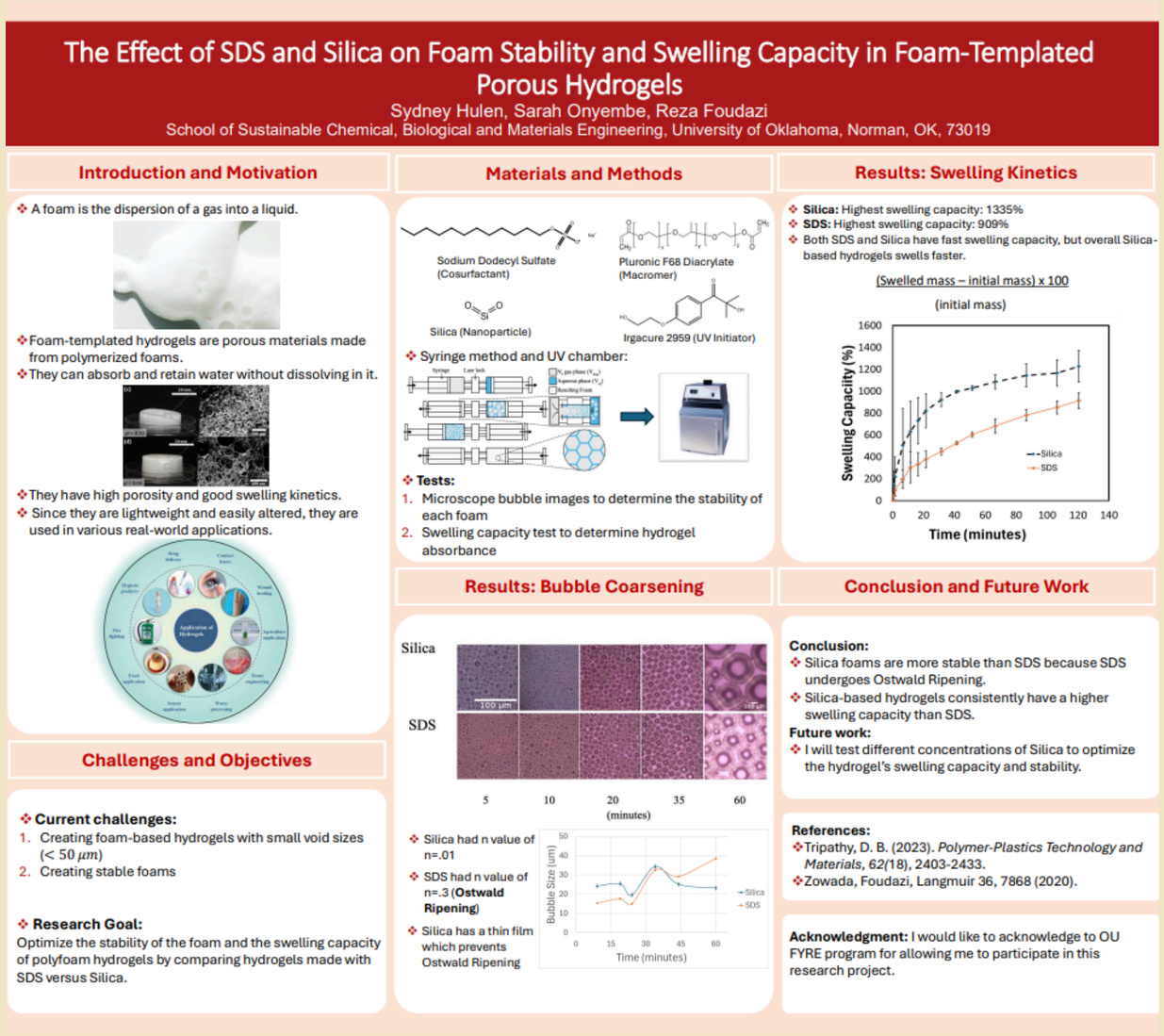
School of Sustainable Chemical, Biological and Materials Engineering, The University of Oklahoma, Norman, OK



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

Sydney Hulen, Sarah Onyembe, Reza Foudazi

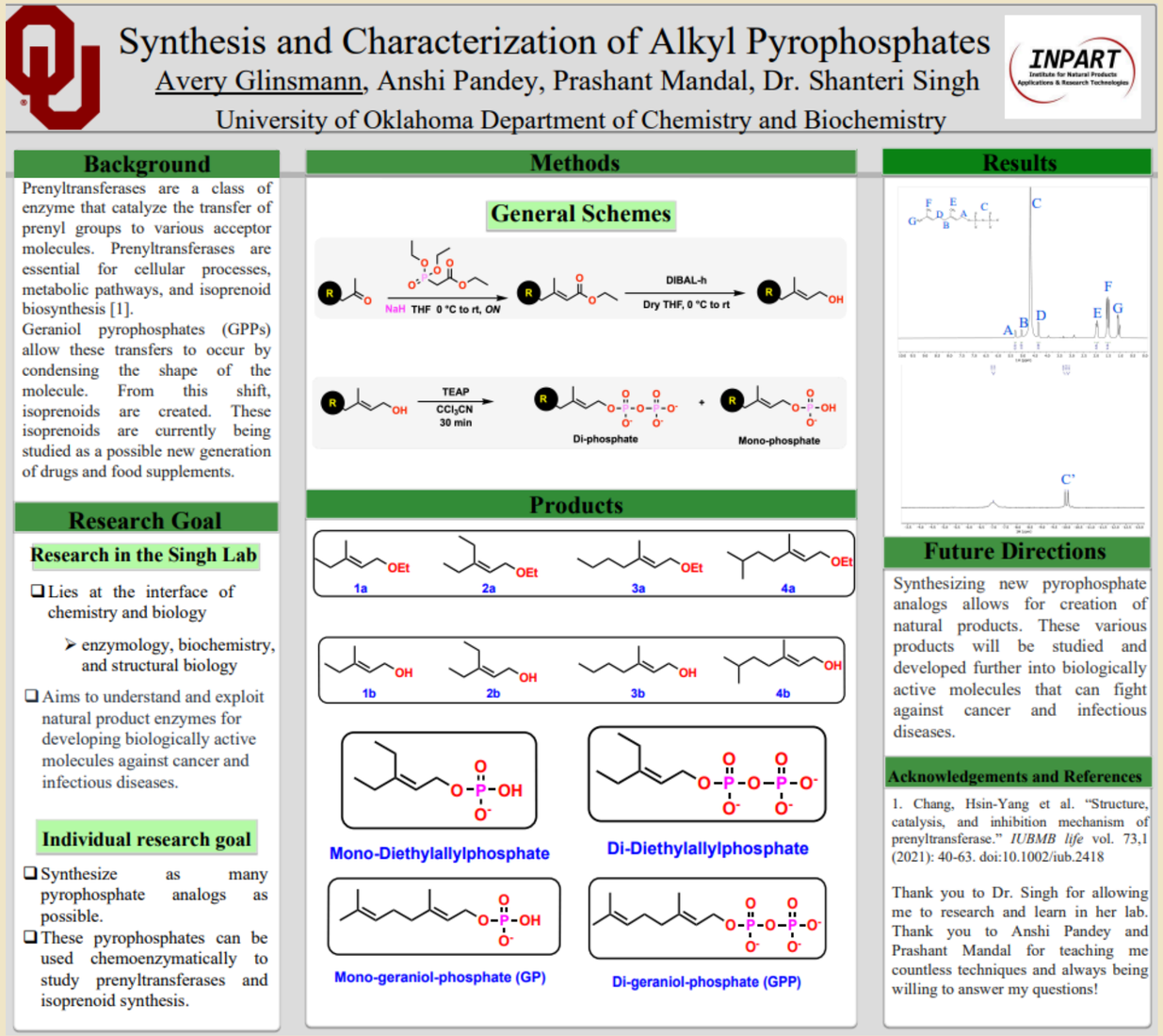
School of Sustainable Chemical, Biological and Materials Engineering, University of Oklahoma, Norman, OK, 73019



