The UNIVERSITY of OKLAHOMA

FYRE

First–year Research Experience

Mentor List and Research Catalog 2024–2025

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Table of Contents by Mentor — Biological Sciences (Biology, Microbiology, Plant Biology)

McCarthy, Heather

My lab studies how trees and other plants respond to environmental stress, including global change factors, like drought, increased temperatures, and urbanization. Our work takes place in field sites, greenhouses, and sometimes the lab. We have several ongoing projects that students might be interested in working with us on: Switchgrass anatomy – Switchgrass is a potential future biofuel source, but the efficiency of conversion to fuel depends on cell characteristics and chemical composition. We are interested in assessing possible differences in anatomy of plants with reduced lignin composition for plants grown under water stressed conditions. Urban forest condition and composition – Urban vegetation provides many ecosystem services, but urban conditions (increased temperatures, sometimes decreased water) can be stressful for plants, especially in Oklahoma. We have long term monitoring of growth and survival of public trees in the OKC/Norman area. Bur oak genetic diversity – Oaks very commonly hybridize with other species, possibility introducing new traits that may be useful in a changing climate. We have established 3 "common" garden environments using bur oak seedlings from across a temperature gradient, where we can investigate differences in adaptive traits such as drought resistance.

Growth and Survival Rates of Norman Parks Trees Over the Past 10 Years

Stein, Laura

The Impact of Dietary Niche Variation in Three Pupfish Species on 11KetoTestosterone Levels and Behavior in Periods of Low Resources

Woodruff, Gavin – https://gcwoodruff.github.io

The Fig Worm Lab at the University of Oklahoma aims to understand the genetic basis of phenotypic diversity across multiple scales of biological organization. We are driven by these questions: • How does genetic change lead to change in developmental processes? • How does developmental variation promote morphological variation? • What are the processes that generate and maintain genetic diversity in the first place? We currently have ongoing projects in: • The evolution and genetic basis of body size • The evolution and genetic basis of developmental rate • The evolution of transposable elements and genomic organization • Nematode diversity and ecology • Host-microbe interactions • Gene copy number variation • Phenotypic plasticity and polyphenism Our projects often involve nematode husbandry and genetic crosses, as well as PCR and gel electrophoresis. We also offer opportunities in genomics/computational biology. Please don't hesitate to reach out if you have further questions (gcwoodruff@ou.edu). Here is our website: https://gcwoodruff.github.io/research_interests.html

Dominance of Nok4 Gene: Body Size Expression in F1 Prodigy of NKZ35xWOU12 Cross

Hung, Keng-Lou James – https://hungpollinatorlab.weebly.com/

We have several projects ongoing that revolve around studying plant-pollinator interactions and pollinator conservation. Students may have the opportunity to work on analyzing pollen samples (including setting up artificial intelligence systems for pollen identification), curating and identifying pollinator specimens, and rearing native plants and wild bees (that do not generally sting humans).

Examining Bee Visitation Patterns in Oklahoma through Flower and Bee Pollen Samples

Table of Contents by Mentor — Biological Sciences (Biology, Microbiology, Plant Biology

Becker, Daniel

Genetic Diversity of *Bartonella* in Vampire Bats from Belize

Yoon, Je-Hyun – http://www.molecularultrasound.com

Synthetic biology - CRISPR screening, contrast agents; Imaging / signal processing - ultrasound imaging manipulation; Transducer fab- single element transducer fab

Measuring RNA Stability with 5-EU and its Implications

Ethridge, Lauren – https://babl.oucreate.com/

Research in the lab is highly collaborative, with a large network of investigators across the country. Current research includes: EEG as a translational, treatment sensitive, biomarker in rare genetic disorders associated with autism and intellectual disability, including Fragile X Syndrome and Phelan-McDermid Syndrome Sensory processing disorders Characteristics of EEG activity related to variation in ASD symptoms across the full spectrum Neural correlates of child well-being and adverse childhood experiences

Examining How Parent-Child Interaction Therapy Enhances Parent and Child Outcomes in Families with Child Maltreatment
Studying the Effects of Free Play on the Wellbeing of 1st-5th Graders

Mooers, Blaine – https://medicine.ouhsc.edu/academic-departments/biochemistry-and-physiology/faculty/blaine-hm-mooers-phd

Larger crystals for more accurate structure-based drug design The crystallization of proteins, nucleic acids, and their complexes with drug molecules is an essential first step in a structure determination project with X-ray crystallography. Over the past three decades, many labs have put much effort into developing crystal screening experiments. These screening experiments usually yield crystals that are too small to give optimal results in diffraction studies. The size of the crystal used in the diffraction experiment matters because larger crystals tend to diffract X-rays to higher resolution. Higher resolution data lead to more accurate structures. Accuracy matters in structure-based drug design, where the structure of protein-drug complexes are used to redesign the drug molecule for improved binding to the protein. The current methods of growing large crystals are time-consuming, frequently unsuccessful, and wasteful of the expensive biomolecular sample, especially those containing drug molecules in low supply. Improved methods for growing large crystals would enable new science and advance medicine. My lab is developing advanced experimental designs that are more efficient and effective than the standard practice. This Fyre project involves extending this work to test its generalizability. This project involves basic biochemistry laboratory skills, including preparing buffers and solutions and the setting up of crystallization experiments. The project includes making images of the crystals with a microscope and measuring the lengths of crystals. The project requires the recording of observations in spreadsheets and the running of R and Python statistical software scripts to analyze the data. However, the student does not need any programming experience.

Experimental Designs to Grow Larger Crystals of RNA

Fornelli, Luca

Saccharomyces cerevisiae Culturing, Spheroplasting, and Lysing for Top-Down Proteomic Analysis

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Table of Contents by Mentor – Biological Sciences (Biology, Microbiology, Plant Biology

Schroeder, Susan – https://www.ou.edu/cas/mpbio/people/faculty/schroeder

RNA viruses are master manipulators of gene expression. The Schroeder lab explores the role of RNA structure in regulating gene expression in virus-host interactions. We are particularly interested in the ways that viruses can sometimes be beneficial to their host and collaborate for survival during environmental stress. We study Tobacco Mosaic Virus in tomatoes and the effects of drought, influenza virus in human lung cells and the effects of smoking, and Sindbis virus in human cells and the effects of nucleotide modifications. Undergraduate researchers in the Schroeder lab gain practical lab skills in plant care and cultivation, plant infection techniques, RNA sample preparation from plant tissue, PCR, gel electrophoresis, bioinformatics analysis, and nanopore sequence analysis.

Investigating the Role of Heparin for Sustained Drug Release via Hydrogel

Katharine Marske – https://kamarske.org/research

I am looking for a student who is interested in using ecological models of species' geographical ranges, or where in space they occur, to explore questions in ecology and evolution. The research would be data/computationally focused and would involve finding data on where species have been detected (e.g., from museum specimens or public sightings) and using these to model the species' ranges past, present and future ranges using climate data.

Julie Van De Weghe – https://www.juliecvdw.com/
My laboratory is focused on cilia and cilia-related diseases. We incorporate human genetics, genome engineering, live-cell microscopy, super resolution microscopy, and real time signaling assays in our studies. We work with human cells and the green algae, Chlamydomonas reinhardtii. Prospective undergraduate students will be paired with a senior doctoral student or postdoctoral fellow. Depending on the students' interests, we will formulate an appropriate project for the semester.

Lanier, Hayley – http://lanierlab.org

My lab studies how mammalian population are responding to changing climates and habitats. This can include shifts related to organismal distributions (e.g., ranges) and adaptation of existing populations. Currently, we're interested in understanding the distribution of cryptic (i.e., difficult to identify) species, and we're hoping to use both morphological (i.e., skeletal features and hair) and molecular (i.e., DNA) tools to identify several difficult species from Oklahoma prairies. Understanding both the range limits and relative abundance of these species will help us understand how each is responding to climatic and habitat changes.

Huang, Liangliang – SCBME

Qin, Wei – http://www.qinweilab.com

I have two projects seeking undergraduate assistance. The first, recently funded by the NSF Biological Oceanography program, focuses on the effects of ocean warming on trace metal utilization by marine nitrogen cycle microorganisms. The second project, recently funded by the Department of Energy, investigates the interactive effects of warming and altered precipitation on soil nitrogen cycle microorganisms. Students will participate in lab research alongside graduate students and postdocs on either project. They will learn how to prepare growth media, cultivate enrichment and pure microbial cultures, measure nutrients and cell abundance, collect field samples, and gain basic bioinformatics skills. There may also be an opportunity to participate in a one-month scientific cruise from Seattle to Hawaii next summer.

Table of Contents by Mentor — Biological Sciences (Biology, Microbiology, Plant Biology

Xiao, Xiangming – https://www.ceom.ou.edu

My research group analyzes time series images from various satellites to (1) identify and track land use and land cover changes, e.g., urban, road, surface water, forest, grassland, and croplands, and generate land cover maps; (2) measure leaf phenology and floral (flowering) phenology of plants; (3) identify fire, tree logging, and plant diseases, (4) identify plant species and biodiversity. We also measure carbon/water/energy fluxes using micrometeorological methods and analyze and model carbon and water fluxes of various terrestrial ecosystems. In addition, I teach Environmental Remote Sensing course (PBIO 4733 and GIS 4733) in spring 2025, thus students can take the course to learn remote sensing technology and data analyses.

Gu, Tingting

Research statement: Microplastics (MPs) are polymeric contaminants ranging in size from 1-5000 microns. They originate from the physical and chemical decay of polymers used in every aspect of modern life. Over the past 70y, the estimated total mass of plastics produced is > 9.1 billion tons. MPs have been found throughout the hydrosphere, atmosphere, and soil. Moreover, MPs are detected in living organisms, including humans, who ingest and inhale MPs present in food, beverages, water, and air. MPs are a pervasive, persistent, and highly heterogenous contaminant varying in size, morphology, and chemical composition. MPs can absorb organic chemicals, heavy metals, bacteria, and viruses, thereby making MPs a transport vector for these contaminants. It is also known that these physical, chemical, and microbial parameters can cause MPs to detrimentally target specific ecological or biochemical processes. To assess MP risks to the extent where prevention and remediation efforts can be designed and implemented, the MP research communities need to address two challenging issues. The first challenge is MP detection. The lack of standardized extraction methods for MPs in complex samples and the need for a high-throughput analytical method for quantitative characterization of MP concentration, size, morphology, and composition. To address this challenge, Dr. Gu is currently developing a new high-throughput, cost-effective method with proper QA and QC standards for MP detection and monitoring. The second challenge is understanding the mechanisms and processes of biological effects, transport, and degradation of MP through different environments. Gu's lab is currently studying the effects and transportation of MPs in soils, particularly through biosolid application. This is a collaborative work with Dr. Mark Nanny from the Civil Engineering and Environmental Science at OU.

Cai, Jiyang – https://medicine.ouhsc.edu/academic-departments/biochemistry-and-physiology/faculty/jiyang-cai-phd

Our lab investigates immune cell interactions in the back of the eye, primarily using mouse models of eye diseases. We offer training for students in foundational eye research techniques, including in vivo eye examinations, microdissection, and tissue preparation. Students will also have the opportunity to contribute to our ongoing projects, which are detailed on our website.

Ketchum, Heather

Arthropod vector-borne diseases have more than tripled between 2004 and 2016. More than 60% of these cases were tickborne. In Oklahoma, 90% of our vector borne diseases are caused by ticks. Since most tickborne diseases are caused by tick bites, reducing exposure is the best defense against tickborne diseases. There are only six EPA registered insect repellents recommended by the Center for Disease Control. Of those, N,N-diethyl-3-methyl benzamide (DEET) a synthetic chemical is the most commonly used however, its effectiveness varies across species, the duration of efficacy is no more than six hours, and there are concerns among the public about toxic effects. Other recommended natural or synthetic repellents have repellent properties and while they may repel ticks their duration of effectiveness is limited to one to two hours. With the lack of effective repellents and increase in tickborne diseases there is an increased interest in investigating novel natural products for tick repellency. The objective of the current study is to evaluate the repellent activity of two natural products for control against cayenne ticks.

Table of Contents by Mentor — Biomedical Engineering

Clegg, John – https://www.ou.edu/coe/sbme/people/clegg

The Clegg laboratory studies biomaterials for induction of therapeutic immune response or reprogramming of the immune response (e.g., re-directing immune cells from inflammatory activity to more tolerogenic or regenerative states). We are particularly interested in applying immune-instructive biomaterials as new treatments for neurotrauma, inflammatory brain injury, and stroke. In the FYRE project, the student will either (1) synthesize immune-instructive nanomaterials, studying how macrophages incubated with those nanoparticles change their expression of cell surface / intracellular antigens or secretome. (2) Development of scaffolds for therapeutic macrophage delivery, which sustain a therapeutic phenotype in adoptively transferred cells even in the presence of oppositely-polarizing soluble cytokines. All projects will include elements of the following technical skills: polymer synthesis, cell culture, flow cytometry, microscopy, as well as the following other skills: data/image analysis, statistics, technical writing, and poster preparation.

Investigating the Role of Heparin for Sustained Drug Release via Hydrogel
Using Dynamic Light Scattering to Test Nanoparticle Samples: Measuring Cell Size and Zeta Potential

Tang, Quinggong – http://tanglab.oucreate.com/

There is a worldwide shortage of kidneys for transplantation due mainly to the fact that there is no reliable means to determine the viability of kidneys available for transplant. We will develop a novel imaging platform that can better predict the post-transplantation renal function, thus promoting the allocation of marginal donor kidneys and decreasing failed kidney transplants. Such an accurate and non-invasive assessment of kidney viability will enable selection and use of high-quality kidneys from high-risk donors, which are currently under-utilized. The students will help on designing the testing experiment using ex-vivo human kidney for data acquisition. Students will have the chance to get experience in experimental design, clinical experience on kidney transplant, machine-learning-based computer-aided diagnosis software development, pathology, and medical system design.

Evaluation of Repurposing Anti-Parasite Drugs for Ovarian Cancer from Cell to Animal Level Using Optical Coherence Tomography

Wilhelm, Stefan – https://www.wilhelm-lab.com/

The Wilhelm Lab in the Stephenson School of Biomedical Engineering focuses on the medical application of nanotechnology to diagnose and treat diseases, including cancer and infectious diseases. As a member of the Wilhelm Lab, students will learn nanoparticle synthesis, characterization, and surface engineering methods to fabricate nanomaterials, such as gold and lipid-based nanoparticles, for biomedical applications in nanomedicine. These applications typically involve cell studies with various cell lines under sterile culture conditions. Research goals include the study of so called nano-bio interactions, and evaluating the safety and efficacy of nanotechnology-based system for drug delivery and diagnostics. Students will engage with experienced undergraduate students, graduate students, and postdocs in the Wilhelm Lab. State-of-the-art equipment will be used to conduct and perform the proposed research. Students will further have an opportunity to develop their oral and written presentation skills and participate in weekly research project update meetings to learn about the full spectrum of nanomedicine research conducted in the Wilhelm Lab.

Quantitative Analysis of PLGA Nanoparticles Produced by Microfluidic Synthesis
Manipulating Fluidic Mixing Techniques to Optimize Liposome Synthesis
Three-Dimensional Super-Resolution Microscopy-Based Imaging of Cancer Spheroids

Table of Contents by Mentor — Biomedical Engineering

Yuan, Han – https://scholar.google.com/citations?hl=en&user=GCB4m6sAAAAJ

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. 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.

Multimodal Imaging with Transcranial Magnetic Stimulation in the Human Brain

Table of Contents by Mentor – Chemical Engineering

Foudazi, Reza – https://foudazi-lab.com/

There are 2-3 undergrad positions available in Soft Matter Research & Technology (SMaRT) group. The current research activities in SMaRT 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 available projects are as follows: 1. Stimuli-responsive ultrafiltration membranes: ultrafiltration membranes are used for water treatment, protein purification, viral filtration, etc. Currently, the available membranes have a fixed pore size, and thus a limited selectivity. Additionally, a lot of solvent is needed for making membranes which is harmful to the environment. In this research, we produce membranes that have better separation performance compared to conventional membranes and are also responsive to temperature and pH. 2. PFAS removal from water resources: PFAS are Per- and Polyfluoroalkyl Substances, known as forever chemicals as they do not break down in the environment. In the U.S., PFAS contaminated water supplies are found in 49 states. PFAS have severe health effects to the wildlife, human, and environment. In this research, we are developing an efficient system for PFAS removal from drinking water. 3. 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 agriculture in outer space, microfiltration membranes, and adsorbents for heavy metal removal.

Interfacial Behavior of Aqueous PFAS Solutions During Droplet Pinch-Off

Grady, Brian – https://coecs.ou.edu/Brian.P.Grady/index.html
A recent paper from our group indicates that the heat of wetting can be used to measure contact angle as a function of temperature, as long as the change with temperature of certain things are constant. In this work, the student will measure the heat of wetting and also measure the contact angle of powders at different temperatures, and see if the contact angle measured corresponds to that predicted from the heat of wetting. A bomb calorimeter (Setaram C-80) will be used to measure the heat of wetting; this procedure is well established. The contact angle will be measured using the Washburn method. Also, Dr. Grady will be the one who supervises the student.

Effect of Temperature on Contact Angle of Liquids on Particulates

Papavassiliou, Dimitrios – https://www.ou.edu/coe/scbme/people/faculty/papavassiliou
The goal is to simulate the photothermal treatment for cancer tumors. The process is as follows: Carbon nanotubes are selectively attached on cancer cells, and a small amount of energy is radiated to them (for example, a laser beam). They get heated up, and as they do so they heat up and kill the tumor cells. The project is computational, using simulation tools. No prior computing experience is required.

Studying the Stress Experienced by a VWF Protein in Hydrodynamic Flow Using Coarse Grained Simulations

Table of Contents by Mentor — Chemistry

Bourne, Christina – https://bournelab.oucreate.com/

Structural biology explains how biochemistry works.