Synthesis and Characterization of Alkyl Pyrophosphates

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

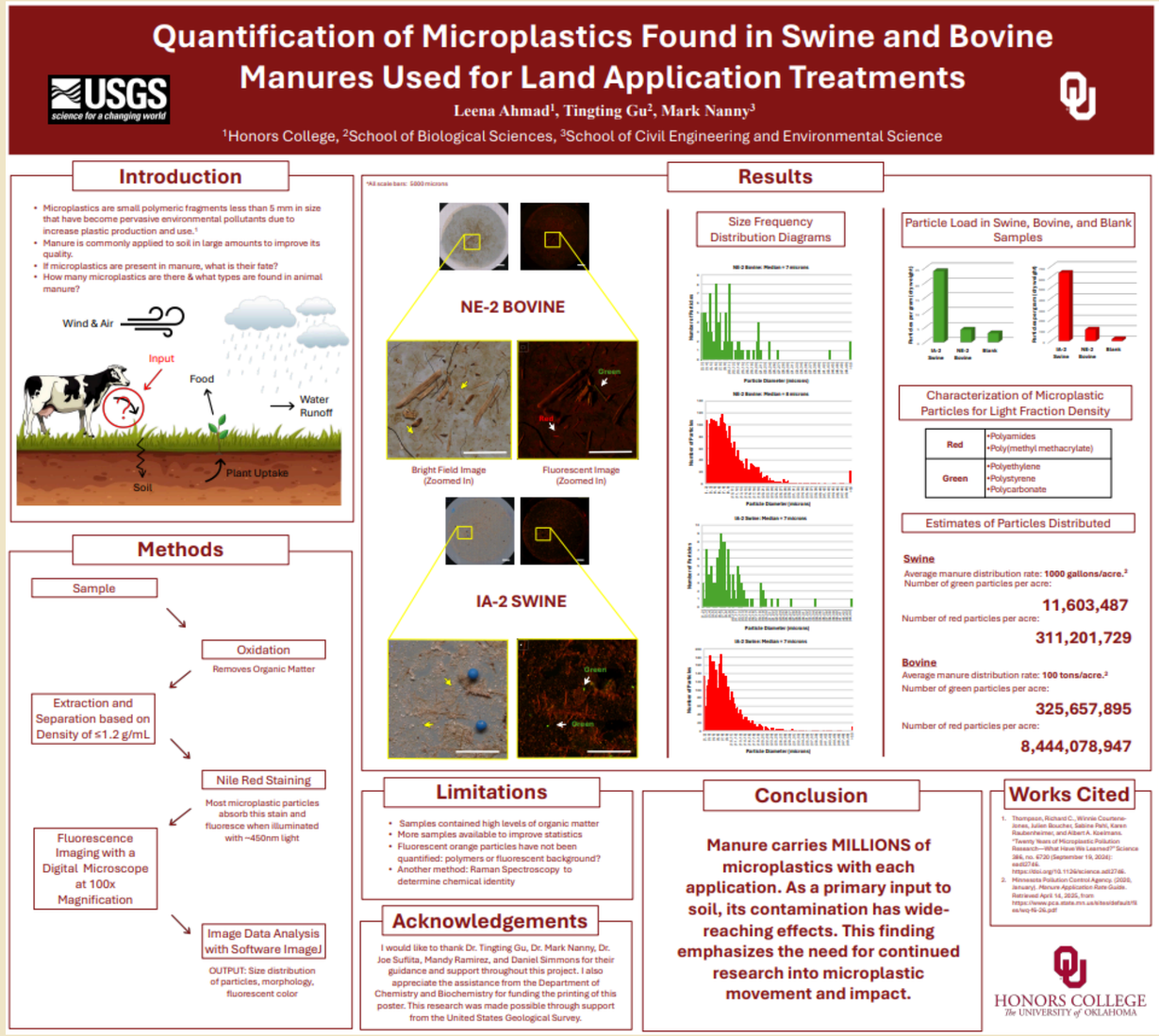
University of Oklahoma Department of Chemistry and Biochemistry