Purifying Pfu DNA polymerase for Polymerase Chain Reactions

Dong, Yitong – https://www.donglabou.com/

The Dong Group's research is focused on colloidal nanocrystal quantum dots, the materials that win the 2023 Nobel Prize in Chemistry. Our projects include development the synthesis of colloidal perovskite quantum dots, understanding their growth mechanisms, surface chemical modifications of perovskite quantum dots, and spectroscopic study of the quantum dots at the single particle level. The goal of our projects is to develop scalable and high-fidelity single photon light sources for the next generation photonic based quantum computing and quantum information sciences. Specifically, we will chemically synthesize lead halide based perovskite quantum dots with sizes tunable from 3 nm to 7 nm. Using an unique thermodynamic equilibrium control synthesis, we are targeting on making perovskite quantum dots with their size and shape precisely controlled at nearly the atomic level. Our powerful single particle fluorescence microscope will be used to study the impact of size and shape of a quantum dots on its single photon emission properties. Our research projects combine chemistry and physics and are highly interdisciplinary. Leveraging our synthesis development, we will also grow organic crystals on the surface of the inorganic perovskite quantum dots to rigidify their surface lattice. We will then understand the effect of lattice rigidity on the single photon emission coherency, promoting the development of quantum emitters.

Synthesis of manganese-doped cesium lead chloride nanocrystals through the hot-injection method
Synthesis of Formamidinium Lead Halide Perovskite Nanocrystals on a Liquid-Liquid Interface
Using Spectroscopy to Understand $CsPbBr_3$ Quantum Dots as Single Photon Emitters

Feng, Yuanning – https://yuanningfeng.wixsite.com/website

On account of the scarcity of molecules with a satisfactory second near-infrared (NIR-II) response, the design of high-performance organic NIR photothermal materials has been limited. Organic photothermal materials have been discovered as some of the most promising photothermal agents with economical cost, improved biocompatibility, and potential biodegradability. Cocrystals are obtained typically by the self-assembly of two alternative molecular building blocks, i.e., an electron-rich donor (D) and an electron-poor acceptor (A). Attributed to the adjustable energy gaps, solvent processability, and easy recyclability as a type of crystalline materials, cocrystals present bright prospects in the fields of field-effect transistors, ferroelectricity materials, dynamic photomechanics, and nonlinear optics. Because the energy absorption and transfer can be adjusted through changing their constituting components, cocrystals have been applied in photothermal conversion. FYRE students will contribute to the synthesis and characterization of donor and acceptor compounds which are small organic molecules.

Synthesis of a 5-membered Cyclophane
Supramolecular Antenna Effect in Fluorescent Dyes
Synthesis of the Pentagonal Cyclophane

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Honeycutt, Wesley **& Mistree, Farrokh** – https://www.ou.edu/coe/ame/people/faculty/farrokh-mistree AND https://scholar.google.com/citations?user=corYfz4AAAAJ

UNDERSTAND RESEARCHING BY REFLECTING ON DESIGNING A LOW-COST, SMART COMPOST SYSTEM This project is open to Honors students who have a social conscience and wish to make a difference in the world by researching and sharing their newfound knowledge. Questions for Reflection 1 Do you wish to learn what researching is about? 2 Do you wish to learn how to identify gaps in that which exist and bridge that gap for the betterment of society? 3 Do you enjoy exploring the internet, talking to ChatGPT, Microsoft Copilot, and equivalent to find information? 3. Do you wish to develop your ability to communicate your findings to a range of people? 4. Are you willing to be pushed outside your comfort zone? If the answer to any of the preceding questions is a yes - Wesley T. Honeycutt [honeycutt@ou.edu] and Farrokh Mistree [farrokh.mistree@ou.edu] are interested in mentoring you in Spring 2025. Project Description The design of a low-cost, smart compost system. Composting has the potential to reduce waste and increase the arable soil to farmers in rural India. The challenge is that compost requires certain conditions to convert to soil properly. These conditions may change depending on the composted input be it vegetable matter, meat, paper products, or even bodies. The user interactions with compost also changes based on the conditions: certain composts need turned on different dates. Expectations and Grades You will approach the design in a systematic and organized fashion. You will be required to reflect on what you have done, write Take Aways and transform these Take Aways into lessons that you will use in the future as researchers. We will meet once a week at a time that is mutually convenient to all to discuss your progress. We invite you to attend the weekly meeting of the Systems Realization Laboratory @ OU on Fridays from 9:00AM to 10:30PM. Every week you will turn in a progress report that will be discussed when we meet. Your grade will be based on an End of Semester Report, a Poster, and a Semester Learning Essay.

Honeycutt, Wesley – https://wesleythoneycutt.com/

I am an interdisciplinary researcher with a very broad interest and skill set. I am not strongly affiliated with any single department. My PhD is in chemistry, and I have worked on projects in many fields. I am not a tenure-track faculty member which means I am able to commit time to ensure my student's success. Check my bio for more info: https://wesleythoneycutt.com I am thrilled to work with students from any discipline, and I tailor each FYRE project to the interests of the student(s). Thus far, I have mentored 6 students through the FYRE program and am proud to advocate for each of my students beyond the time we spend together in the lab. All students learn from a holistic perspective: you will be able to do a little of everything on your project by the end. The projects I have ready for Spring 2025 includes: - Work with CO_2 and CH_4 remote sensing data for spatial and temporal analysis. - Engineering design of novel strategies at the device and system level for sustainability challenges. - Electrical engineering hands-on projects to develop new widgets like a rain-sensing actuator. - Dramatic theory applications for training future STEM communicators. - Spatial analysis of migratory birds to novel lighting cues. This list is incomplete and subject to change based on opportunities/resources which I have in the Spring and the interest of the FYRE student.

Comparison of Retrieval Algorithms for EM27/SUN Spectrometer Data

Noh, Hyunho – https://www.nohlab-ou.com/

With the rise in energy demand, it is critical to develop catalysts that can harness solar/wind energy and convert abundant chemicals to value-added feedstocks. While decades of research have developed some promising catalysts, their surface structures are quite complex, precluding an atomic-level understanding of the reaction mechanism. In our lab, we employ metal-organic frameworks (MOFs) as candidate electrocatalysts to examine the reaction mechanisms to generate H2 from H2O, CO2 to fuels, and many others with atomic-level precision. The exact structure of candidate MOFs is known, owing to their crystallinity. Using electrochemistry as a primary tool, students will learn how to experimentally derive catalytically relevant thermodynamics and kinetics and conclude reaction mechanisms. Our lab focuses on MOFs with transition metals and even lanthanides and thus can explore a wide range of elements within the periodic table, otherwise challenging in other fields. The success of this project should instruct chemists and engineers on the exact catalytic motif we need to install to synthesize highly active catalysts and shift the energy and chemical sectors to become more renewable for a sustainable economy.

Topology-Dependent Proton-Coupled Electron Transfer (PCET) Thermochemistry of Ce-based Metal Organic Frameworks

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Rybenjov, Valentin – antibiotics.oucreate.com

The project explores chemical compounds with antibacterial activity that were discovered by Rybenkov group and are presentle under development as potential antibiotics with a new mode of action. These compounds act by inhibiting condensins, which play a central role in chromosome organization and segregation. Bacteria can develop resistance to these through a combination of mutations in several genes. The project involves molecular cloning of one of the genes that was implicated in the resistance and investigating the phenotype of the mutant.

Effect of DNA Binding Agents On Cell Division and Chromosome Segregation
Impact of DNA-binding compounds on chromosome segregation in Pseudomonas aeruginosa **Saparov, Bayram** – https://saparov-lab.com/

Synthesis, crystals growth and characterization of brand new materials for lighting, solar energy harvesting and other applications

Rajan, Rahki – https://www.ou.edu/cas/chemistry/people/faculty/rakhi-rajan

The students will work on molecular biology and protein expression of components related to the CRISPR-Cas systems. They will also interact with lab members to familiarize with the lab goals of protein engineering to improve the fidelity of CRISPR-based gene editing systems.

Singh, Shanteri

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

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Metcalf, Justin

The student will be working in a team to learn how to use a software defined radar to look for birds, bats, and invertebrates. These are radars whose functionality is controlled by open source "blocks", designed to be easy to use without programming knowledge. Each block provides a radar function, and these blocks are easily modifiable using the Python scripting language. This project is to help with environmental site assessment for current and future offshore wind farms. The student will need to be willing to learn Python and work with software. There will be multiple graduate and undergraduate students working with the student on the team. This project is suitable for a wide variety of majors, particularly computer science, electrical engineering, computer engineering, and biology.

ADS-B Tracking with GNU Radio: Tracking Planes for Radar Surveillance

Ebert, David – https://www.ou.edu/disc

We have numerous projects on data analytics, AI, and interactive visual analysis solving problems in many disciplines and across disciplines.

Impact of SMART Machine Learning Algorithms in Classifying Social Media Misinformation and Disinformation
Modeling Carbon Dioxide Fluxes and Evapotranspiration in Grain-Only Wheat Pastures Using Weather and Satellite Data

Aikaterini P. Kyprioti

Depending on the students' interests, there are different projects that they can work. I have the ability to supervise projects that might be more computationally-driven in solving engineering problems (small uncertainty propagation projects), as well as more heavily involved civil engineering ones, focusing on specific typology of housing like mobile homes and masonry historical buildings. There is also the opportunity for students to gain some experience in software that will be useful later on in their professional career when it comes to structural software and modeling civil infrastructure.

Yijie Jiang

The project will focus on developing a dip coating and electric poling (DCEP) integrated machine. This machine will achieve the automatic and batch processing of sensor specimens to enable novel applications and performance.

Vogel, Jason

Our laboratory completes analysis of wastewater for eight different pathogens that cause infectious disease. This student would integrate into our lab and learn the process of extraction and analysis using RT-qPCR. This information is utilized by health departments across Oklahoma to track infectious disease occurrence and outbreaks at the community level.

Table of Contents by Mentor — Engineering

Kittur, Javeed https://www.researchgate.net/profile/Javeed-Kittur/research?ev=prf_act&_tp=eyJjb250ZXh0Ijp7ImZpcnN0UGFnZSI6InByb2ZpbGUiLCJwYWdlIjoicHJvZmlsZSIsInBvc2l0aW9uIjoicGFnZUhlYWRlciJ9fQ

In these projects, students will design and implement innovative educational tools involving chatbots and generative AI to enhance engineering education. Project 1 focuses on creating an interactive chatbot to capture and analyze engineering students' emotions throughout the semester, exploring how these emotions impact their sense of belonging, motivation, and persistence. The student will collect both quantitative and qualitative data to assess the chatbot's effectiveness, understand students' experiences, and identify areas for improvement. Project 2 involves developing a generative AI-based instructional setup to teach the engineering design process to freshmen. With minimal guidance, students will self-learn the design process using AI. The effectiveness of this approach will be evaluated through data collection, examining students' learning outcomes and comparing their perceptions of learning with and without AI. Project 3 requires designing a chatbot to moderate role-play activities in a classroom setting, replacing the instructor in this role. The student will gather data to assess the chatbot's success, investigate its impact on students' learning, and compare perceptions of learning with and without the chatbot as a moderator. Each project aims to innovate in educational methods, combining technology and pedagogy to improve student engagement and learning outcomes.

Ghamarian, Iman

AI4Science: Our research group focuses on harnessing the power of machine learning to analyze complex experimental data, with a particular emphasis on image analysis. We develop cutting-edge supervised and unsupervised machine learning techniques to extract meaningful insights from scientific images across various disciplines. Our projects offer an exciting opportunity to apply artificial intelligence to real-world scientific challenges. While a general background in Python programming is required, you'll have the chance to enhance your coding skills and gain hands-on experience with state-of-the-art AI technologies. Join us to explore the intersection of computer science and scientific discovery!

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Kellawan, Mikhail – https://www.ou.edu/cas/hes/research/research-laboratories/human-circulation-research-lab

How humans regulate/control blood flow to the Brain and to Muscles during exercise and/or environmental challenges.

The Effect of EDHF on the Resistance of Sympathetic Vasoconstriction In Healthy Young Adults

Cai, Chanjie – https://medicine.ouhsc.edu/academic-departments/biochemistry-and-physiology/faculty/jiyang-cai-phd

Our lab investigates immune cell interactions in the back of the eye, primarily using mouse models of eye diseases. We offer training for students in foundational eye research techniques, including in vivo eye examinations, microdissection, and tissue preparation. Students will also have the opportunity to contribute to our ongoing projects, which are detailed on our website.

Biophotonic Imaging Utilizing Deep Learning Techniques
Particle Deposition in 3D Printed Human Lung Model Under Realistic Physiological Conditions

Balasubramanian, Priya – https://medicine.ouhsc.edu/directory/details/priya-balasubramanian-bvsc-phd

We have a couple of ongoing projects that the students can pick to work on: 1. Role of lipolysis in calorie-restriction mediated anti-aging benefits: Limiting daily calorie intake is one of the well-established interventions that has been proven to extend lifespan and health span in several species. One of the organs significantly affected by CR is fat tissue. Not only does CR reduce fat mass but it also changes how it functions. CR reprograms fat tissue metabolism to increase lipid breakdown and usage as an adaptive strategy to support whole-body metabolic needs during energy deficiency. These adaptive changes in fat metabolism likely contribute to the anti-aging benefits of CR. Understanding the mechanisms through which CR reprograms fat tissue metabolism and phenotype will inform strategies to maximize the health span in the elderly population. Specifically, we are interested to investigate if the breakdown of stored lipids in the fat tissue is a key initial step required for the metabolic benefits of CR. Further, we want to investigate how the products of lipid breakdown (free fatty acids) regulate functionally different subpopulations of white fat cells in CR. 2. Role of brain lipid droplets in age-related cognitive impairment: In this project, we are focusing how age-related lipid droplet accumulation in endothelial cells of the brain contribute to microvascular dysfunction, impaired cerebral blood flow responses and cognitive impairment.

Lu, Yu
My research focuses on understanding and preventing risk behaviors such as substance use and interpersonal violence. Students joining the Risk Behaviors and Intervention lab will work in teams contributing to studies that examine how these risk behaviors co-occur and progress from adolescence to adulthood and explore social and cultural factors influencing these behaviors. Students will get involved in various research activities including literature review, data analysis, result interpretation, and report writing.

Table of Contents by Mentor – Health Sciences

Cheney, Marshall

Our research team is working with researchers at the OUHSC and the University of Houston to help evaluate smartphone apps developed to help people improve their health. The 5 different apps we are currently evaluating aim to help people reduce/quit smoking, improve their mental health, reduce marijuana use, and increase adherence to HIV medications. Our role is to analyze the qualitative interviews done at the mid point and end of the intervention to see what worked (and did not work) and make recommendations for how to improve the smartphone apps. I try to give students a choice of teams but it will depend on where the teams are in the analysis process at the start of the Spring 2025 semester. The FYRE student will need to complete the Human Subjects online training by December 15th so that we can get IRB approval for the FYRE student participantion. Students will recieve additional training in qualitative data analysis and be involved with data analysis as a full participating member of the team at the beginning of the Spring 2025 semester. Students are included on professional presentations and manuscripts if they stay with the analysis team until the project is completed (usually an additional semester).

Li, Dan https://publichealth.ouhsc.edu/About/Directory/details/dan-li-phd-ncc-lsc-nc-k-12
My research focuses on mental health promotion in economically disadvantaged K-12 schools. One project I plan to initiate is a meta-analysis of factors associated with school absenteeism, particularly examining how COVID-19 may have impacted students′ attendance during and after the pandemic.

Mehla, Kamiya https://medicine.ouhsc.edu/directory/details/dr-kamiya-mehla-phd

We will assess the role of inflammatory cells in imparting muscle wasting in pancreatic tumor bearing mice by assessing the expression of inflammatory genes using real time PCR and immunostaining.

Yoon, Je-Hyun https://medicine.ouhsc.edu/directory/details/je-hyun-yoon-phd

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

Muthukrishnan, Sree Deepthi https://medicine.ouhsc.edu/directory/sree-deepthi-muthukrishnan-phd

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.

Table of Contents by Mentor – Continued

Proietti, Tiziana https://tizianaproietti.com

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.

Hamory, Joan https://jhamory.oucreate.com/

Dr. Hamory is currently conducting several data collection projects in Eastern and Southern Africa, collecting and analyzing surveys of thousands of adolescents (aged 10-19) to understand the challenges they face at home, at school, at work, and in their communities, and to evaluate interventions that seek to alleviate barriers to their economic empowerment and overall well-being. The overarching research question is to understand "what works" to boost the well-being of adolescents in contexts where educational attainment is low, girls marry and start having children young, and labor market opportunities are limited. Mentees will assist with cleaning and summarizing data for early-stage analysis.

Oxendine, Christy – Educational Leadership and Policy Studies

Lamba, Manika https://manika-lamba.github.io

Knowledge-Driven Text Generation: Integrating Neo4j Graph Retrieval with Language Models Project Description Retrieval-augmented generation (RAG) is a technique to search for information based on a user query and provide the results as a reference for generating an AI answer. In contrast, Knowledge Graph Retrieval Augmented Generation (Graph RAG) leverages the structured nature of graph databases, which organize data as nodes and relationships, to enhance the depth and contextuality of retrieved information. In this project, we will first build a knowledge graph interface using Neo4J using different actors from Electronic Theses and Dissertations (ETDs) metadata. Next, we will fine-tune a large language model using the RAG technique to combine structured graph data with vector search through unstructured text to achieve the best of both worlds. Expected Student Research Activities Tasks Involved: 1. Perform literature review to identify recent studies related to the project (technical and usability/query aspects) 2. Building graph schema (nodes representing entities and relationships representing connections between them) for the ETD dataset 3. Using Cypher queries to populate graph data in Neo4J 4. Build a large language model to fine-tune the entire dataset, creating references to all entities and relationships within the source data, which are then used to create an LLM-generated knowledge graph 5. Evaluate the model Prerequisite skills or experience (if any) - Python programming language - Demonstrated experience or interest in designing graph schema - Familiarity with large language models and how they work - Understanding of how to interact with external APIs or interest to learn it.