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

Leena Ahmad, Tingting Gu, Mark Nanny

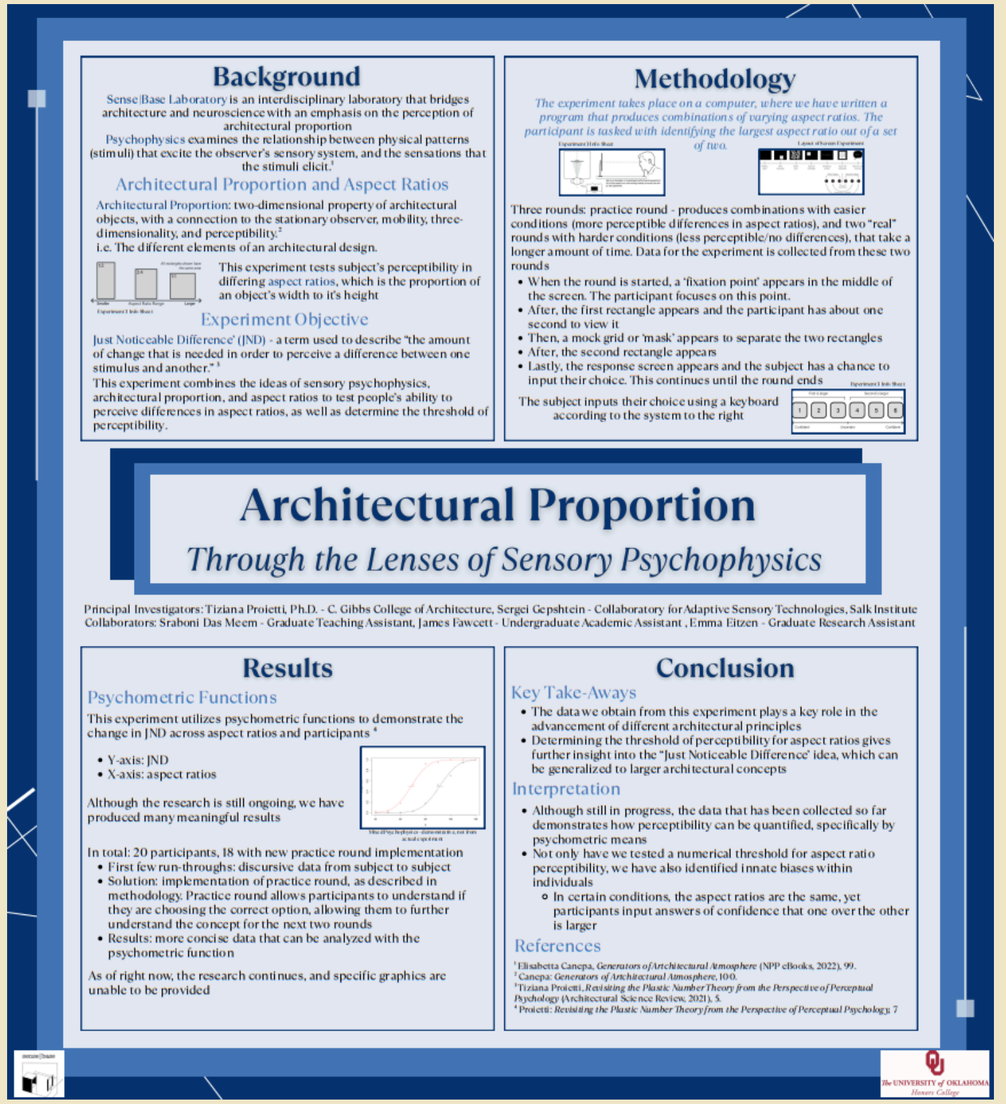
Honors College, School of Biological Sciences, School of Civil Engineering and Environmental Science



Architectural Proportion Through the Lenses of Sensory Psychophysics

Principal Investigators: Tiziana Proietti, Ph.D., C. Gibbs College of Architecture, Sergei Gepshtein - Collaboratory forAdaptive Sensory Technologies

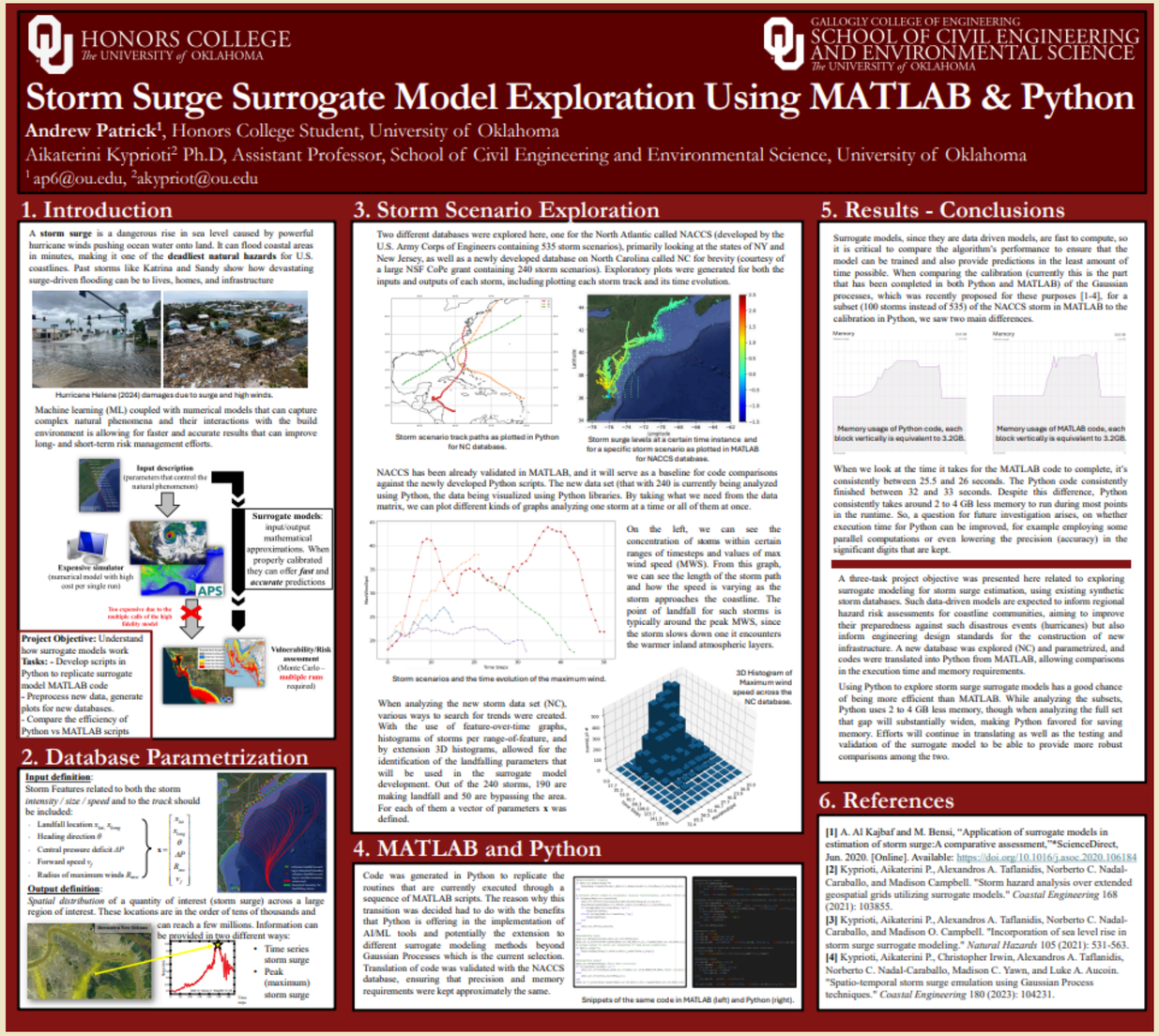
Salk Institute Collaborators: Sraboni Das Meem - Graduate Teaching Assistant, James Fawcett - Undergraduate Academic Assistant , Emma Eitzen - Graduate Research Assistant



Storm Surge Surrogate Model Exploration Using MATLAB & Python

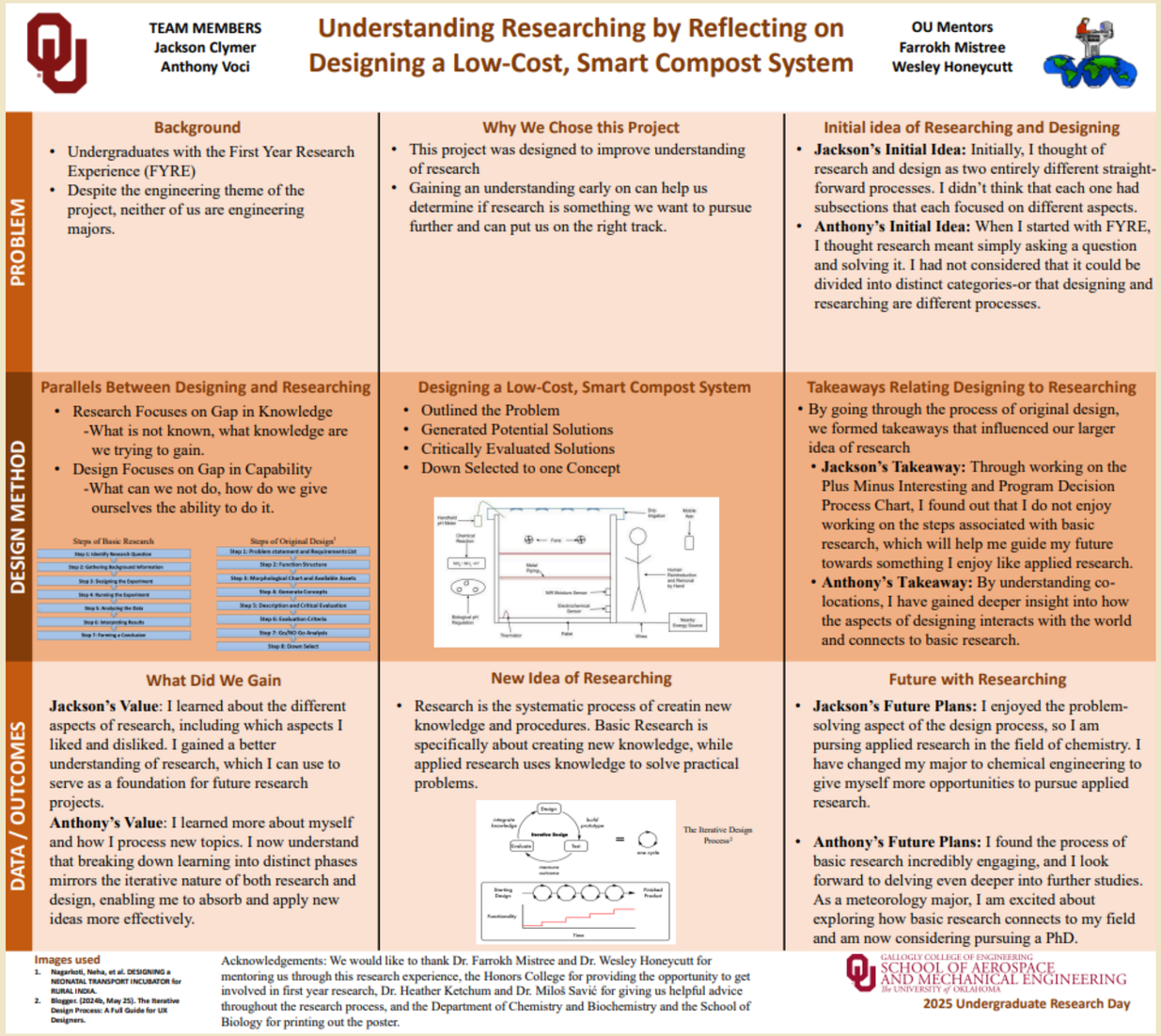
Andrew Patrick, Honors College Student, University of Oklahoma

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



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

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



TEAM MEMBERS
Jackson Clymer
Anthony Voci

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

OU Mentors
Farrokh Mistree
Wesley Honeycutt

PROBLEM

Background

- Undergraduates with the First Year Research Experience (FYRE)
- Despite the engineering theme of the project, neither of us are engineering majors.

Why We Chose this Project

- This project was designed to improve understanding of research
- Gaining 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.

Initial idea of Researching and Designing

- **Jackson's Initial Idea:** Initially, I thought of research and design as two entirely different straight-forward 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.

DESIGN METHOD

Parallels Between Designing and Researching

- Research Focuses on Gap in Knowledge
  -What is not known, what knowledge are we trying to gain.
- Design Focuses on Gap in Capability
  -What can we not do, how do we give ourselves the ability to do it.

Designing a Low-Cost, Smart Compost System

- Outlined the Problem
- Generated Potential Solutions
- Critically Evaluated Solutions
- Down Selected to one Concept

Takeaways Relating Designing to Researching

- By going through the process of original design, we formed takeaways that influenced our larger idea of research
  - **Jackson'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.

DATA / OUTCOMES

What Did We Gain

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.

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.

New Idea of Researching

- Research is the systematic process of creatin new knowledge and procedures. Basic Research is specifically about creating new knowledge, while applied research uses knowledge to solve practical problems.

The Iterative Design Process[2]

Future with Researching

- **Jackson's Future Plans:** I enjoyed the problem-solving aspect of the design process, so I am pursing 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.

Images used

1. Nagarkoti, Neha, et al. DESIGNING a NEONATAL TRANSPORT INCUBATOR for RURAL INDIA.
2. Blogger. (2024b, May 25). The Iterative Design Process: A Full Guide for UX Designers.

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.

GALLOGLY COLLEGE OF ENGINEERING
SCHOOL OF AEROSPACE AND MECHANICAL ENGINEERING
The UNIVERSITY of OKLAHOMA

2025 Undergraduate Research Day

Relevance Classification A Learning Approach for Social Media

Shawn Agarwal

RELEVANCE CLASSIFICATION

A LEARNING APPROACH FOR SOCIAL MEDIA

SHAWN AGARWAL

BACKGROUND

PROBLEM:

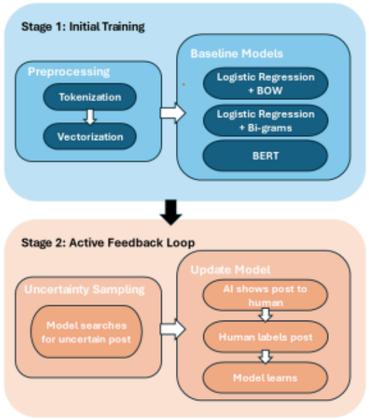
Social media classification is challenging due to sarcasm, slang, and ambiguous langugage.

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:

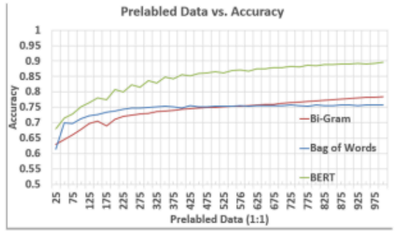
Contains 1.6 million tweets from 2009 collected using the Twitter API.