Table of Contents by Mentor — Continued

Jablonski, Michael

For thousand of years, a focal point of mathematics has been symmetry. Objects with more symmetry are considered most desirable and serve as model objects on which to build scientific theories. This spring, our group will investigate how symmetry occurs naturally in a dynamical system and ways for deforming non-symmetric objects to increase their symmetry. Activities will include: • Studying polygons and polyhedra in 2- and 3-space. • Studying curvature flows. • Proving theorems. • Experimenting with computers to build new examples and suggest theoretical results.

Carvallo, Mauricio

My research explores the influence of culture and minority status on health-related outcomes and attitudes towards the self and others.

Hodges, Caitlin www.caitlinhodges-soil.com

NASA Project: Extreme environments on Earth provide many challenges and opportunities for the development of life. Therefore, these sites may serve as good proxies for environments that support the evolution on life on Mars and other planetary bodies. In this project, we use a fieldsite in Western OK to explore the utility of novel sensors to record the activity of microorganisms in the soil and groundwater. We ultimately aim to develop a set of tools to deploy on other planetary bodies that can efficiently detect environments in which life could thrive. USDA Project: Soils are the largest terrestrial sink of carbon, and respiration by roots and heterotrophic microorganisms is the largest flux of carbon from soils. For this reason, soil respiration is a key component of the global carbon (C) cycle and represents soil's ecosystem services related to regulation of the global climate. However, land use and climate change can shift soil respiration rates and deplete soil C stocks. Further, reactions within the soil system can obscure ecosystem response to global change and confound efforts to characterize soil health. In this project, we will use both field experiments and laboratory incubations to investigate the roles of drought, nitrogen fertilization, and hay harvest in controlling organic and inorganic C cycling in soils.

Wang, Chenghao

McFarquhar, Greg https://www.ou.edu/ags/meteorology/people/faculty/greg-mcfarquhar

Cloud Properties over the Arctic: Cold air outbreaks (CAOs) have a big influence on weather patterns, yet their cloud regimes are poorly sampled and understood. The Cold-Air outbreak Experiment in the Sub-Arctic Region (CAESAR) field campaign used the National Science Foundation/National Center for Atmospheric Research (NSF/NCAR) C-130 aircraft to acquire in-situ and remote sensing data of clouds over the Norwegian Sea in February and March 2024. This project will use data collected by the cloud probes on the C-130 during CAESAR to determine the vertical dependence of the microphysical and macrophysical properties of clouds in CAOs, its variability and their dependence on environmental conditions.

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The UNIVERSITY of OKLAHOMA

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Characterizing interactions between Rothia dentocariosa and common human pathogens to determine changes in microbial physiology

Emma Land, Dr. Carolyn Ibberson, Sam Varriale

Department of Microbiology and Plant Biology, University of Oklahoma

Characterizing interactions between *Rothia dentocariosa* and common human pathogens to determine changes in microbial physiology

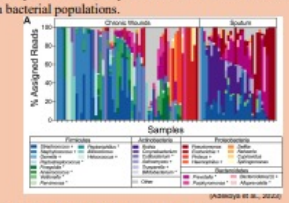
Emma Land, Dr. Carolyn Ibberson, Sam Varriale
Department of Microbiology and Plant Biology, University of Oklahoma

Question

Do interactions between *Rothia Dentocariosa* and ESKAPE pathogens change microbial physiology?

Background

Chronic Infections are a great burden on the healthcare system as treatment is costly. Oftentimes, they are resistant to antibiotics due to the variety in bacterial populations.

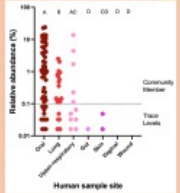


It has been shown that bacterial interactions within a chronic infection can affect a patient's outcome. However, these interactions are not well understood.

Rothia dentocariosa is a non-motile, Gram-positive, and aerobic bacteria. It has been found in the oral cavity of healthy individuals, but it has also been known to cause infections elsewhere in the body.

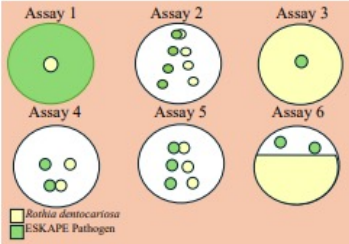
Human site subcategory	Number of samples (n)	Samples with *Rothia* reads (n)
Oral	79	53
Lung	55	21
Upper Resp.	13	11
Gut	18	1
Skin	9	2
Vaginal	10	0
Wound	10	0
Total	194	88

(West et al., 2024)



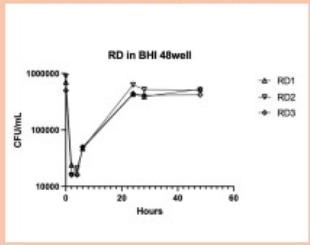
ESKAPE pathogens consist of six pathogens that are the leading cause of hospital-acquired infections. For our purposes, we used a modified panel consisting of *Candida albicans, Staphylococcus aureus, Staphylococcus epidermidis, Pseudomonas aeruginosa, Klebsiella pneumoniae,* and *Bacillus subtilis*

Methods



Results

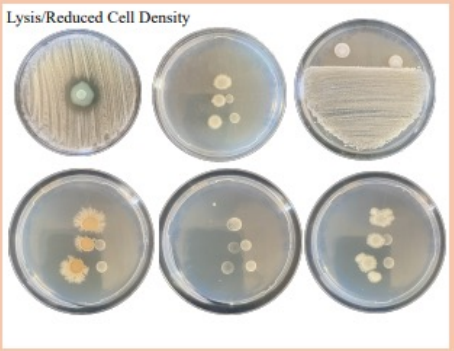
Rothia dentocariosa Growth Curve



Increased Growth

Exploratory Growth

Lysis/Reduced Cell Density



What's Next

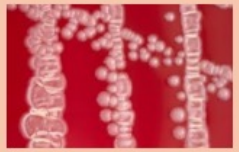
We could conduct further analysis by extracting DNA from a growth curve.

We could modify the nutrient concentrations of the media used to plate on and see how this alters the interactions.

- Already done in Assays 5 and 6 (50% and 10% BHI)

We could plate on medias other than BHI to see if modifying the types of nutrients affects the interactions between the bacteria.

- Congo Red
- SCFM2
- CWM



(Rothia Dentocariosa, n.d.)

Acknowledgements

I want to thank everyone from the Ibberson Lab for the support throughout this project. I want to thank Dr. Ibberson for this opportunity, and I want to give a big thank you to Sam Varriale for all the guidance. I also want to thank the OU Honors College for providing for the posters.

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Impact of Microbe-Microbe Interactions on R. mucilaginosa Physiology

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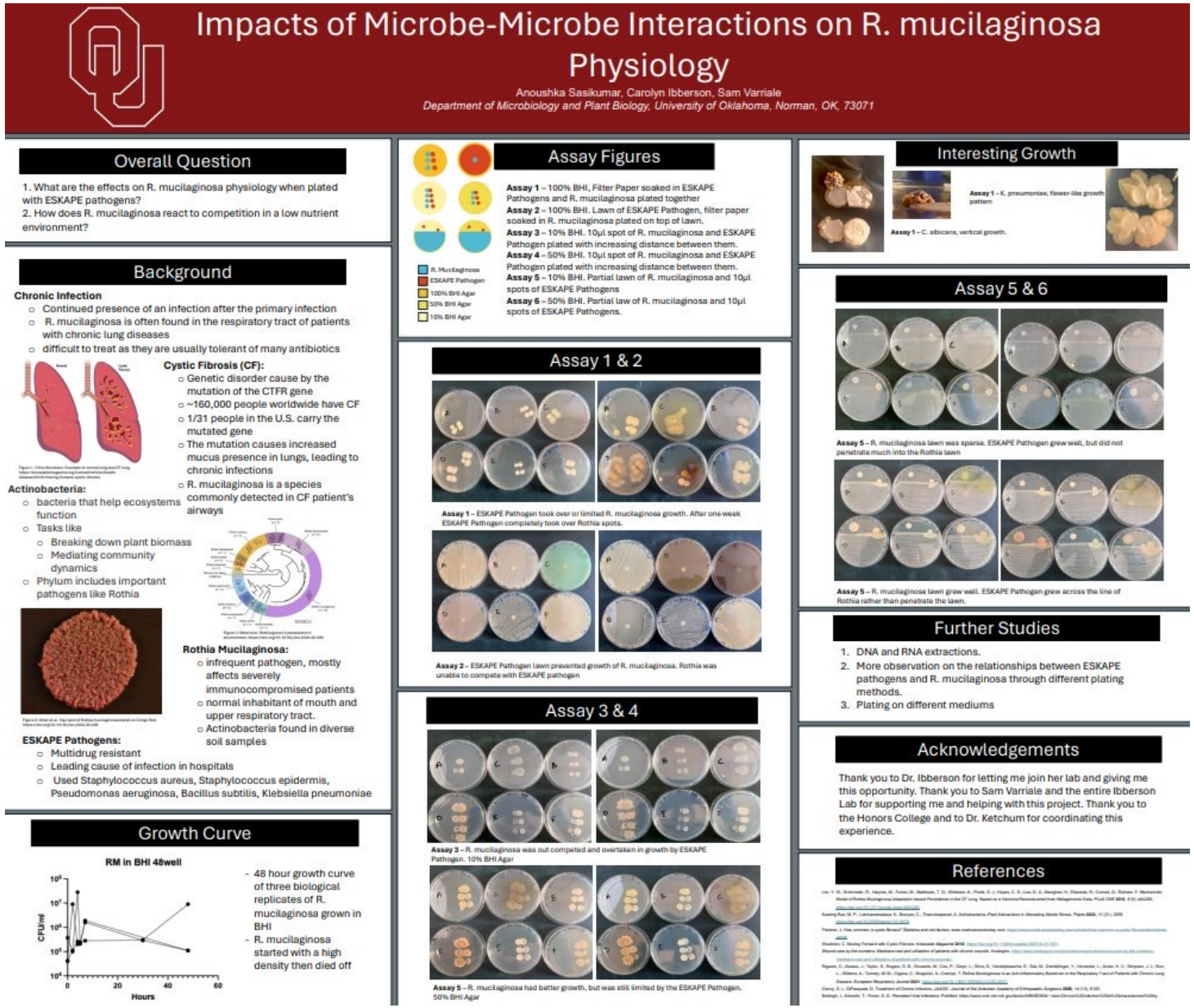
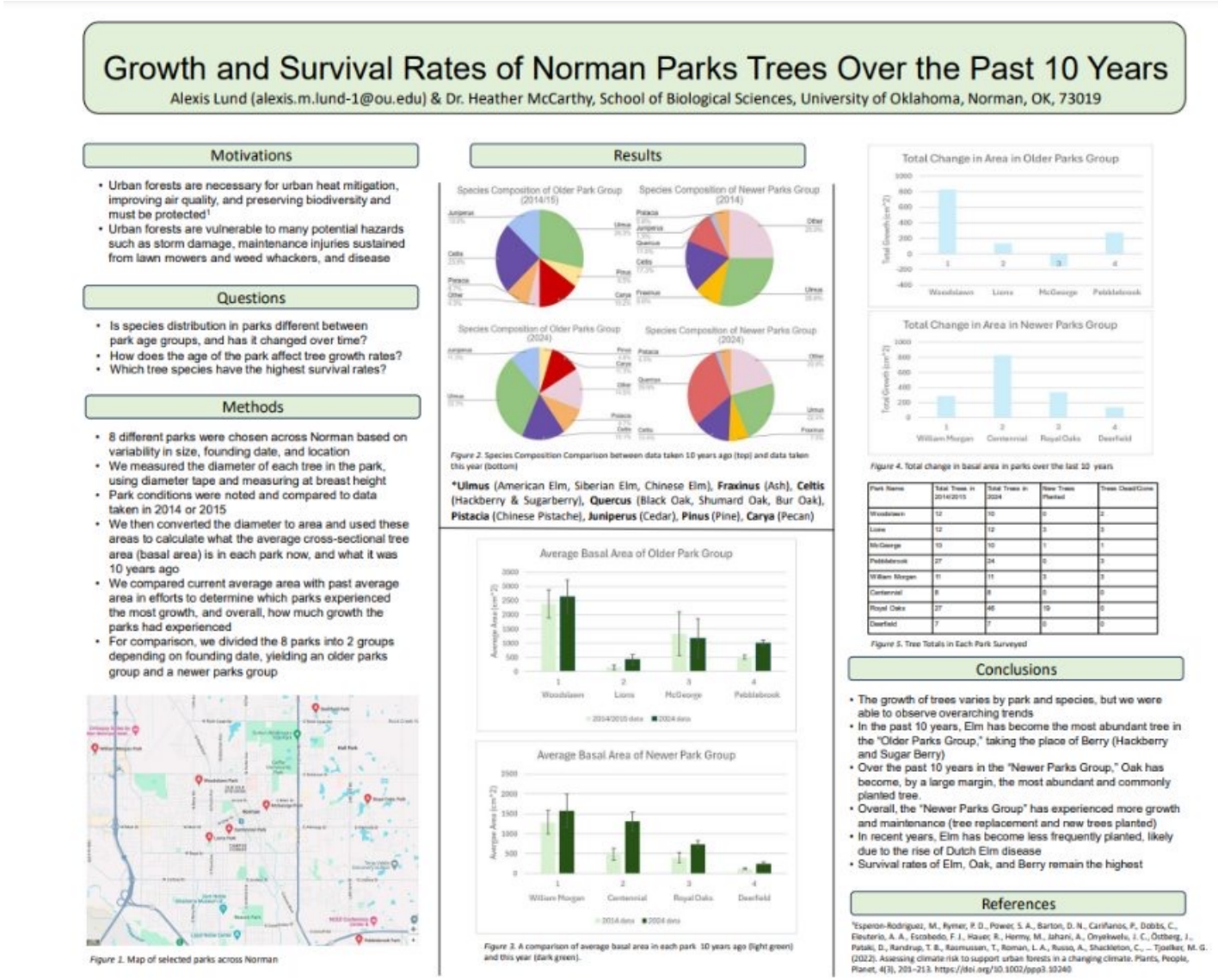


Growth and Survival Rates of Norman Parks Trees Over the Past 10 Years

Alexis Lund and Dr. Heather McCarthy

School of Biological Sciences, University of Oklahoma, Norman, Oklahoma, 73019



Growth and Survival Rates of Norman Parks Trees Over the Past 10 Years

Alexis Lund (alexis.m.lund-1@ou.edu) & Dr. Heather McCarthy, School of Biological Sciences, University of Oklahoma, Norman, OK, 73019

Motivations

- Urban forests are necessary for urban heat mitigation, improving air quality, and preserving biodiversity and must be protected[1]
- Urban forests are vulnerable to many potential hazards such as storm damage, maintenance injuries sustained from lawn mowers and weed whackers, and disease

Questions

- Is species distribution in parks different between park age groups, and has it changed over time?
- How does the age of the park affect tree growth rates?
- Which tree species have the highest survival rates?

Methods

- 8 different parks were chosen across Norman based on variability in size, founding date, and location
- We measured the diameter of each tree in the park, using diameter tape and measuring at breast height
- Park conditions were noted and compared to data taken in 2014 or 2015
- We then converted the diameter to area and used these areas to calculate what the average cross-sectional tree area (basal area) is in each park now, and what it was 10 years ago
- We compared current average area with past average area in efforts to determine which parks experienced the most growth, and overall, how much growth the parks had experienced
- For comparison, we divided the 8 parks into 2 groups depending on founding date, yielding an older parks group and a newer parks group

Figure 1. Map of selected parks across Norman

Results

Figure 2. Species Composition Comparison between data taken 10 years ago (top) and data taken this year (bottom)

***Ulmus** (American Elm, Siberian Elm, Chinese Elm), **Fraxinus** (Ash), **Celtis** (Hackberry & Sugarberry), **Quercus** (Black Oak, Shumard Oak, Bur Oak), **Pistacia** (Chinese Pistache), **Juniperus** (Cedar), **Pinus** (Pine), **Carya** (Pecan)

Figure 3. A comparison of average basal area in each park 10 years ago (light green) and this year (dark green).