HONORS COLLEGE
The University of Oklahoma

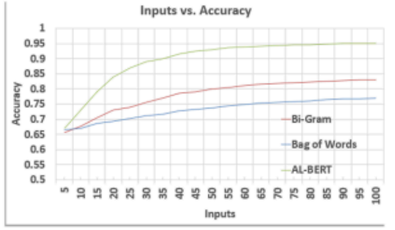
RESULTS

BI-GRAMS: WORD PAIR FREQUENCY
BAG OF WORDS: SINGLE WORD FREQUENCY
BERT: CONTEXTUAL UNDERSTANDING
AL-BERT: ACTIVE LEARNING BERT

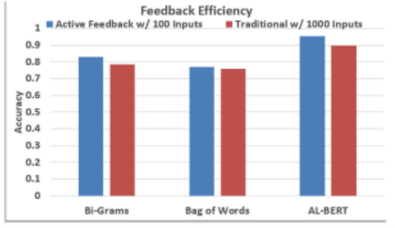
ACCURACY WITHOUT FEEDBACK :



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 yeilds 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

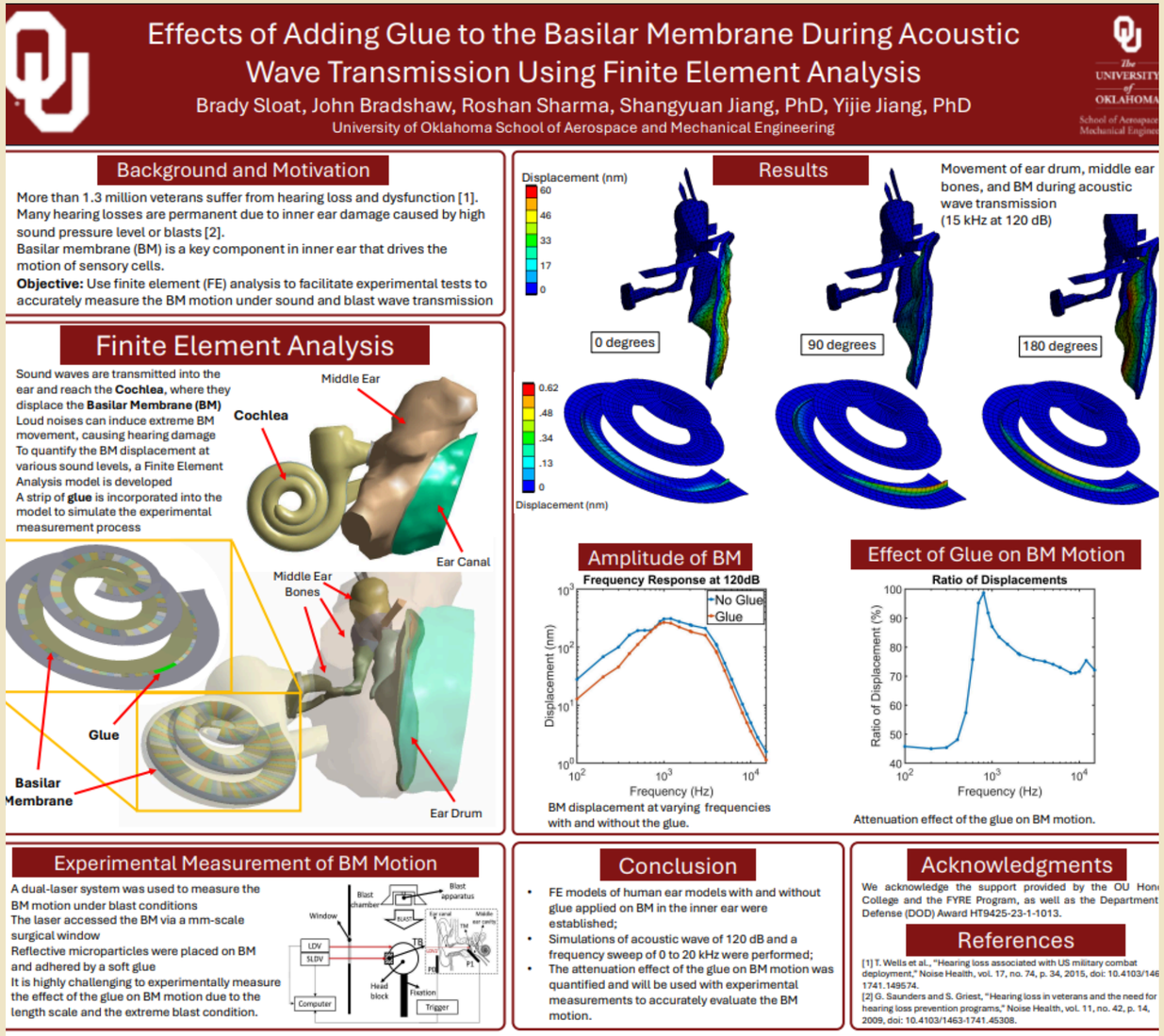
Cook, T. (2020, August 30). How BERT determines search relevance. Towards Data Science.

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 30(EMNLP). Association for Computational Linguistics.

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

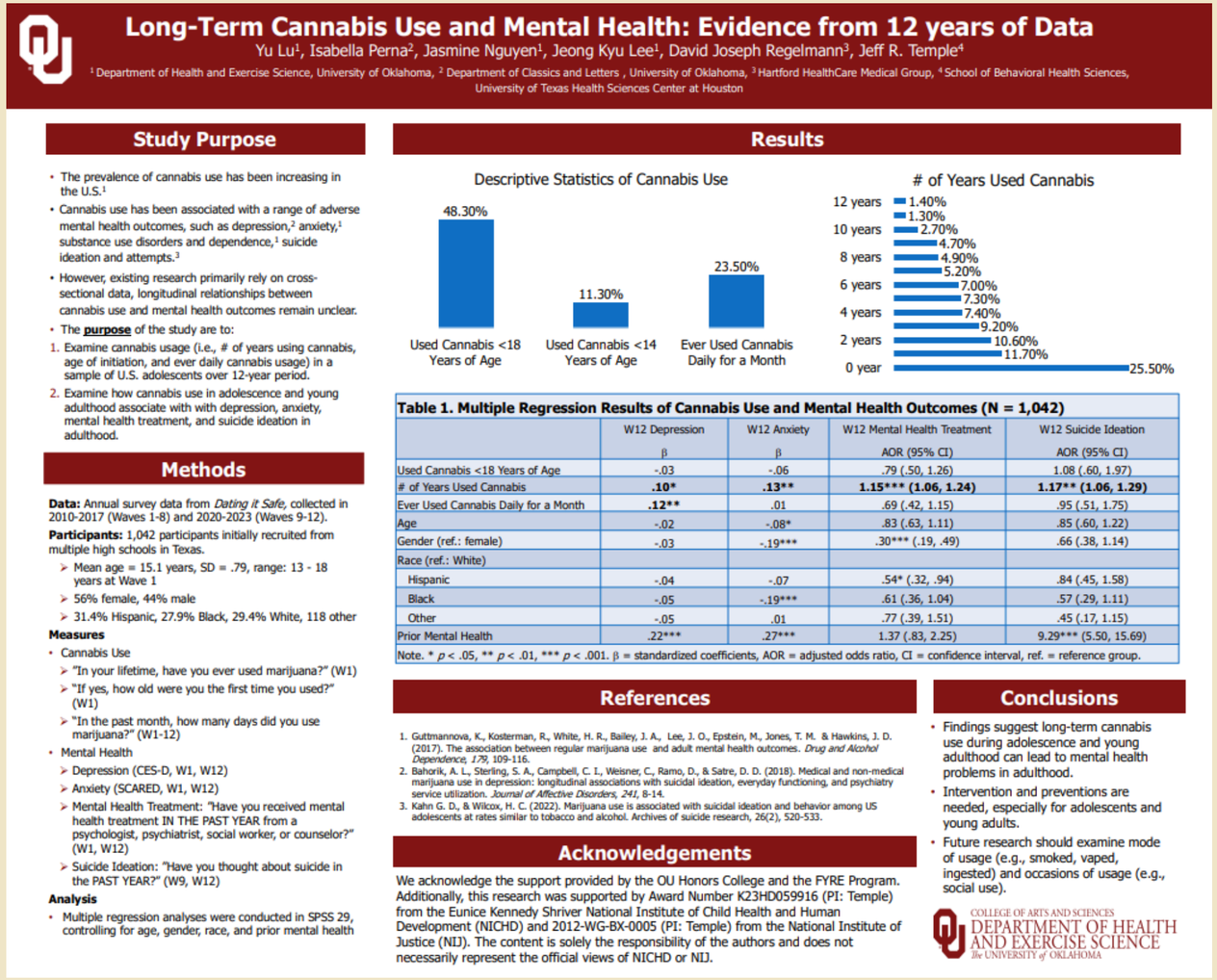
Brady Sloat, John Bradshaw, Roshan Sharma, Shangyuan Jiang, PhD, Yijie Jiang, PhD
University of Oklahoma School of Aerospace and Mechanical Engineering