Figure 4. Total change in basal area in parks over the last 10 years

Park Name	Total Trees in 2014/2015	Total Trees in 2024	New Trees Planted	Trees Dead/Gone
Woodslawn	12	10	0	2
Lions	12	12	3	3
McGeorge	10	10	1	1
Pebblebrook	27	24	0	3
William Morgan	11	11	3	3
Centennial	8	8	0	0
Royal Oaks	37	46	10	0
Deerfield	7	7	0	0

Figure 5. Tree Totals in Each Park Surveyed

Conclusions

- The growth of trees varies by park and species, but we were able to observe overarching trends
- In the past 10 years, Elm has become the most abundant tree in the "Older Parks Group," taking the place of Berry (Hackberry and Sugar Berry)
- Over the past 10 years in the "Newer Parks Group," Oak has become, by a large margin, the most abundant and commonly planted tree.
- Overall, the "Newer Parks Group" has experienced more growth and maintenance (tree replacement and new trees planted)
- In recent years, Elm has become less frequently planted, likely due to the rise of Dutch Elm disease
- Survival rates of Elm, Oak, and Berry remain the highest

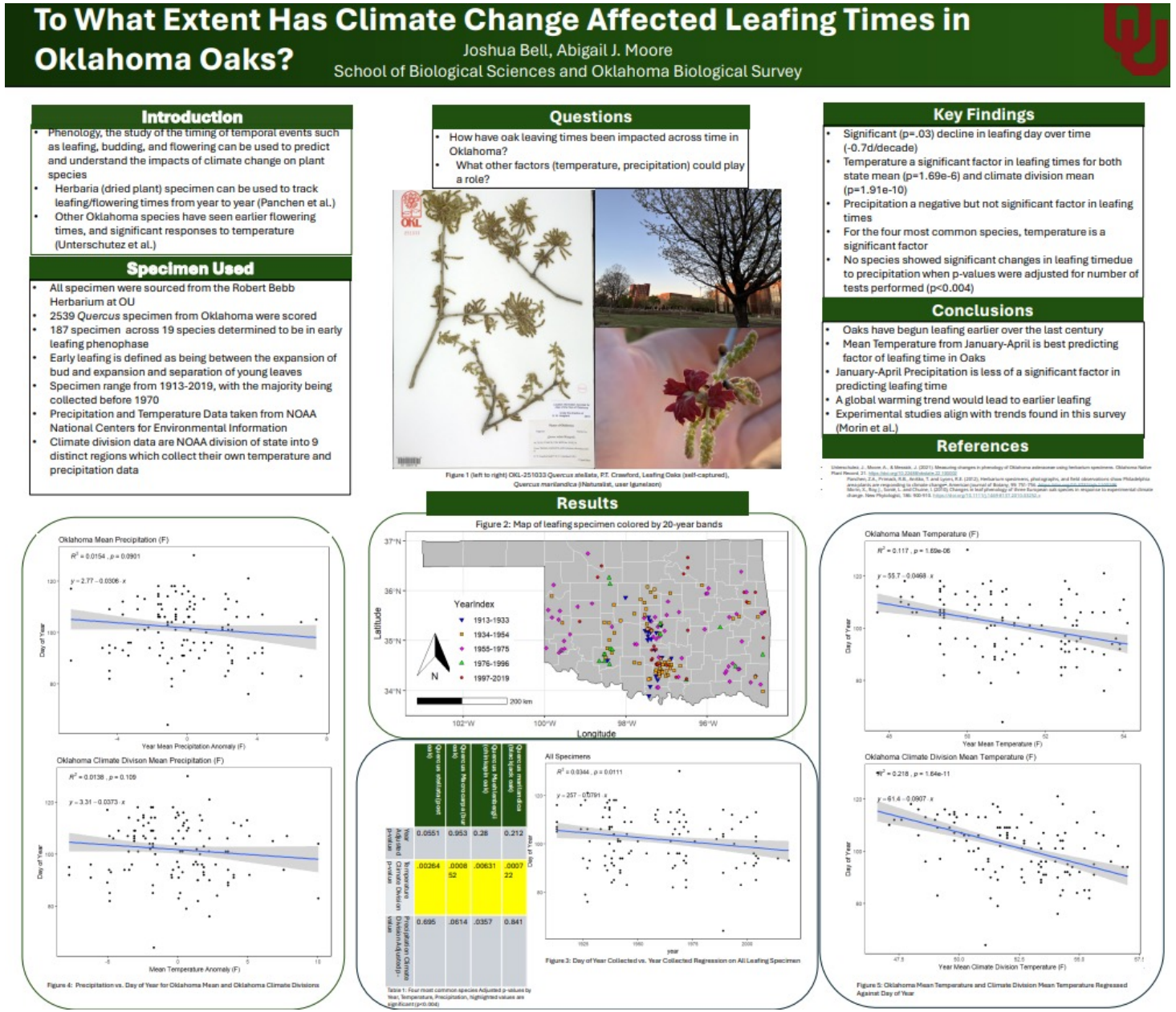
References

[1]Esperon-Rodriguez, M., Rymer, P. D., Power, S. A., Barton, D. N., Cariñanos, P., Dobbs, C., Eleuterio, A. A., Escobedo, F. J., Hauer, R., Hermy, M., Jahani, A., Onyekwelu, J. C., Östberg, J., Pataki, D., Randrup, T. B., Rasmussen, T., Roman, L. A., Russo, A., Shackleton, C., … Tjoelker, M. G. (2022). Assessing climate risk to support urban forests in a changing climate. Plants, People, Planet, 4(3), 203–213. https://doi.org/10.1002/ppp3.10240

To What Extent Has Climate Change Affected Leafing Times in Oklahoma Oaks?

Joshua Bell, Abigail J. Moore

School of Biological Sciences and Oklahoma Biological Survey



Analyzing Changes in Invasive Triadica sebifera Phenology Using Herbarium and iNaturalist Samples

Lena Jurik, Abigail J. Moore

School of Biological Sciences, University of Oklahoma

Analyzing Changes in Invasive *Triadica sebifera* Phenology Using Herbarium and iNaturalist Samples

Lena Jurik, Abigail J. Moore

School of Biological Sciences, University of Oklahoma

Introduction

- Chinese Tallow is an angiosperm native to East Asia.
- The tree was introduced to America in the 1700s for ornamental uses and became widespread in the 1900s as a part of soap production.
- It is now considered to be one of the most invasive species in the American Southeast.
- The tree can produce 100,000 viable seeds in a year and remain reproductively active for 100 years.

Figure 1. iNaturalist image showing *Triadica sebifera* from Pulaski, Arkansas. Hunt, E. (2012). iNaturalist observation: https://www.inaturalist.org/observations/88978

- Herbariums are collections of dried plant samples collected and labeled by botanists to be studied in the future.
- Primack et al. (2004) demonstrated that herbarium samples can be used to test phenological change in response to climate change.
- iNaturalist is a citizen science database in which users log image observations that are identified using AI and volunteers.
- iNaturalist has being used by researchers to supplement herbarium data (Iwanycki et al., 2004).

Figure 2. Herbarium Sample showing *Triadica sebifera*. U.S.A., Texas. Nueces County: Swamp, Baton Rouge. Deaver 6729 (ASC [ASC0069609]).

- Flowering for many plant species is starting sooner due to changes in weather patterns related to climate change.
- Earlier blooming times could affect plant-pollinator interactions and could increase total flowering time, potentially increasing the reproductive output.

Methodology

- 935 digital herbarium samples were analyzed from the TORCH database and physical samples in OU's Robert Bebb Herbarium.
- 8511 iNaturalist samples were downloaded from GBIF for the contiguous US and analyzed.
- Samples were categorized as having flowers but no fruit, having flowers and fruit, having no flowers but fruit, and having no fruit or flowers.
- These data were compared on regression lines to year and to average annual temperature from their year on both a national and statewide scale using data downloaded from NOAA.

Results

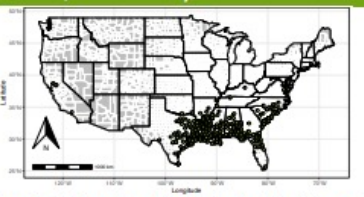


Figure 9. Map showing the county centroids of collection for herbarium specimens used.

Independent Variable	Phenophase	Data Types	R^2	p-value	Adjusted p-value
Year	Flowers but No Fruit	Herbarium	0.010	0.15	2.7
Year	Flower and Fruit	Herbarium	7.9E-03	0.44	7.9
Year	No Flowers but Fruit	Herbarium	0.017	0.013	0.23
Nationwide Annual Mean Temperature	Flowers but No Fruit	Herbarium	1.9E-03	0.54	9.7
Nationwide Annual Mean Temperature	Flower and Fruit	Herbarium	0.16	2.4E-04	4.4E-03
Nationwide Annual Mean Temperature	No Flowers but Fruit	Herbarium	7.2E-04	0.61	11
Statewide Annual Mean Temperature	Flowers but No Fruit	Herbarium	4.0E-04	0.77	14
Statewide Annual Mean Temperature	Flower and Fruit	Herbarium	0.101	4.6E-03	0.083
Statewide Annual Mean Temperature	No Flowers but Fruit	Herbarium	1.2E-03	0.51	9.2
Year	Flowers but No Fruit	Herbarium and iNaturalist	0.040	1.0E-13	1.8E-12
Year	Flower and Fruit	Herbarium and iNaturalist	0.045	2.6E-03	0.047
Year	No Flowers but Fruit	Herbarium and iNaturalist	7.8E-03	2.3E-03	0.041
Nationwide Annual Mean Temperature	Flowers but No Fruit	Herbarium and iNaturalist	0.023	5.8E-10	1.2E-08
Nationwide Annual Mean Temperature	Flower and Fruit	Herbarium and iNaturalist	0.086	2.4E-05	4.3E-04
Nationwide Annual Mean Temperature	No Flowers but Fruit	Herbarium and iNaturalist	0.03	4.1E-10	7.4E-09
Statewide Annual Mean Temperature	Flowers but No Fruit	Herbarium and iNaturalist	0.16	<2.2E-16	<4.0E-15
Statewide Annual Mean Temperature	Flower and Fruit	Herbarium and iNaturalist	0.35	<2.2E-16	<4.0E-15
Statewide Annual Mean Temperature	No Flowers but Fruit	Herbarium and iNaturalist	0.019	9.3E-07	1.7E-05

Table 1. Table showing significance of all statistical tests and Bonferroni adjusted p-values.

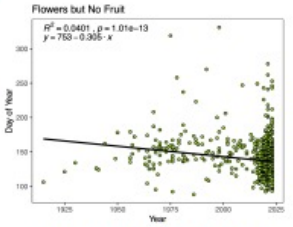


Figure 3. Scatterplot showing day of year of collection vs. year for plants with flowers but no fruit.

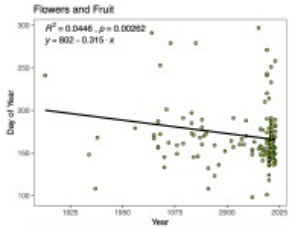


Figure 4. Scatterplot showing day of year of collection vs. year for plants with flowers and fruit.

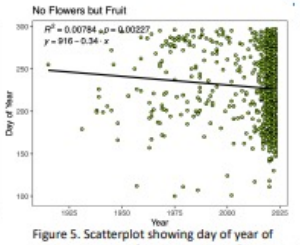


Figure 5. Scatterplot showing day of year of collection vs. year for plants with no flowers but with fruit.

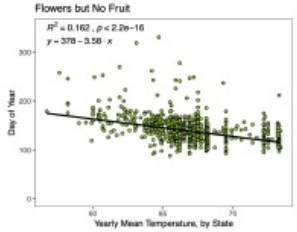


Figure 6. Scatterplot showing day of year of collection vs. yearly mean temperature for collection state for plants with flowers but no fruit.

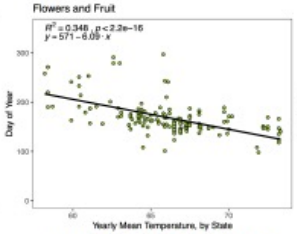


Figure 7. Scatterplot showing day of year of collection vs. yearly mean temperature for collection state for plants with flowers and fruit.

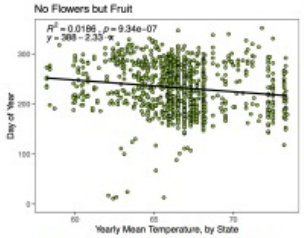


Figure 8. Scatterplot showing day of year of collection vs. yearly mean temperature of collection state for plants with no flowers but with fruit.

Conclusion

- iNaturalist provides large amounts of data in more depth than herbarium samples but only shows relatively recent occurrences and is less likely to show parts like flowers and fruits when present.
- The adjusted p-value for all analyses including both herbarium and iNaturalist specimens was below 0.05, and therefore is considered significant.
- Generally, analysis comparing day of year to yearly mean temperature by state was more significant than comparing to the national annual mean temperature or year.
- Analyses of only herbarium specimens showed significance only in day of year vs annual national mean temperature for flowers and fruit present.
- Difference in significance between herbarium and iNaturalist data indicates that there may be issues with comparing the sample types or could result from the larger sample size of the iNaturalist and herbarium combined data set.
- There is evidence that blooming time is shifting earlier and that it is tied to mean temperature
- Since all phenophases are shifting earlier, there is no evidence that the flowering period will be extended.
- Further research would be required to determine how plant-pollinator relationships would be impacted by this change in blooming time.
- Future research could also be done to look at the effects of other factors on Chinese Tallow phenology.

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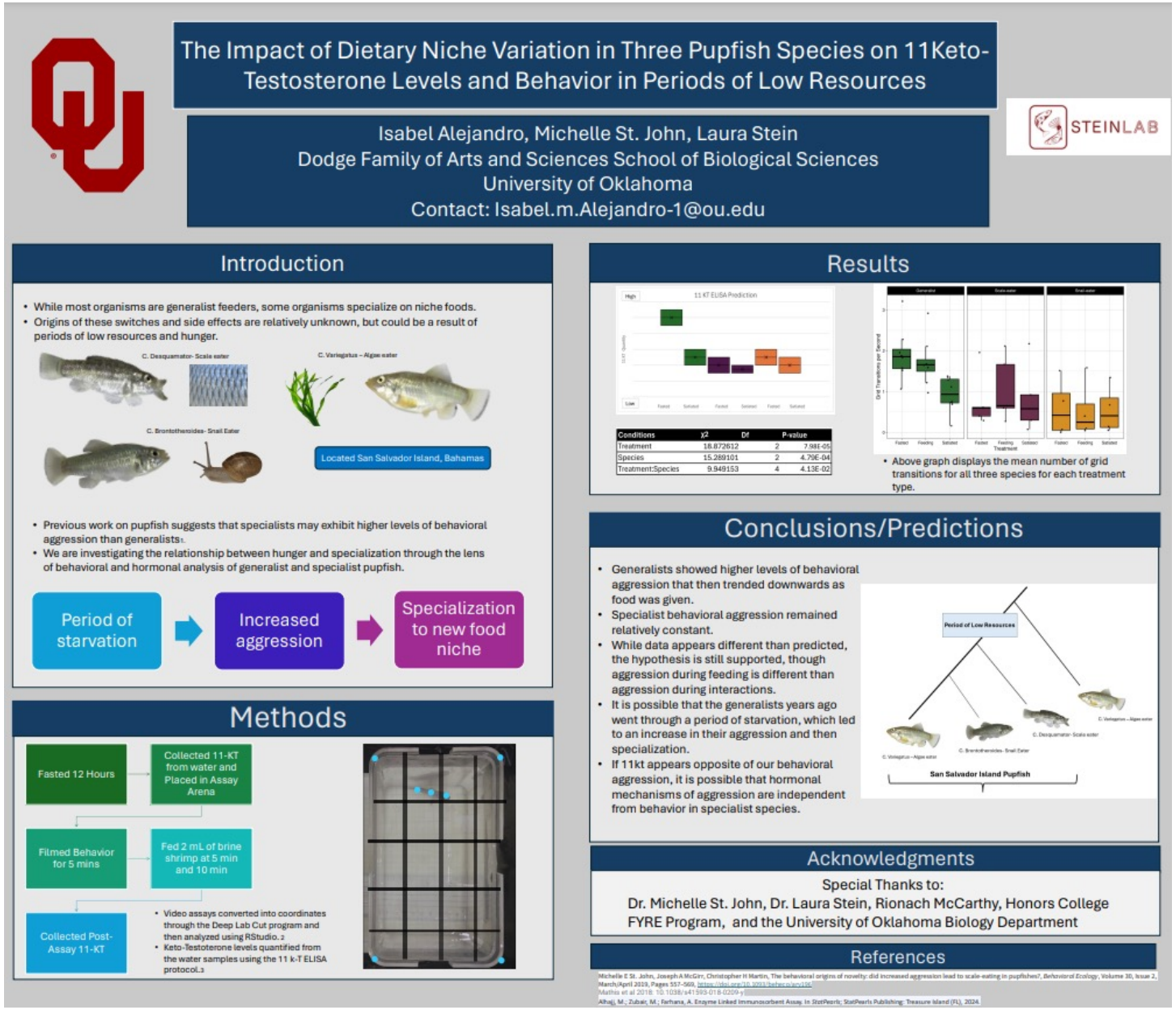
The Impact of Dietary Niche Variation in Three Pupfish Species on 11KetoTestosterone Levels and Behavior in Periods of Low Resources

Isabel Alejandro, Michelle St. John, Laura Stein Dodge

Family of Arts and Sciences School of Biological Sciences University of Oklahoma



Dominance of Nok4 Gene: Body Size Expression in F1 Prodigy of NKZ35xWOU12 Cross

Author: Kaylee McWhorter

Coauthors: Gavin Woodruff

Kimberly Moser Fig Worm Lab, Department of Biology, University of Oklahoma

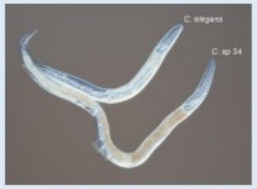
Dominance of Nok4 Gene: Body Size Expression in F1 Prodigy of NKZ35xWOU12 Cross

Author: Kaylee McWhorter
Coauthors: Gavin Woodruff, Kimberly Moser
Fig Worm Lab, Department of Biology, University of Oklahoma

Background:

Figure 1

(Woodruff, 2018)



Recently discovered Sister Species, Caenorhabditis Inopinata

Characterized by its significantly larger body size

Our lab is interested in what genes regulate its size -- applications in cancer research.

Objective:

For our experiment, we sought to determine whether the Nok4 gene mutation, responsible for the WOU12 mutant, is dominant or recessive. Furthermore, we hoped to identify if the gene was x-linked based on its compliance with Mendelian inheritance. This poster focuses on the first cross direction for the F1 progeny.

Hypothesis:

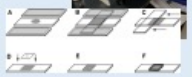
The gene associated with body size regulation (Nok4), being a loss of function mutation in WOU12, is recessive and x-linked because there are only male mutants in the F1 progeny.

Methods

- Cross: Picked 100 NKZ35 males and 50 WOU12 females and separated them onto 10 plates to reproduce.