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 Lu[1], Isabella Perna[2], Jasmine Nguyen[1], Jeong Kyu Lee[1], David Joseph Regelmann[3], Jeff R. Temple[4]

[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:

1. 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.
2. 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 β	W12 Anxiety β	W12 Mental Health Treatment AOR (95% CI)	W12 Suicide Ideation 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

1. 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.
2. 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.
3. 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.

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).

Acknowledgements

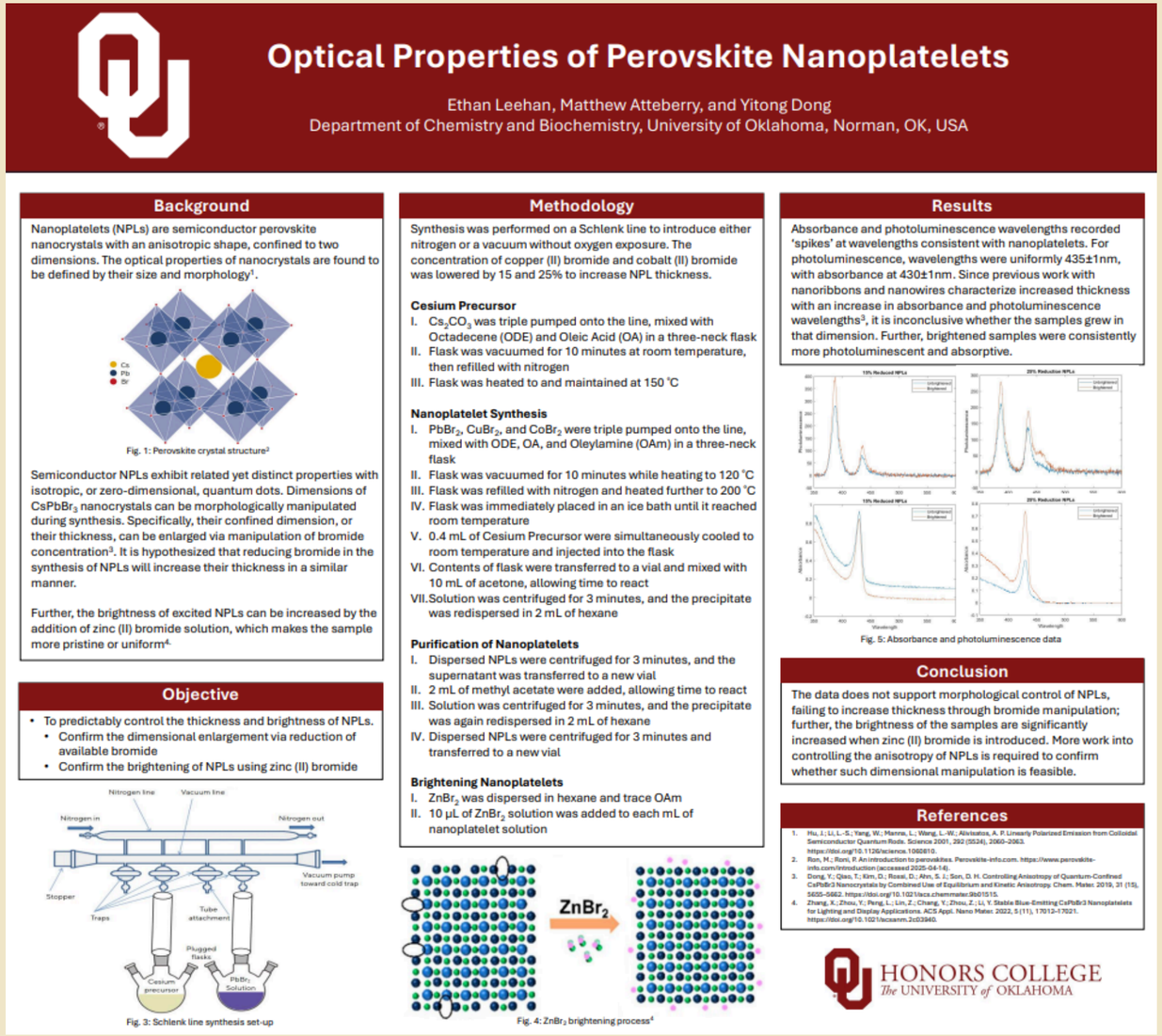
We acknowledge the support provided by the OU Honors College and the FYRE Program. Additionally, this research was supported by Award Number K23HD059916 (PI: Temple) from the Eunice Kennedy Shriver National Institute of Child Health and Human Development (NICHD) and 2012-WG-BX-0005 (PI: Temple) from 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.

COLLEGE OF ARTS AND SCIENCES
DEPARTMENT OF HEALTH AND EXERCISE SCIENCE
THE UNIVERSITY of OKLAHOMA

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 morphology[1].

Cs
Pb
Br

Fig. 1: Perovskite crystal structure[2]

Semiconductor NPLs exhibit related yet distinct properties with isotropic, or zero-dimensional, quantum dots. Dimensions of $CsPbBr_3$ nanocrystals can be morphologically manipulated during synthesis. Specifically, their confined dimension, or their thickness, can be enlarged via manipulation of bromide concentration[3]. 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 uniform[4].