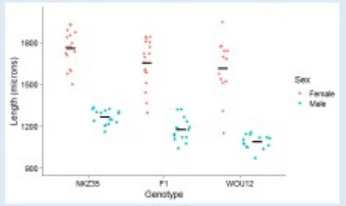
- Synchronized Egglay: Took the gravid females off and isolated them on fresh plates to lay their eggs. After a few hours, I removed the females. Then waited 3 days for the egg population to mature into adults.

- Phenotyping: Mounted nematodes onto slides by paralyzing them with levamisole and took pictures at 10x with the microscope.
used Fiji to measure arbitrary length and
After converting this to microns (micrometers), I graphed and analyzed the results using R-Studio.



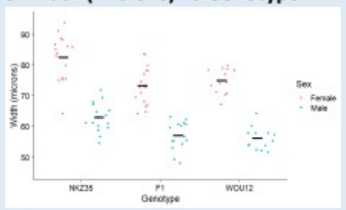
Results:

Figure 2 Length (microns) vs Genotype



Wilcox Rank Sun Exact Test:
NKZ35 vs WOU12 P-Value = 0.004664
Female NKZ35 vs Female WOU12 P-Value = 0.05554
Male NKZ35 vs Male WOU12 P-Value = 1.375e-08

Figure 3 Width (microns) vs Genotype



Wilcox Rank Sun Exact Test:
NKZ35 vs WOU12 P-Value = 0.01105
Female NKZ35 vs Female WOU12 P-Value = 0.003796
Male NKZ35 vs Male WOU12 P- Value = 0.0002966

Figure 4 Length (microns) vs Width (microns)

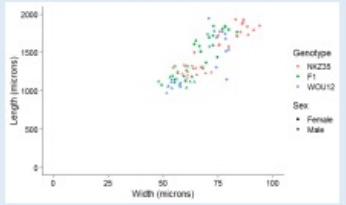
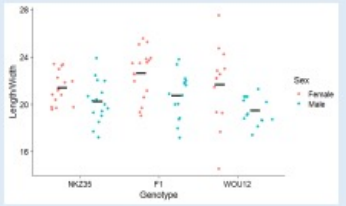


Figure 5 Length Over Width vs Genotype



NKZ 35 vs WOU12 P-Value = 0.3762

Discussion/Conclusion:

- Hypothesis and observations were incorrect
- WOU12 strand is smaller than NKZ35 (wild-type).
- Body size ratio is lower
- Gene seems to be dominant for width but does not follow Mendelian Inheritance for length
- Differences in Male and Female

What could be causing this?

The gene could be Non-Mendelian or width alone could follow Mendelian inheritance.

What are our next steps?

Further research is needed to determine the gene expression. Our next step is to do the cross direction in the reverse direction. If the gene follows Mendelian inheritance and the allele is dominant, 100% of the F1 progeny will have the wild-type phenotype.

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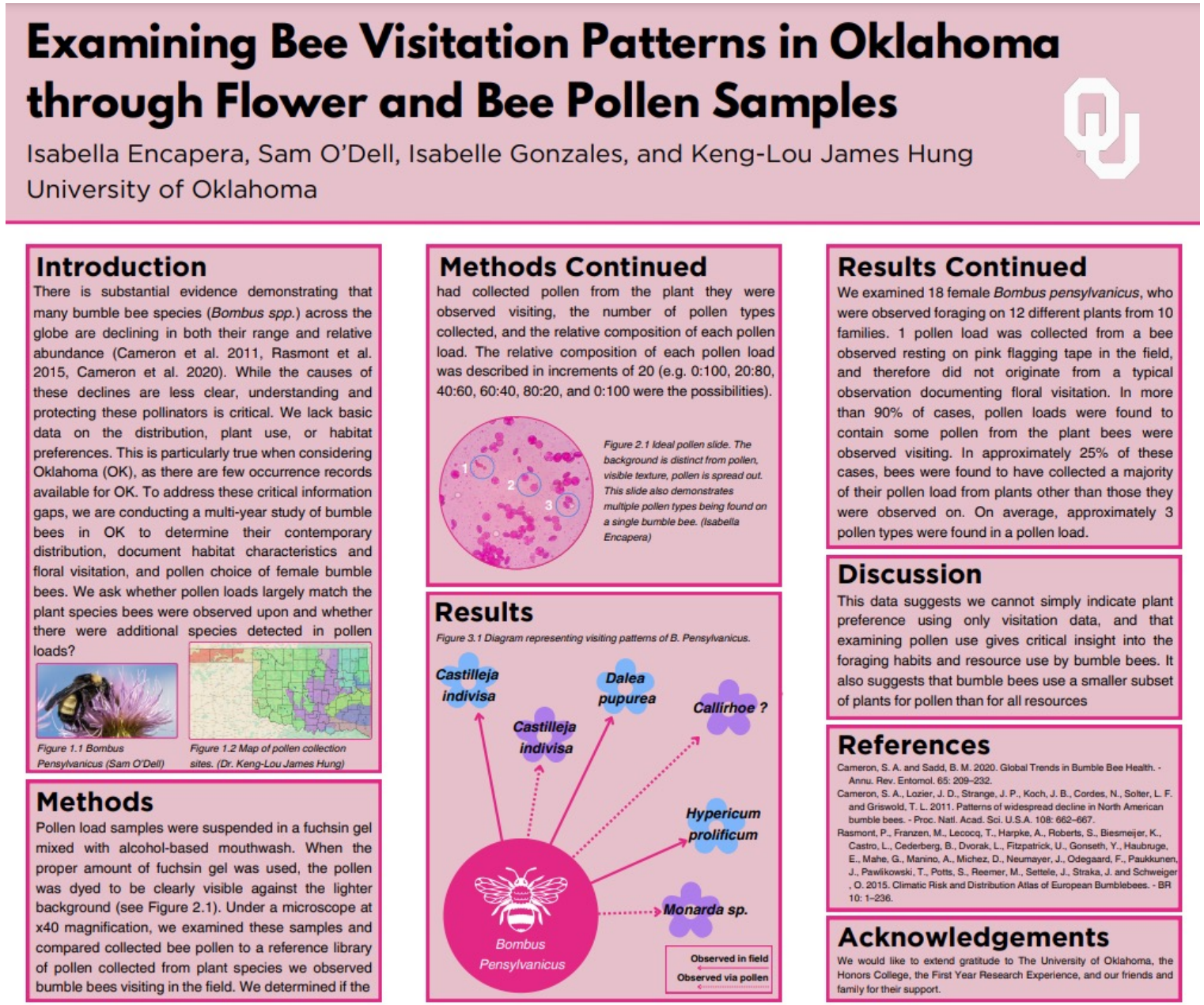
Examining Bee Visitation Patterns in Oklahoma through Flower and Bee Pollen Samples

Isabella Encapera, Sam O'Dell, Isabelle Gonzales, and Keng-Lou James Hung

University of Oklahoma



Examining Bee Visitation Patterns in Oklahoma through Flower and Bee Pollen Samples

Isabella Encapera, Sam O'Dell, Isabelle Gonzales, and Keng-Lou James Hung
University of Oklahoma

Introduction

There is substantial evidence demonstrating that many bumble bee species (*Bombus spp.*) across the globe are declining in both their range and relative abundance (Cameron et al. 2011, Rasmont et al. 2015, Cameron et al. 2020). While the causes of these declines are less clear, understanding and protecting these pollinators is critical. We lack basic data on the distribution, plant use, or habitat preferences. This is particularly true when considering Oklahoma (OK), as there are few occurrence records available for OK. To address these critical information gaps, we are conducting a multi-year study of bumble bees in OK to determine their contemporary distribution, document habitat characteristics and floral visitation, and pollen choice of female bumble bees. We ask whether pollen loads largely match the plant species bees were observed upon and whether there were additional species detected in pollen loads?

Figure 1.1 Bombus Pensylvanicus (Sam O'Dell)

Figure 1.2 Map of pollen collection sites. (Dr. Keng-Lou James Hung)

Methods

Pollen load samples were suspended in a fuchsin gel mixed with alcohol-based mouthwash. When the proper amount of fuchsin gel was used, the pollen was dyed to be clearly visible against the lighter background (see Figure 2.1). Under a microscope at x40 magnification, we examined these samples and compared collected bee pollen to a reference library of pollen collected from plant species we observed bumble bees visiting in the field. We determined if the

Methods Continued

had collected pollen from the plant they were observed visiting, the number of pollen types collected, and the relative composition of each pollen load. The relative composition of each pollen load was described in increments of 20 (e.g. 0:100, 20:80, 40:60, 60:40, 80:20, and 0:100 were the possibilities).

Figure 2.1 Ideal pollen slide. The background is distinct from pollen, visible texture, pollen is spread out. This slide also demonstrates multiple pollen types being found on a single bumble bee. (Isabella Encapera)

Results

Figure 3.1 Diagram representing visiting patterns of B. Pensylvanicus.

Results Continued

We examined 18 female *Bombus pensylvanicus*, who were observed foraging on 12 different plants from 10 families. 1 pollen load was collected from a bee observed resting on pink flagging tape in the field, and therefore did not originate from a typical observation documenting floral visitation. In more than 90% of cases, pollen loads were found to contain some pollen from the plant bees were observed visiting. In approximately 25% of these cases, bees were found to have collected a majority of their pollen load from plants other than those they were observed on. On average, approximately 3 pollen types were found in a pollen load.

Discussion

This data suggests we cannot simply indicate plant preference using only visitation data, and that examining pollen use gives critical insight into the foraging habits and resource use by bumble bees. It also suggests that bumble bees use a smaller subset of plants for pollen than for all resources

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Acknowledgements

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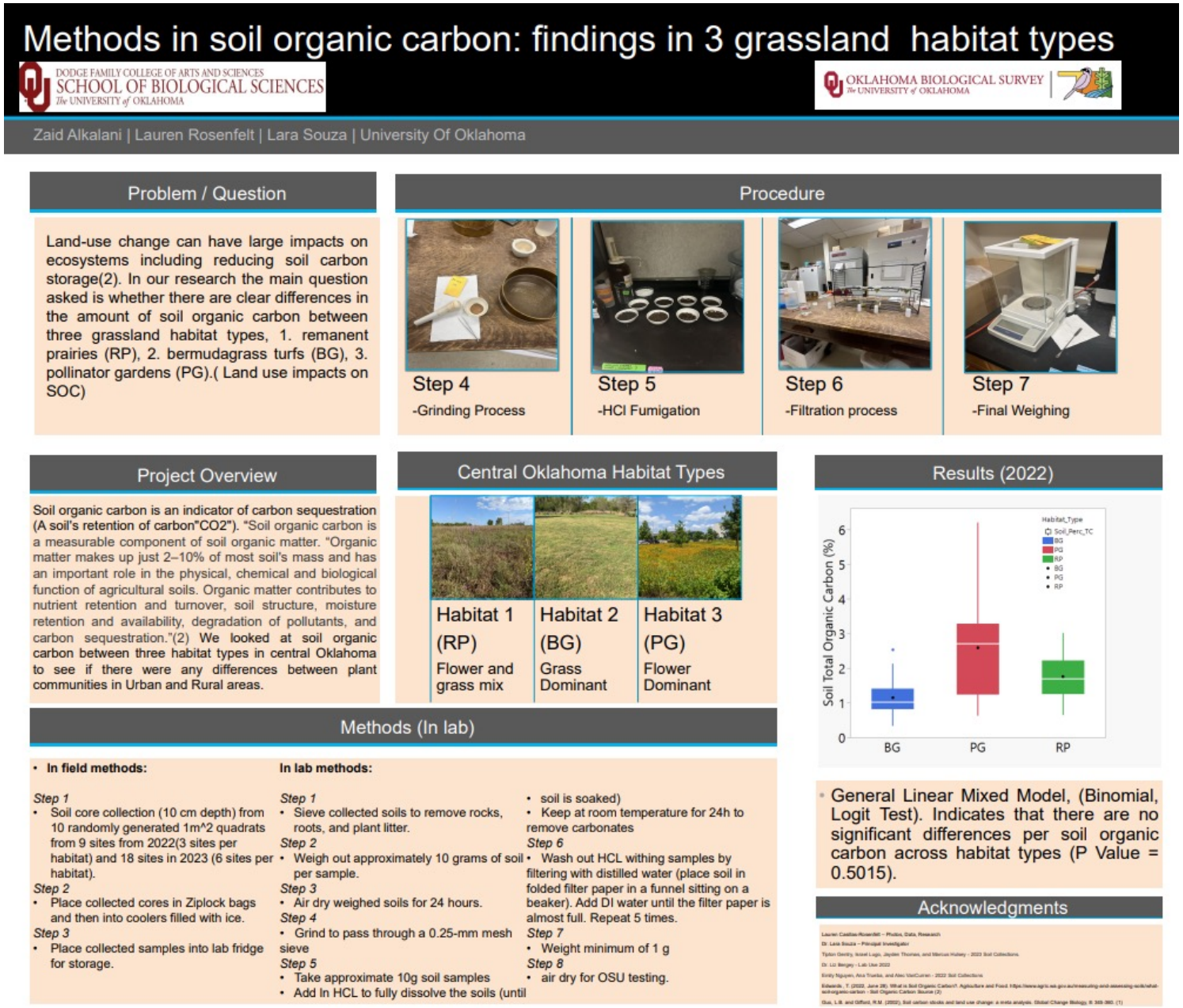
Methods in soil organic carbon: findings in 3 grassland habitat types

Zaid Alkalan, Lauren Rosenfelt, Lara Souza

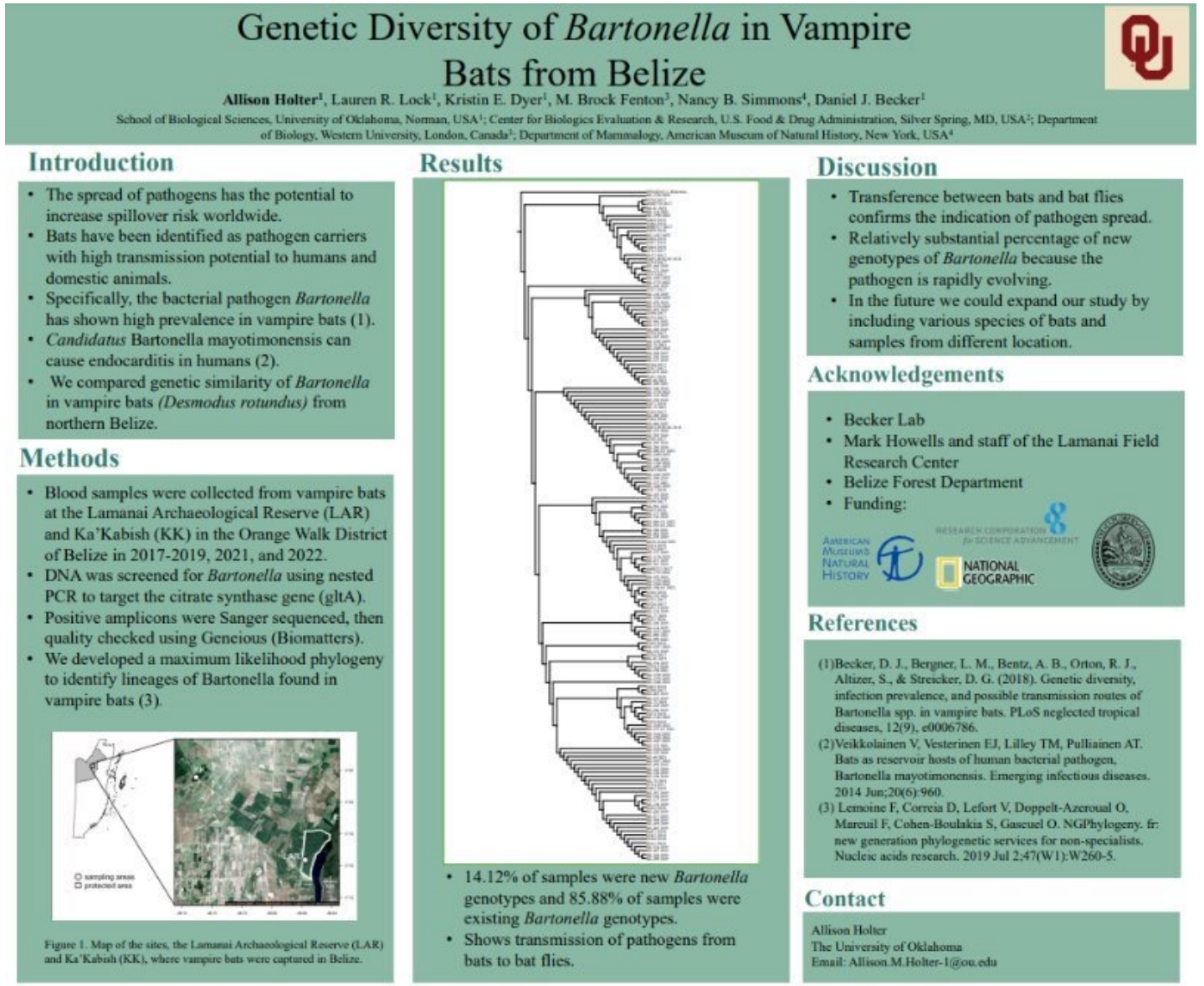
University Of Oklahoma



Genetic Diversity of *Bartonella* in Vampire Bats from Belize

Allison Holter 1 , Lauren R. Lock 1, Kristin E. Dyer 1, M. Brock Fenton 3, Nancy B. Simmons 4, Daniel J. Beck 1

School of Biological Sciences, University of Oklahoma, Norman, USA 1; Center for Biologics Evaluation & Research, U.S. Food & Drug Administration, Silver Spring, MD, USA 2; Department of Biology, Western University, London, Canada 3; Department of Mammalogy, American Museum of Natural History, New York, USA 4



Genetic Diversity of *Bartonella* in Vampire Bats from Belize

Allison Holter[1], Lauren R. Lock[1], Kristin E. Dyer[1], M. Brock Fenton[3], Nancy B. Simmons[4], Daniel J. Becker[1]

School of Biological Sciences, University of Oklahoma, Norman, USA[1]; Center for Biologics Evaluation & Research, U.S. Food & Drug Administration, Silver Spring, MD, USA[2]; Department of Biology, Western University, London, Canada[3]; Department of Mammalogy, American Museum of Natural History, New York, USA[4]

Introduction

- The spread of pathogens has the potential to increase spillover risk worldwide.
- Bats have been identified as pathogen carriers with high transmission potential to humans and domestic animals.
- Specifically, the bacterial pathogen *Bartonella* has shown high prevalence in vampire bats (1).
- *Candidatus* Bartonella mayotimonensis can cause endocarditis in humans (2).
- We compared genetic similarity of *Bartonella* in vampire bats *(Desmodus rotundus)* from northern Belize.

Methods

- Blood samples were collected from vampire bats at the Lamanai Archaeological Reserve (LAR) and Ka'Kabish (KK) in the Orange Walk District of Belize in 2017-2019, 2021, and 2022.
- DNA was screened for *Bartonella* using nested PCR to target the citrate synthase gene (gltA).
- Positive amplicons were Sanger sequenced, then quality checked using Geneious (Biomatters).
- We developed a maximum likelihood phylogeny to identify lineages of Bartonella found in vampire bats (3).

Figure 1. Map of the sites, the Lamanai Archaeological Reserve (LAR) and Ka'Kabish (KK), where vampire bats were captured in Belize.

Results

- 14.12% of samples were new *Bartonella* genotypes and 85.88% of samples were existing *Bartonella* genotypes.
- Shows transmission of pathogens from bats to bat flies.

Discussion

- Transference between bats and bat flies confirms the indication of pathogen spread.
- Relatively substantial percentage of new genotypes of *Bartonella* because the pathogen is rapidly evolving.
- In the future we could expand our study by including various species of bats and samples from different location.

Acknowledgements

- Becker Lab
- Mark Howells and staff of the Lamanai Field Research Center
- Belize Forest Department
- Funding:

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(3) Lemoine F, Correia D, Lefort V, Doppelt-Azeroual O, Mareuil F, Cohen-Boulakia S, Gascuel O. NGPhylogeny. fr: new generation phylogenetic services for non-specialists. Nucleic acids research. 2019 Jul 2;47(W1):W260-5.

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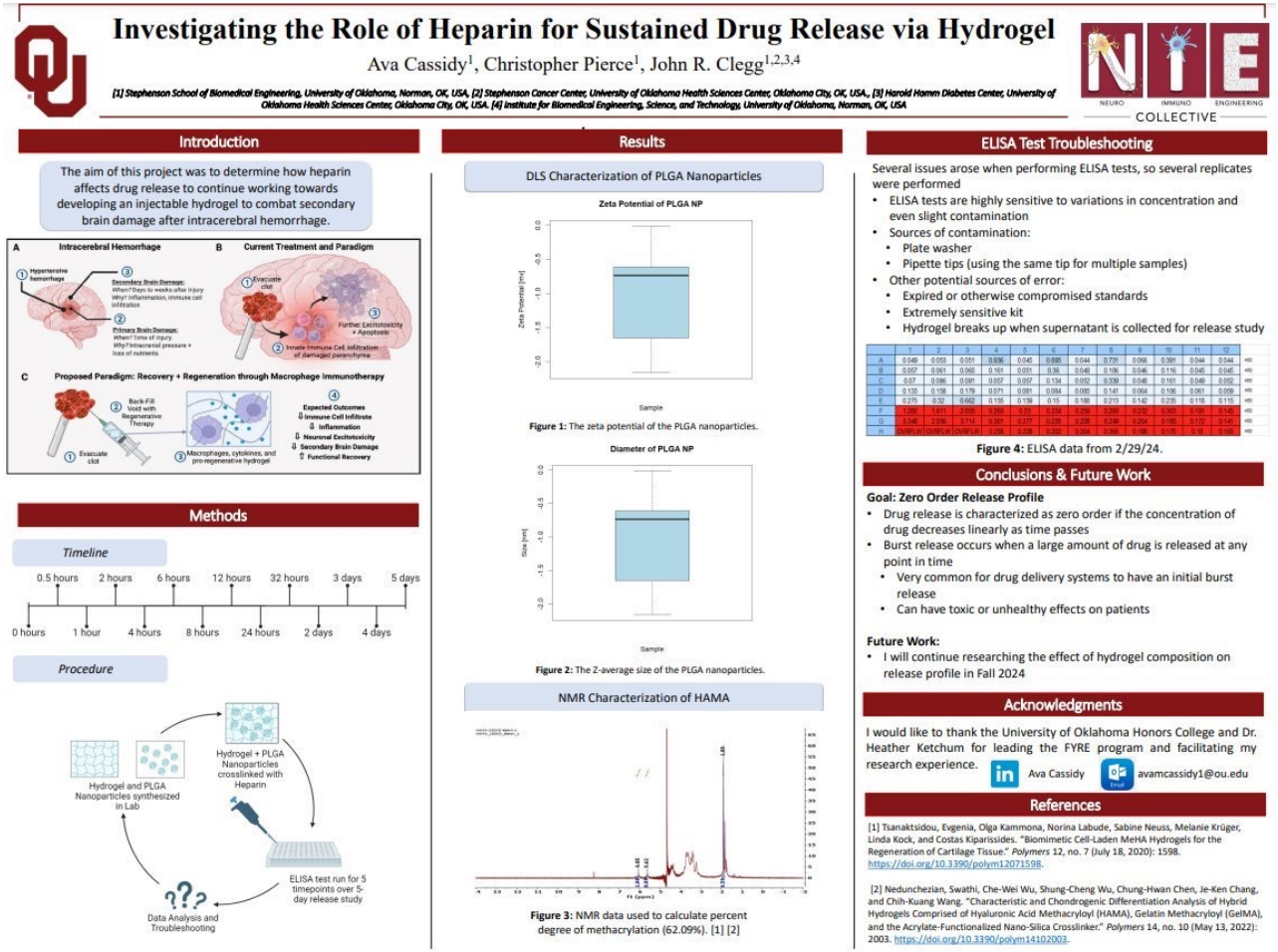
Investigating the Role of Heparin for Sustained Drug Release via Hydrogel

Ava Cassidy 1, Christopher Pierce 1, John R. Clegg 1,2,3,4



Investigating the Role of Heparin for Sustained Drug Release via Hydrogel

Ava Cassidy[1], Christopher Pierce[1], John R. Clegg[1,2,3,4]

[1] Stephenson School of Biomedical Engineering, University of Oklahoma, Norman, OK, USA, [2] Stephenson Cancer Center, University of Oklahoma Health Sciences Center, Oklahoma City, OK, USA., [3] Harold Hamm Diabetes Center, University of Oklahoma Health Sciences Center, Oklahoma City, OK, USA. [4] Institute for Biomedical Engineering, Science, and Technology, University of Oklahoma, Norman, OK, USA

NEURO IMMUNO ENGINEERING COLLECTIVE

Introduction

The aim of this project was to determine how heparin affects drug release to continue working towards developing an injectable hydrogel to combat secondary brain damage after intracerebral hemorrhage.

Methods

Timeline

Procedure

Results

DLS Characterization of PLGA Nanoparticles

Figure 1: The zeta potential of the PLGA nanoparticles.

Figure 2: The Z-average size of the PLGA nanoparticles.

NMR Characterization of HAMA

Figure 3: NMR data used to calculate percent degree of methacrylation (62.09%). [1] [2]

ELISA Test Troubleshooting

Several issues arose when performing ELISA tests, so several replicates were performed

- ELISA tests are highly sensitive to variations in concentration and even slight contamination
- Sources of contamination:
  - Plate washer
  - Pipette tips (using the same tip for multiple samples)
- Other potential sources of error:
  - Expired or otherwise compromised standards
  - Extremely sensitive kit
  - Hydrogel breaks up when supernatant is collected for release study

Figure 4: ELISA data from 2/29/24.

Conclusions & Future Work

Goal: Zero Order Release Profile

- Drug release is characterized as zero order if the concentration of drug decreases linearly as time passes
- Burst release occurs when a large amount of drug is released at any point in time
  - Very common for drug delivery systems to have an initial burst release
  - Can have toxic or unhealthy effects on patients

Future Work:

- I will continue researching the effect of hydrogel composition on release profile in Fall 2024

Acknowledgments

I would like to thank the University of Oklahoma Honors College and Dr. Heather Ketchum for leading the FYRE program and facilitating my research experience.

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Using Dynamic Light Scattering to Test Nanoparticle Samples: Measuring Cell Size and Zeta Potential

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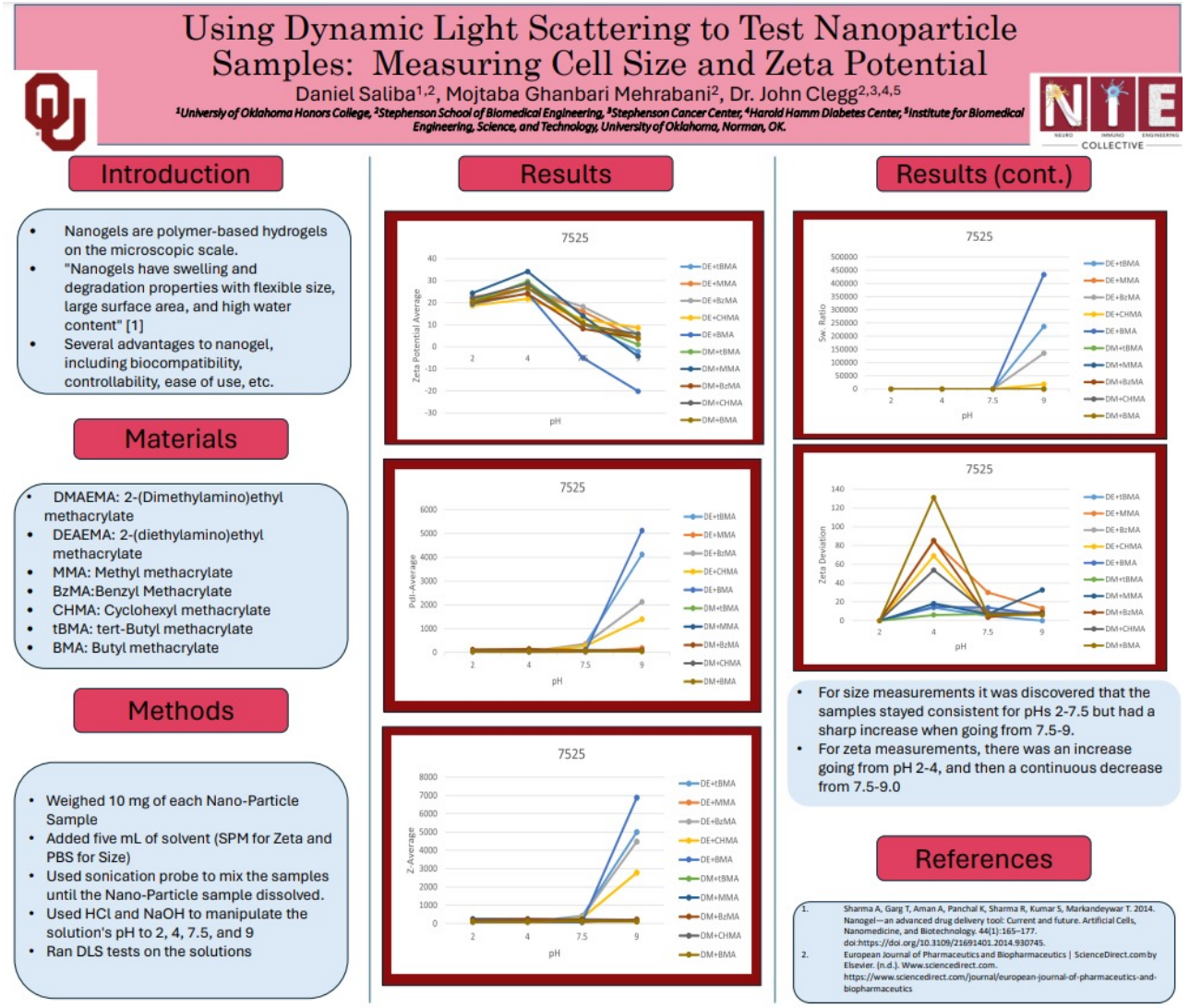
1 Universiy of Oklahoma Honors College, 2 Stephenson School of Biomedical Engineering, 3 Stephenson Cancer Center, 4 Harold Hamm Diabetes Center, 5 Institute for Biomedical Engineering, Science, and Technology, University of Oklahoma, Norman, OK.



Evaluation of Repurposing Anti-Parasite Drugs for Ovarian Cancer from Cell to Animal Level Using Optical Coherence Tomography

Takaki Mishima, Feng Yan[1], Rajani Rai[2], Chen Wang[1], Qinghao Zhang[1], Ebenezer Raj Selvaraj Mercyshalinie[1], Lauren E. Dockery[2], and Qinggong Tang[1]

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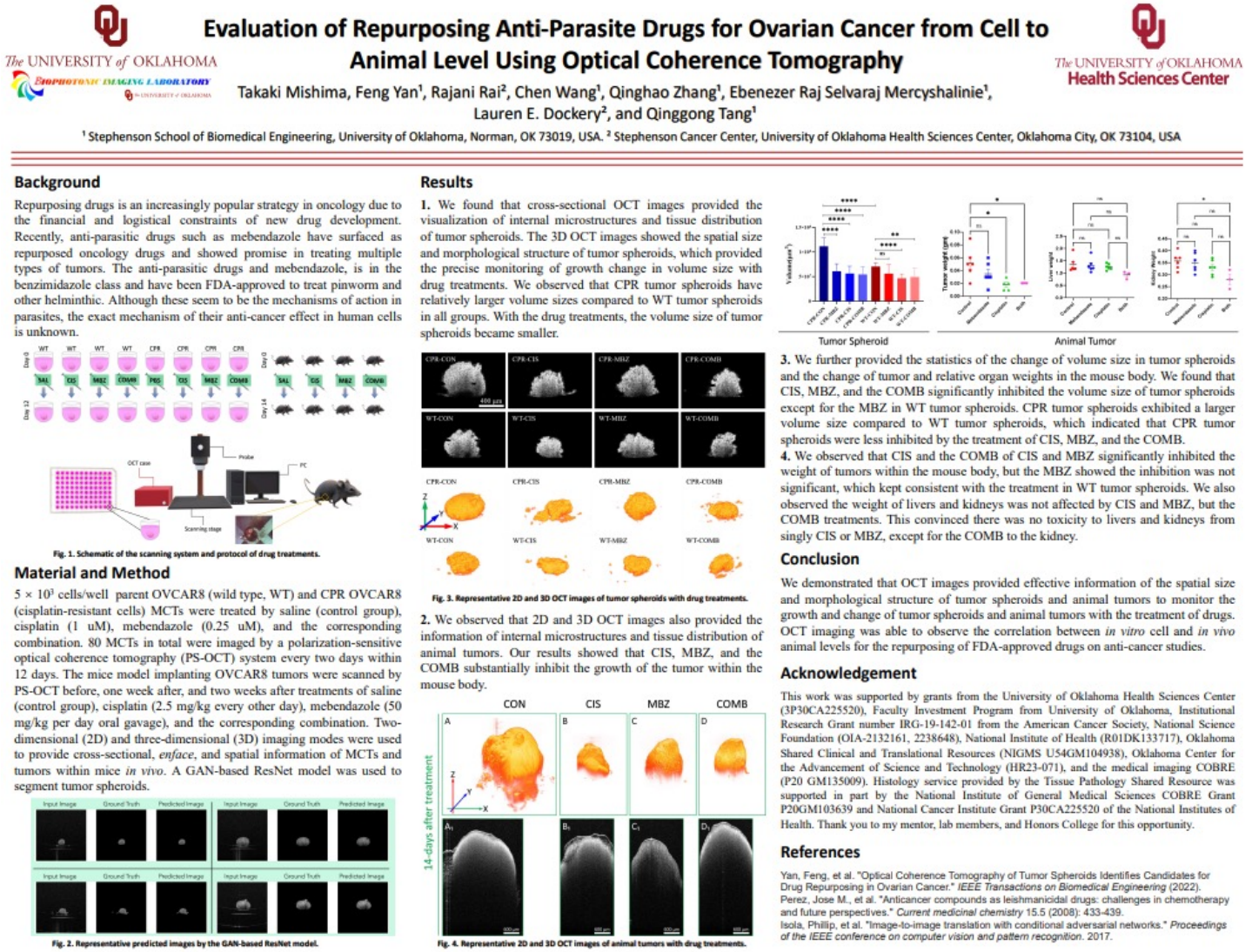

Evaluation of Repurposing Anti-Parasite Drugs for Ovarian Cancer from Cell to Animal Level Using Optical Coherence Tomography

Takaki Mishima, Feng Yan[1], Rajani Rai[2], Chen Wang[1], Qinghao Zhang[1], Ebenezer Raj Selvaraj Mercyshalinie[1], Lauren E. Dockery[2], and Qinggong Tang[1]

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Background

Repurposing drugs is an increasingly popular strategy in oncology due to the financial and logistical constraints of new drug development. Recently, anti-parasitic drugs such as mebendazole have surfaced as repurposed oncology drugs and showed promise in treating multiple types of tumors. The anti-parasitic drugs and mebendazole, is in the benzimidazole class and have been FDA-approved to treat pinworm and other helminthic. Although these seem to be the mechanisms of action in parasites, the exact mechanism of their anti-cancer effect in human cells is unknown.

Fig. 1. Schematic of the scanning system and protocol of drug treatments.