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

Nitrogen line
Vacuum line
Nitrogen in
Nitrogen out
Vacuum pump toward cold trap
Stopper
Traps
Tube attachment
Plugged flasks
Cesium precursor
$PbBr_2$ Solution

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

I. Cs_2CO_3 was triple pumped onto the line, mixed with Octadecene (ODE) and Oleic Acid (OA) in a three-neck flask
II. Flask was vacuumed for 10 minutes at room temperature, then refilled with nitrogen
III. Flask was heated to and maintained at 150 °C

Nanoplatelet Synthesis

I. $PbBr_2$, $CuBr_2$, and $CoBr_2$ were triple pumped onto the line, mixed with ODE, OA, and Oleylamine (OAm) in a three-neck flask
II. Flask was vacuumed for 10 minutes while heating to 120 °C
III. Flask was refilled with nitrogen and heated further to 200 °C
IV. Flask was immediately placed in an ice bath until it reached room temperature
V. 0.4 mL of Cesium Precursor were simultaneously cooled to room temperature and injected into the flask
VI. Contents of flask were transferred to a vial and mixed with 10 mL of acetone, allowing time to react
VII. Solution was centrifuged for 3 minutes, and the precipitate was redispersed in 2 mL of hexane

Purification of Nanoplatelets

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

Brightening Nanoplatelets

I. $ZnBr_2$ was dispersed in hexane and trace OAm
II. 10 µL of $ZnBr_2$ solution was added to each mL of nanoplatelet solution

$ZnBr_2$

Fig. 4: $ZnBr_2$ brightening process[4]

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 wavelengths[3], it is inconclusive whether the samples grew in that dimension. Further, brightened samples were consistently more photoluminescent and absorptive.

15% Reduced NPLs
20% Reduction NPLs
Photoluminescence
Absorbance
Wavelength

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

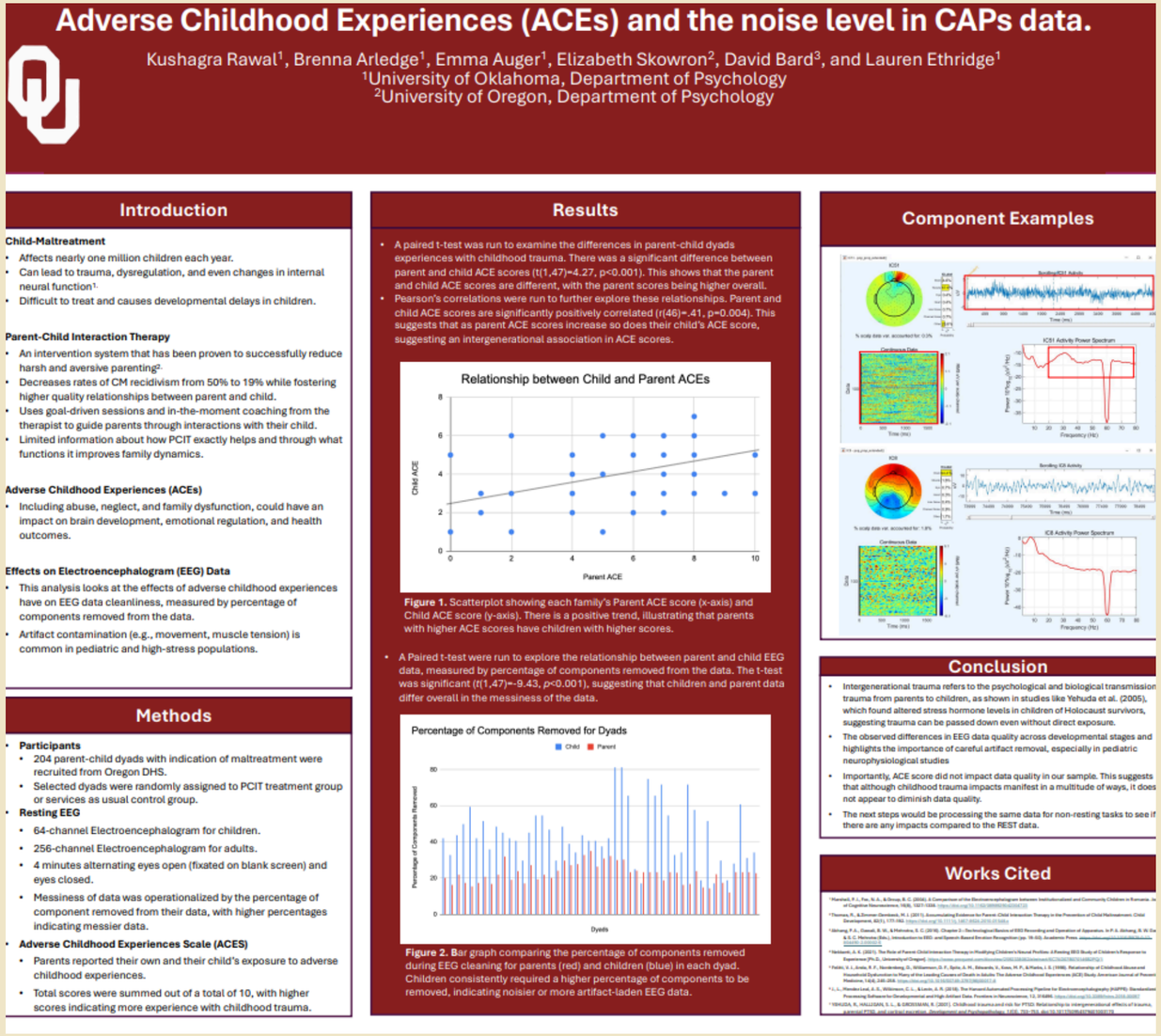
1. Hu, J.; Li, L.-S.; Yang, W.; Manna, L.; Wang, L.-W.; Alivisatos, A. P. Linearly Polarized Emission from Colloidal Semiconductor Quantum Rods. Science 2001, 292 (5524), 2060–2063. https://doi.org/10.1126/science.1060010.
2. Ron, M.; Roni, P. An introduction to perovskites. Perovskite-info.com. https://www.perovskite-info.com/introduction (accessed 2025-04-14).
3. Dong, Y.; Qiao, T.; Kim, D.; Rossi, D.; Ahn, S. J.; Son, D. H. Controlling Anisotropy of Quantum-Confined 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.
4. 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), 17012–17021. https://doi.org/10.1021/acsanm.2c03940.