Material and Method

5×10^3 cells/well parent OVCAR8 (wild type, WT) and CPR OVCAR8 (cisplatin-resistant cells) MCTs were treated by saline (control group), cisplatin (1 uM), mebendazole (0.25 uM), and the corresponding combination. 80 MCTs in total were imaged by a polarization-sensitive optical coherence tomography (PS-OCT) system every two days within 12 days. The mice model implanting OVCAR8 tumors were scanned by PS-OCT before, one week after, and two weeks after treatments of saline (control group), cisplatin (2.5 mg/kg every other day), mebendazole (50 mg/kg per day oral gavage), and the corresponding combination. Two-dimensional (2D) and three-dimensional (3D) imaging modes were used to provide cross-sectional, *enface*, and spatial information of MCTs and tumors within mice *in vivo*. A GAN-based ResNet model was used to segment tumor spheroids.

Fig. 2. Representative predicted images by the GAN-based ResNet model.

Results

1. We found that cross-sectional OCT images provided the visualization of internal microstructures and tissue distribution of tumor spheroids. The 3D OCT images showed the spatial size and morphological structure of tumor spheroids, which provided the precise monitoring of growth change in volume size with drug treatments. We observed that CPR tumor spheroids have relatively larger volume sizes compared to WT tumor spheroids in all groups. With the drug treatments, the volume size of tumor spheroids became smaller.

Fig. 3. Representative 2D and 3D OCT images of tumor spheroids with drug treatments.

2. We observed that 2D and 3D OCT images also provided the information of internal microstructures and tissue distribution of animal tumors. Our results showed that CIS, MBZ, and the COMB substantially inhibit the growth of the tumor within the mouse body.

Fig. 4. Representative 2D and 3D OCT images of animal tumors with drug treatments.

Tumor Spheroid | Animal Tumor

3. We further provided the statistics of the change of volume size in tumor spheroids and the change of tumor and relative organ weights in the mouse body. We found that CIS, MBZ, and the COMB significantly inhibited the volume size of tumor spheroids except for the MBZ in WT tumor spheroids. CPR tumor spheroids exhibited a larger volume size compared to WT tumor spheroids, which indicated that CPR tumor spheroids were less inhibited by the treatment of CIS, MBZ, and the COMB.

4. We observed that CIS and the COMB of CIS and MBZ significantly inhibited the weight of tumors within the mouse body, but the MBZ showed the inhibition was not significant, which kept consistent with the treatment in WT tumor spheroids. We also observed the weight of livers and kidneys was not affected by CIS and MBZ, but the COMB treatments. This convinced there was no toxicity to livers and kidneys from singly CIS or MBZ, except for the COMB to the kidney.

Conclusion

We demonstrated that OCT images provided effective information of the spatial size and morphological structure of tumor spheroids and animal tumors to monitor the growth and change of tumor spheroids and animal tumors with the treatment of drugs. OCT imaging was able to observe the correlation between *in vitro* cell and *in vivo* animal levels for the repurposing of FDA-approved drugs on anti-cancer studies.

Acknowledgement

This work was supported by grants from the University of Oklahoma Health Sciences Center (3P30CA225520), Faculty Investment Program from University of Oklahoma, Institutional Research Grant number IRG-19-142-01 from the American Cancer Society, National Science Foundation (OIA-2132161, 2238648), National Institute of Health (R01DK133717), Oklahoma Shared Clinical and Translational Resources (NIGMS U54GM104938), Oklahoma Center for the Advancement of Science and Technology (HR23-071), and the medical imaging COBRE (P20 GM135009). Histology service provided by the Tissue Pathology Shared Resource was supported in part by the National Institute of General Medical Sciences COBRE Grant P20GM103639 and National Cancer Institute Grant P30CA225520 of the National Institutes of Health. Thank you to my mentor, lab members, and Honors College for this opportunity.

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Quantitative Analysis of PLGA Nanoparticles Produced by Microfluidic Synthesis

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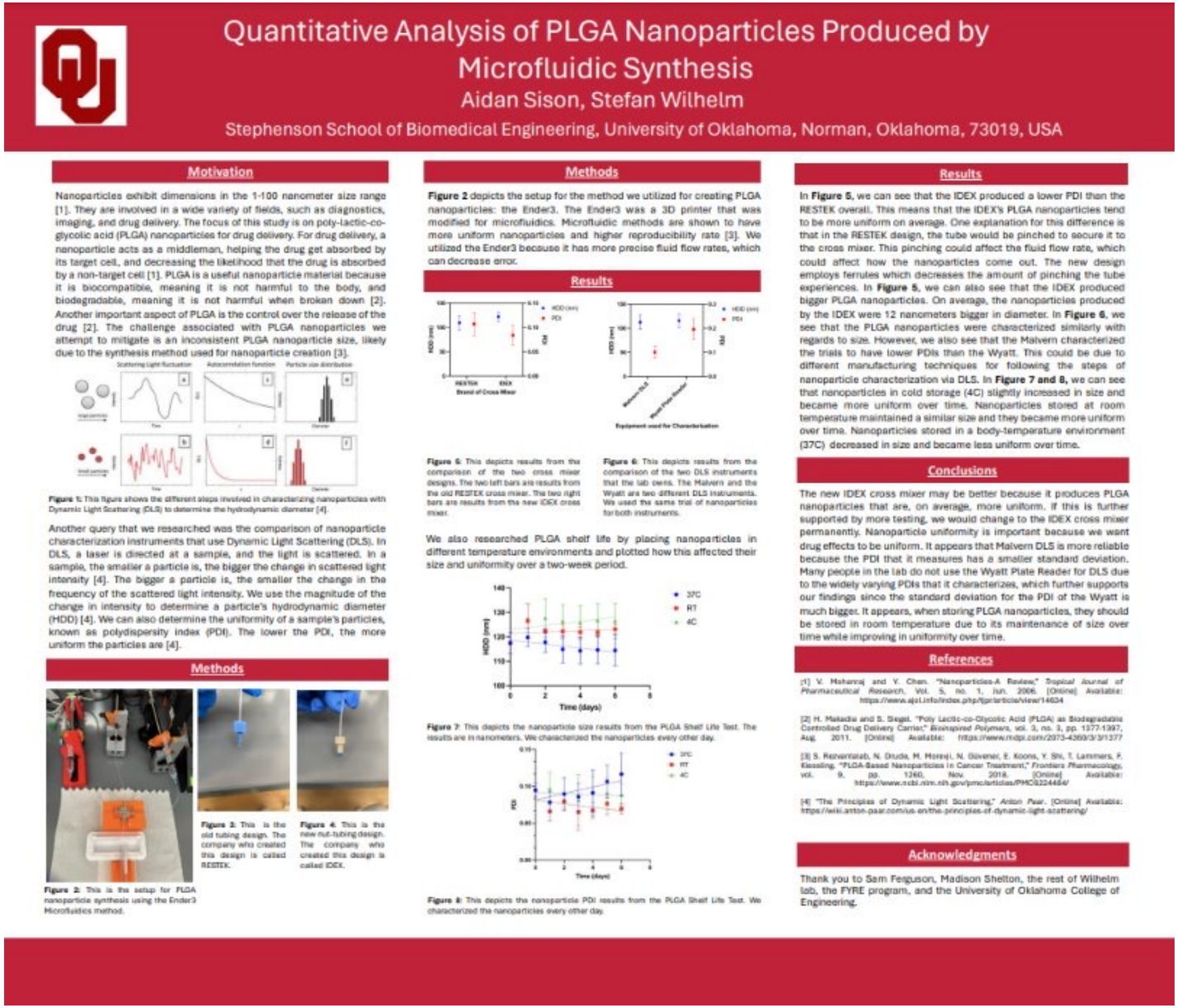

Quantitative Analysis of PLGA Nanoparticles Produced by Microfluidic Synthesis

Aidan Sison, Stefan Wilhelm

Stephenson School of Biomedical Engineering, University of Oklahoma, Norman, Oklahoma, 73019, USA

Motivation

Nanoparticles exhibit dimensions in the 1-100 nanometer size range [1]. They are involved in a wide variety of fields, such as diagnostics, imaging, and drug delivery. The focus of this study is on poly-lactic-co-glycolic acid (PLGA) nanoparticles for drug delivery. For drug delivery, a nanoparticle acts as a middleman, helping the drug get absorbed by its target cell, and decreasing the likelihood that the drug is absorbed by a non-target cell [1]. PLGA is a useful nanoparticle material because it is biocompatible, meaning it is not harmful to the body, and biodegradable, meaning it is not harmful when broken down [2]. Another important aspect of PLGA is the control over the release of the drug [2]. The challenge associated with PLGA nanoparticles we attempt to mitigate is an inconsistent PLGA nanoparticle size, likely due to the synthesis method used for nanoparticle creation [3].

Figure 1: This figure shows the different steps involved in characterizing nanoparticles with Dynamic Light Scattering (DLS) to determine the hydrodynamic diameter [4].

Another query that we researched was the comparison of nanoparticle characterization instruments that use Dynamic Light Scattering (DLS). In DLS, a laser is directed at a sample, and the light is scattered. In a sample, the smaller a particle is, the bigger the change in scattered light intensity [4]. The bigger a particle is, the smaller the change in the frequency of the scattered light intensity. We use the magnitude of the change in intensity to determine a particle's hydrodynamic diameter (HDD) [4]. We can also determine the uniformity of a sample's particles, known as polydispersity index (PDI). The lower the PDI, the more uniform the particles are [4].

Methods

Figure 2: This is the setup for PLGA nanoparticle synthesis using the Ender3 Microfluidics method.

Figure 3: This is the old tubing design. The company who created this design is called RESTEK.

Figure 4: This is the new nut-tubing design. The company who created this design is called IDEX.

Methods

Figure 2 depicts the setup for the method we utilized for creating PLGA nanoparticles: the Ender3. The Ender3 was a 3D printer that was modified for microfluidics. Microfluidic methods are shown to have more uniform nanoparticles and higher reproducibility rate [3]. We utilized the Ender3 because it has more precise fluid flow rates, which can decrease error.

Results

Figure 5: This depicts results from the comparison of the two cross mixer designs. The two left bars are results from the old RESTEK cross mixer. The two right bars are results from the new IDEX cross mixer.

Figure 6: This depicts results from the comparison of the two DLS instruments that the lab owns. The Malvern and the Wyatt are two different DLS instruments. We used the same trial of nanoparticles for both instruments.

We also researched PLGA shelf life by placing nanoparticles in different temperature environments and plotted how this affected their size and uniformity over a two-week period.

Figure 7: This depicts the nanoparticle size results from the PLGA Shelf Life Test. The results are in nanometers. We characterized the nanoparticles every other day.

Figure 8: This depicts the nanoparticle PDI results from the PLGA Shelf Life Test. We characterized the nanoparticles every other day.

Results

In **Figure 5**, we can see that the IDEX produced a lower PDI than the RESTEK overall. This means that the IDEX's PLGA nanoparticles tend to be more uniform on average. One explanation for this difference is that in the RESTEK design, the tube would be pinched to secure it to the cross mixer. This pinching could affect the fluid flow rate, which could affect how the nanoparticles come out. The new design employs ferrules which decreases the amount of pinching the tube experiences. In **Figure 5**, we can also see that the IDEX produced bigger PLGA nanoparticles. On average, the nanoparticles produced by the IDEX were 12 nanometers bigger in diameter. In **Figure 6**, we see that the PLGA nanoparticles were characterized similarly with regards to size. However, we also see that the Malvern characterized the trials to have lower PDIs than the Wyatt. This could be due to different manufacturing techniques for following the steps of nanoparticle characterization via DLS. In **Figure 7 and 8,** we can see that nanoparticles in cold storage (4C) slightly increased in size and became more uniform over time. Nanoparticles stored at room temperature maintained a similar size and they became more uniform over time. Nanoparticles stored in a body-temperature environment (37C) decreased in size and became less uniform over time.

Conclusions

The new IDEX cross mixer may be better because it produces PLGA nanoparticles that are, on average, more uniform. If this is further supported by more testing, we would change to the IDEX cross mixer permanently. Nanoparticle uniformity is important because we want drug effects to be uniform. It appears that Malvern DLS is more reliable because the PDI that it measures has a smaller standard deviation. Many people in the lab do not use the Wyatt Plate Reader for DLS due to the widely varying PDIs that it characterizes, which further supports our findings since the standard deviation for the PDI of the Wyatt is much bigger. It appears, when storing PLGA nanoparticles, they should be stored in room temperature due to its maintenance of size over time while improving in uniformity over time.

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Acknowledgments

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Manipulating Fluidic Mixing Techniques to Optimize Liposome Synthesis

Jay Agarwal, Hamilton Young, Dr. Stefan Wilhelm

Manipulating Fluidic Mixing Techniques to Optimize Liposome Synthesis

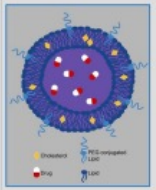
Jay Agarwal, Hamilton Young, Dr. Stefan Wilhelm

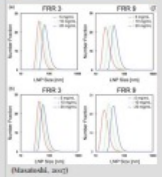
Background and Motivation

Liposomes have applications in Drug Delivery, Immunology, and Cancer Treatments. **Microfluidic Synthesis** is a method of Liposome synthesis that relies on the controlled flow rates of a ethanol lipid solution and a polar liquid (PBS). The ratio of polarizing/ethanol flow rates is commonly known as the **FRR**. Studies show that **concentration and FRR play a role in particle size and precision (Masatoshi, 2017).**

One of the components of the Lipid Solution **DSPE-PEG** is a lipid-conjugated Polyethylene-glycol. This component prolongs the half-life of the Liposome in the bloodstream and enhances colloidal stability.

Due to the molecular properties of DSPE-PEG, the lipid solution may not dissolve as fast as Cholesterol or DSPE. **The goal is to test whether the Sonication of the DSPE-PEG lipid solution before synthesis improves particle quality?**

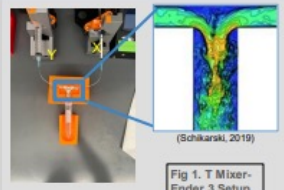




Methods

Particle Synthesis

1. **Solutions**
   a. **Prepare 5 mg/ml Ethanol solution of DSPC, Cholesterol, and DSPE-PEG.**
   b. 1x synthesis 0.6/0.6/1.6mg Chol/PEG/DSPE
2. **Mixing (a - unsonicated, a+b - sonicated)**
   a. Vortex Lipid solutions for 4 min or until solute is no longer visible.
   b. Sonificate DSPE-PEG solution for 10 min on High.
3. **Lipid Solution/PBS**
   a. 300/100/100 µl, DSPC/Chol/PEG (5mg/ml)
4. **Synthesis**
   a. Assemble T-Mixer (Fig 1)
   b. Load the 0.5 ml of lipid solution into X pump.
   c. Load the 3.5ml of PBS into the Y pump.
   d. Start synthesis
      i. G-CODE is calibrated for FRR 7 and output of 15 ml/min
5. If aggregate above 220 nm (particles should be around 80-100 nm) Filter with a .22 Micron Syringe Filter (Fig 2)



(Schikarski, 2019)

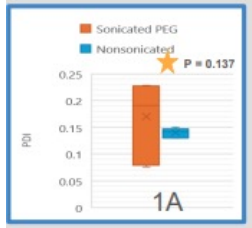
Fig 1. T Mixer-Ender 3 Setup.

Analysis of Particles

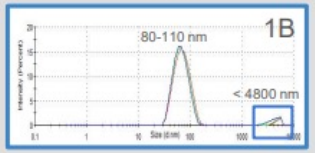
1. **Dynamic Light Scattering.** (Malvern Zetasizer Nano) To get **PDI** and Hydrodynamic **Diameter.**
2. **Wyatt Platt Reader** to get **concentrations** (Dynapro III)

Fig 2. .22 Micron Syringe Filter

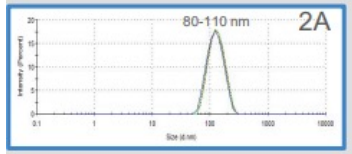
Results

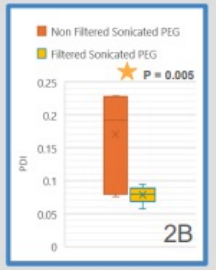


(Fig 1A) Comparison of sonicated vs. nonsonicated DSPE-PEG liposomes. **(Fig 1B)** Presence of aggregate around 5µm (88% of sonicated samples)

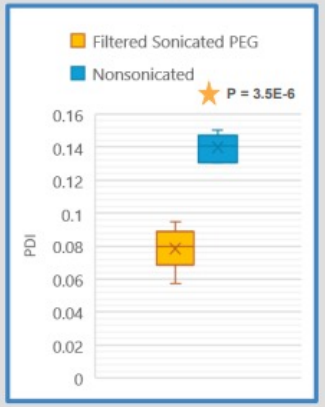


(Fig 2A) shows the DLS readings after the filtration with the .22 micron syringe filter **(Fig 2B)** Comparison of the Sonicted DSPE-PEG Particles before and after filtration.





Final Comparison



Nonsonicated PEG particles are less precise than the sonicated PEG Particles.

Discussion

It is reasonable to assume that sonicating the DSPE-PEG lipid solution produces better particles, **we will from now on incorporate in our protocols the sonification of polymer solutions before Lipid particle synthesis.**

The aggregate present in my Sonicated Solutions, this could be due to multiple factors.

1. During Sonication Bath I used could've been contaminated with the presence of water.
2. Or the DSPE-PEG solution could've been oversaturated.

Using the Wyatt Plate Reader I have measured the concentrations of my lipid solutions. For the futre scale up, to compare the FRR and diffrences that come with the scale up.

Acknowledgments

Stephenson School of Biomedical Engineering (SBME), University of Oklahoma. This work was supported in part by an NSF CAREER award (2048130) and the NIH MIRA R35 (1R35GM150758).