HONORS COLLEGE
The UNIVERSITY of OKLAHOMA

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

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

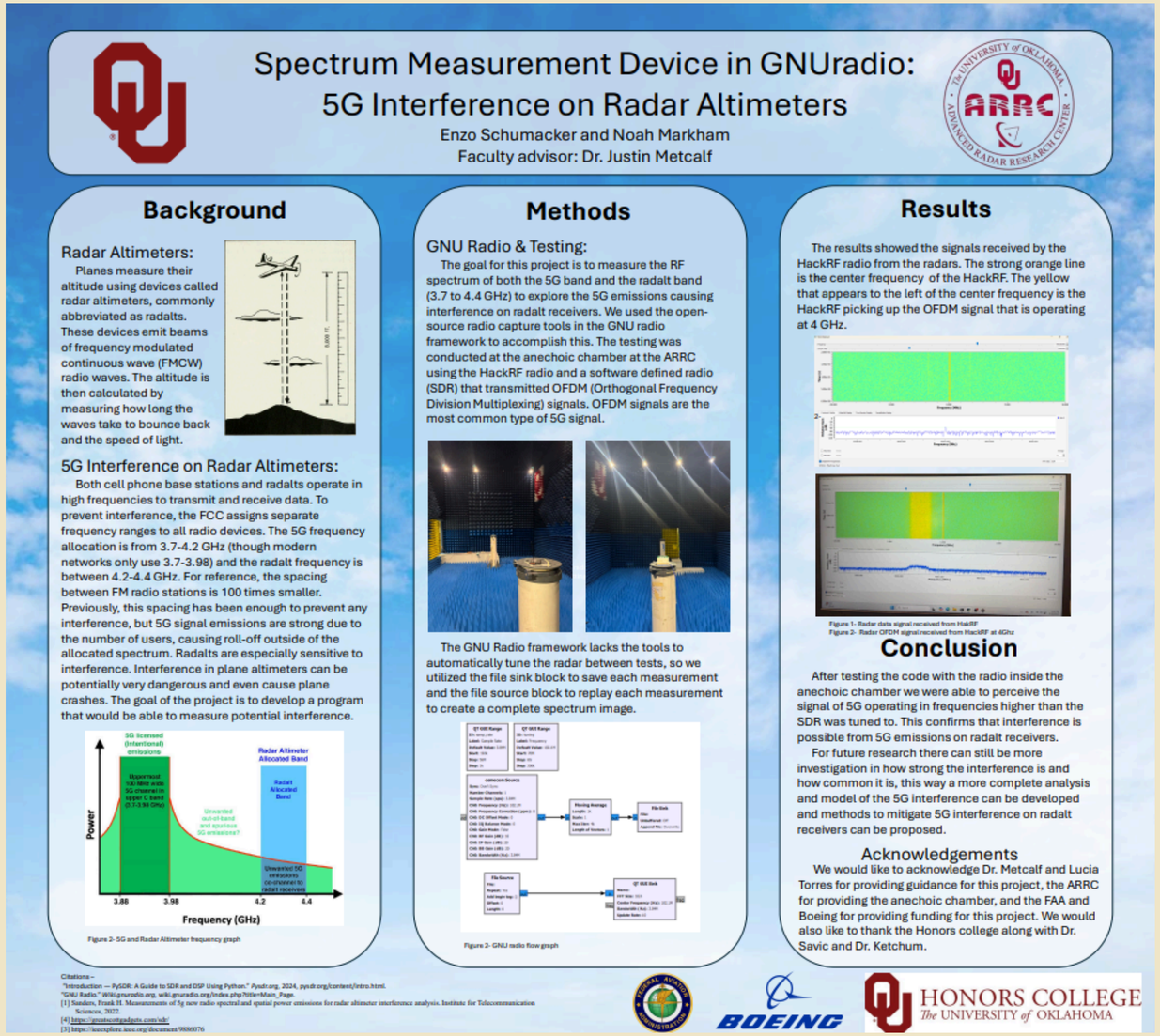
University of Oklahoma, Department of Psychology University of Oregon, Department of Psychology



Spectrum Measurement Device in GNUradio: 5G Interference on Radar Altimeters

Enzo Schumacker and Noah Markham

Faculty advisor: Dr. Justin Metcalf



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 measurements[3]. 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 bioengineering[5].

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 temperatures[2].

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/decane 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 Grady[2].
- Comparing the values of both methods for accuracy through error measurements and variability.

HONORS COLLEGE
The UNIVERSITY of OKLAHOMA

Fundamental Equations

- Washburn Equation

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

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

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

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

where h_i = 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/s)	Standard Deviation
	40º	5.86433E-12	2.0107E-12
	55º	1.62763E-07	1.16749E-07
R-974	70º	1.53274E-07	6.44372E-08
	40º	1.05334E-08	6.958E-09
	55º	2.99111E-08	1.56493E-08
R-380	70º	5.12316E-08	3.09967E-08
	40º	2.04873E-08	8.93297E-09
	55º	3.80383E-08	1.73803E-08
R-300	70º	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 40º and 55º)/Decane (for 70º)			
	Temperature	Average Slope (kg^2/s)	Standard Deviation
	40º	4.6363E-10	3.07456E-11
	55º	5.53536E-10	5.53319E-11
R-974	70º		
	40º	1.6322E-09	1.06739E-09
	55º	5.24266E-09	3.83656E-09
R-380	70º		
	40º		
	55º		
R-300	70º		

Table 2. Average slopes derived from the Washburn trials in hexane/decane 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)
	40º	89.817º
	55º	
R-974	70º	
	40º	0º (clipped)
	55º	
R-380	70º	
	40º	
	55º	
R-300	70º	

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 trial[9].

After measuring the slope five times of a trial in water for each temperature in kg/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(θ) is replaced with 1, which is equivalent to cos(0°), and the (m²/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 (m²/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 below[1].

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(θ) 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

(1) Josyula, T.; Kumar Malla, L.; Thomas, T. M.; Kalichetty, S. S.; Sinha Mahapatra, P.; Pattamatta, A. Fundamentals and Applications of Surface Wetting. *Langmuir* **2024**, 40 (16), 8293–8326. https://doi.org/10.1021/acs.langmuir.3c03339.

(2) 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.

(3) *How it Works (Antiperspirants)*. Carpe. https://mycarpe.com/pages/how-it-works (accessed 2025-04-11).

(4) Arrizabalaga, J. H.; Nollert, 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/acsbiomaterials.8b00015.

(5) 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:jmsm.0000021129.60818.ca.

(6) *Structure and Wettability of Various Silica Surfaces. Evaluation in Nano and Macro Levels*. CoLab. https://colab.ws/articles/10.4164%2Fspfj.36.528 (accessed 2025-04-11).

(7) *Washburn method*. KRÜSS Scientific. https://www.kruss-scientific.com/en-US/know-how/glossary/washburn-method (accessed 2025-04-11).

(8) *Wettability - an overview | ScienceDirect Topics*. https://www.sciencedirect.com/topics/materials-science/wettability (accessed 2025-04-11).

(9) Kirdponpattara, S.; Phisalaphong, M.; Newby, B. Z. Applicability of Washburn Capillary Rise for Determining Contact Angles of Powders/Porous Materials. *Journal of Colloid and Interface Science* **2013**, 397, 169–176. 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.

The UNIVERSITY of OKLAHOMA

Questions?

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