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Three-Dimensional Super-Resolution Microscopy-Based Imaging of Cancer Spheroids

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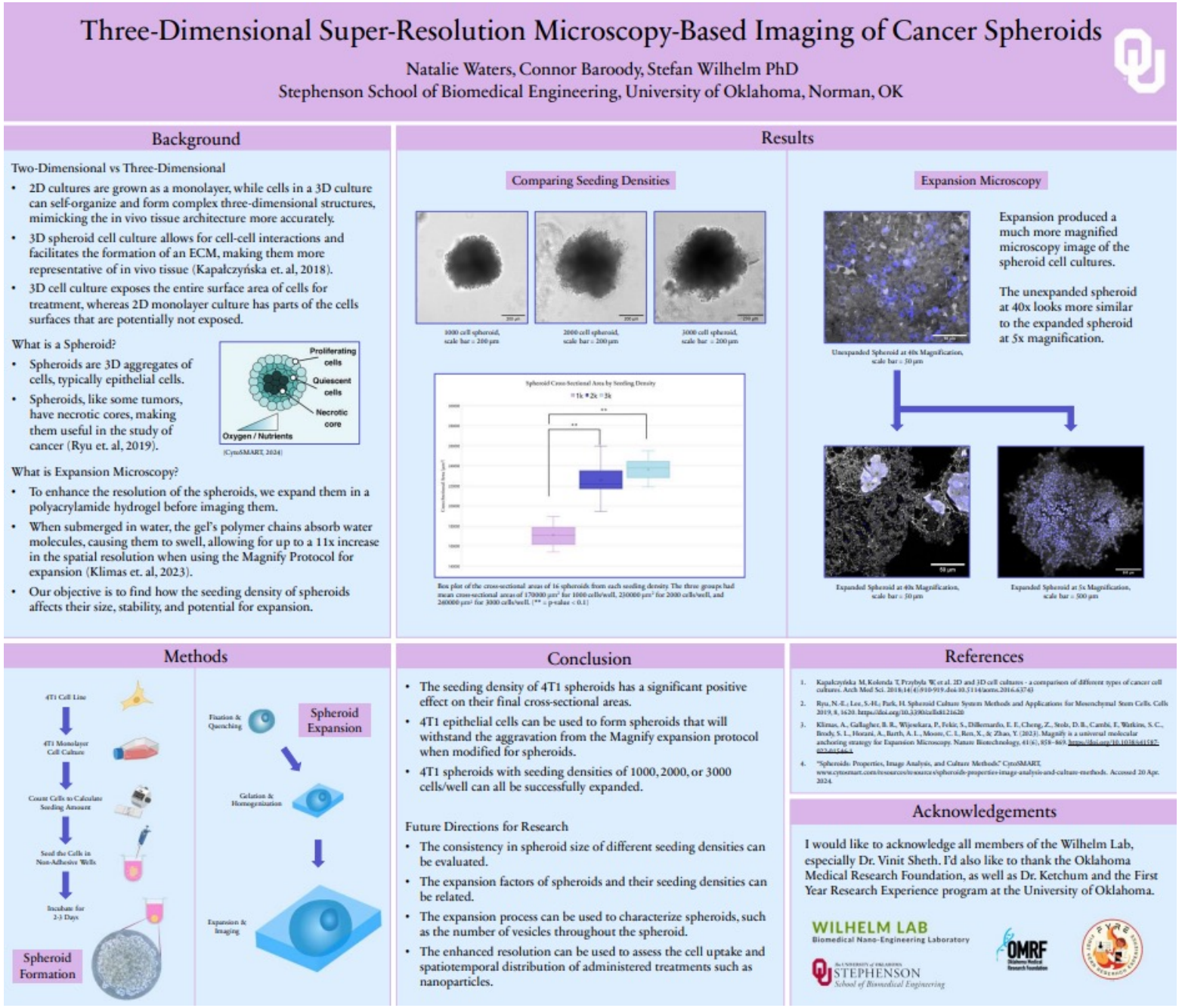

Multimodal Imaging with Transcranial Magnetic Stimulation in the Human Brain

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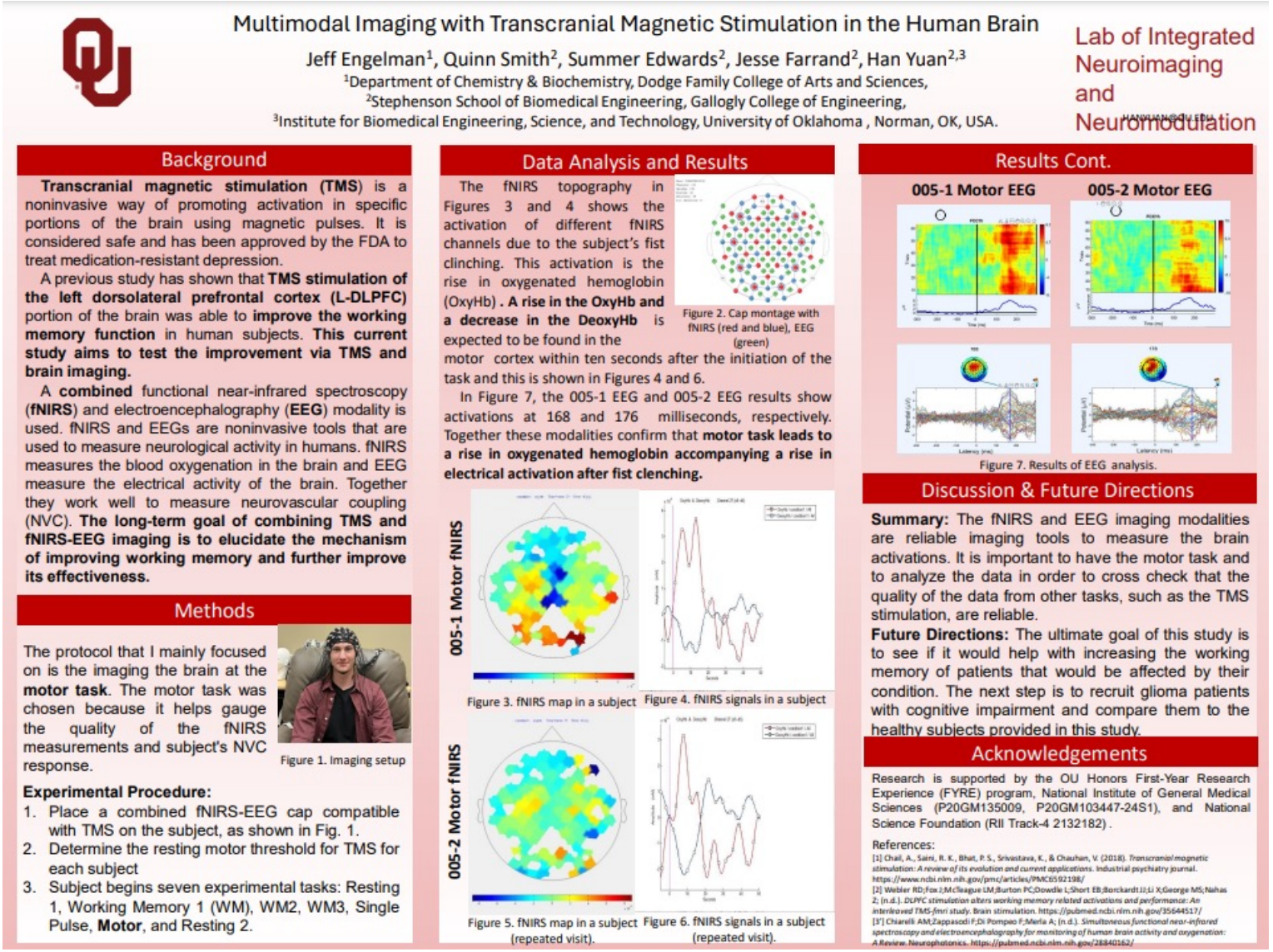

Multimodal Imaging with Transcranial Magnetic Stimulation in the Human Brain

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Lab of Integrated Neuroimaging and Neuromodulation

Background

Transcranial magnetic stimulation (TMS) is a noninvasive way of promoting activation in specific portions of the brain using magnetic pulses. It is considered safe and has been approved by the FDA to treat medication-resistant depression.

A previous study has shown that **TMS stimulation of the left dorsolateral prefrontal cortex (L-DLPFC)** portion of the brain was able to **improve the working memory function** in human subjects. **This current study aims to test the improvement via TMS and brain imaging.**

A **combined** functional near-infrared spectroscopy (**fNIRS**) and electroencephalography (**EEG**) modality is used. fNIRS and EEGs are noninvasive tools that are used to measure neurological activity in humans. fNIRS measures the blood oxygenation in the brain and EEG measure the electrical activity of the brain. Together they work well to measure neurovascular coupling (NVC). **The long-term goal of combining TMS and fNIRS-EEG imaging is to elucidate the mechanism of improving working memory and further improve its effectiveness.**

Methods

The protocol that I mainly focused on is the imaging the brain at the **motor task**. The motor task was chosen because it helps gauge the quality of the fNIRS measurements and subject's NVC response.

Figure 1. Imaging setup

Experimental Procedure:

1. Place a combined fNIRS-EEG cap compatible with TMS on the subject, as shown in Fig. 1.
2. Determine the resting motor threshold for TMS for each subject
3. Subject begins seven experimental tasks: Resting 1, Working Memory 1 (WM), WM2, WM3, Single Pulse, **Motor**, and Resting 2.

Data Analysis and Results

The fNIRS topography in Figures 3 and 4 shows the activation of different fNIRS channels due to the subject's fist clinching. This activation is the rise in oxygenated hemoglobin (OxyHb) **. A rise in the OxyHb and a decrease in the DeoxyHb** is expected to be found in the motor cortex within ten seconds after the initiation of the task and this is shown in Figures 4 and 6.

Figure 2. Cap montage with fNIRS (red and blue), EEG (green)

In Figure 7, the 005-1 EEG and 005-2 EEG results show activations at 168 and 176 milliseconds, respectively. Together these modalities confirm that **motor task leads to a rise in oxygenated hemoglobin accompanying a rise in electrical activation after fist clenching.**

005-1 Motor fNIRS

Figure 3. fNIRS map in a subject

Figure 4. fNIRS signals in a subject

005-2 Motor fNIRS

Figure 5. fNIRS map in a subject (repeated visit).

Figure 6. fNIRS signals in a subject (repeated visit).

Results Cont.

005-1 Motor EEG

005-2 Motor EEG

Figure 7. Results of EEG analysis.

Discussion & Future Directions

Summary: The fNIRS and EEG imaging modalities are reliable imaging tools to measure the brain activations. It is important to have the motor task and to analyze the data in order to cross check that the quality of the data from other tasks, such as the TMS stimulation, are reliable.

Future Directions: The ultimate goal of this study is to see if it would help with increasing the working memory of patients that would be affected by their condition. The next step is to recruit glioma patients with cognitive impairment and compare them to the healthy subjects provided in this study.

Acknowledgements

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Biophotonic Imaging Utilizing Deep Learning Techniques

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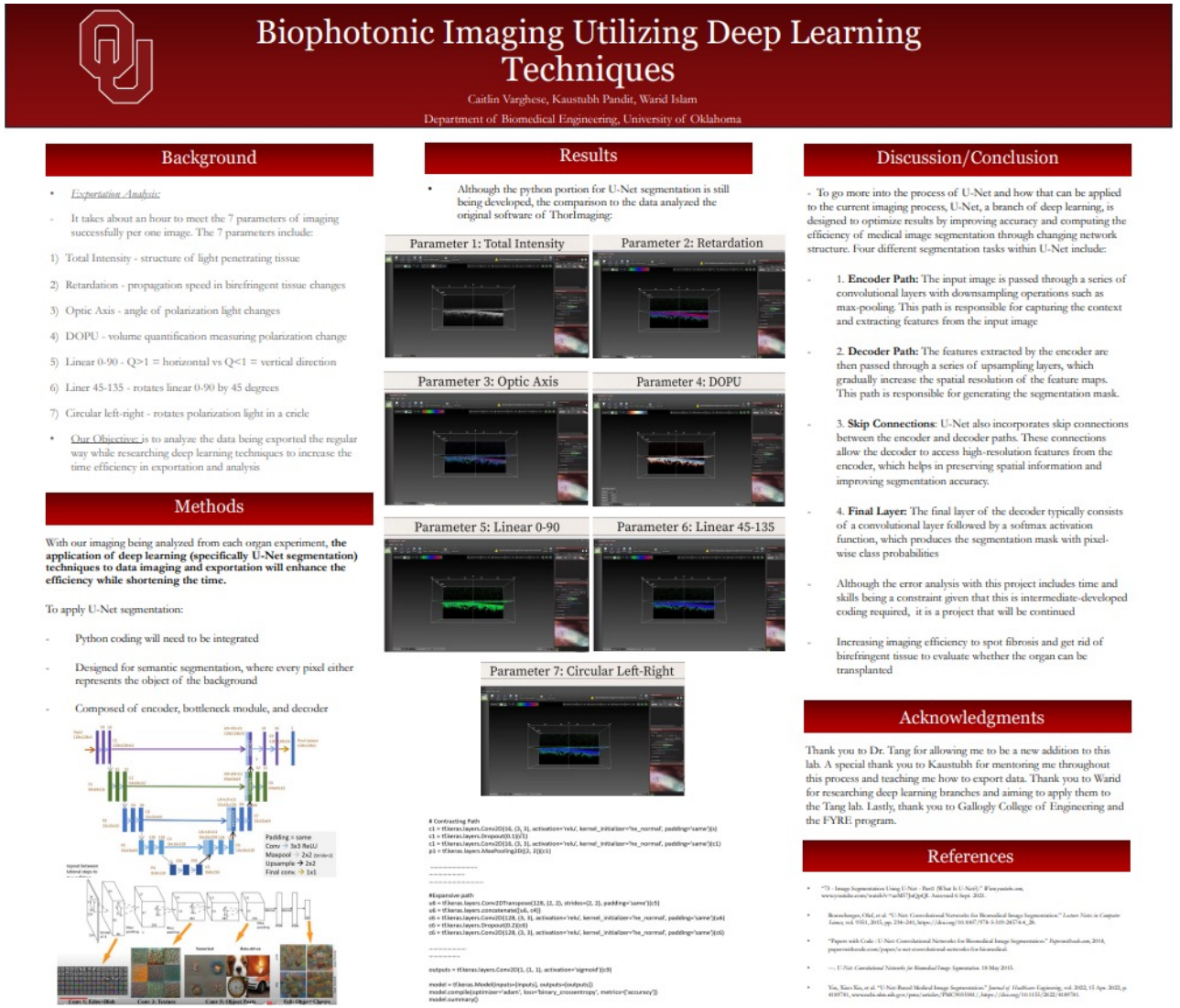

Biophotonic Imaging Utilizing Deep Learning Techniques

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Department of Biomedical Engineering, University of Oklahoma

Background

- *Exportation Analysis:*
  - It takes about an hour to meet the 7 parameters of imaging successfully per one image. The 7 parameters include:

1) Total Intensity - structure of light penetrating tissue
2) Retardation - propagation speed in birefringent tissue changes
3) Optic Axis - angle of polarization light changes
4) DOPU - volume quantification measuring polarization change
5) Linear 0-90 - Q>1 = horizontal vs Q<1 = vertical direction
6) Liner 45-135 - rotates linear 0-90 by 45 degrees
7) Circular left-right - rotates polarization light in a cricle

- Our Objective: is to analyze the data being exported the regular way while researching deep learning techniques to increase the time efficiency in exportation and analysis

Methods

With our imaging being analyzed from each organ experiment, **the application of deep learning (specifically U-Net segmentation) techniques to data imaging and exportation will enhance the efficiency while shortening the time.**

To apply U-Net segmentation:

- Python coding will need to be integrated
- Designed for semantic segmentation, where every pixel either represents the object of the background
- Composed of encoder, bottleneck module, and decoder

Results

- Although the python portion for U-Net segmentation is still being developed, the comparison to the data analyzed the original software of ThorImaging:

Parameter 1: Total Intensity

Parameter 2: Retardation

Parameter 3: Optic Axis

Parameter 4: DOPU

Parameter 5: Linear 0-90

Parameter 6: Linear 45-135

Parameter 7: Circular Left-Right

Discussion/Conclusion

- To go more into the process of U-Net and how that can be applied to the current imaging process, U-Net, a branch of deep learning, is designed to optimize results by improving accuracy and computing the efficiency of medical image segmentation through changing network structure. Four different segmentation tasks within U-Net include:
  - 1. **Encoder Path:** The input image is passed through a series of convolutional layers with downsampling operations such as max-pooling. This path is responsible for capturing the context and extracting features from the input image
  - 2. **Decoder Path:** The features extracted by the encoder are then passed through a series of upsampling layers, which gradually increase the spatial resolution of the feature maps. This path is responsible for generating the segmentation mask.
  - 3. **Skip Connections**: U-Net also incorporates skip connections between the encoder and decoder paths. These connections allow the decoder to access high-resolution features from the encoder, which helps in preserving spatial information and improving segmentation accuracy.
  - 4. **Final Layer:** The final layer of the decoder typically consists of a convolutional layer followed by a softmax activation function, which produces the segmentation mask with pixel-wise class probabilities
  - Although the error analysis with this project includes time and skills being a constraint given that this is intermediate-developed coding required, it is a project that will be continued
  - Increasing imaging efficiency to spot fibrosis and get rid of birefringent tissue to evaluate whether the organ can be transplanted

Acknowledgments

Thank you to Dr. Tang for allowing me to be a new addition to this lab. A special thank you to Kaustubh for mentoring me throughout this process and teaching me how to export data. Thank you to Warid for researching deep learning branches and aiming to apply them to the Tang lab. Lastly, thank you to Gallogly College of Engineering and the FYRE program.

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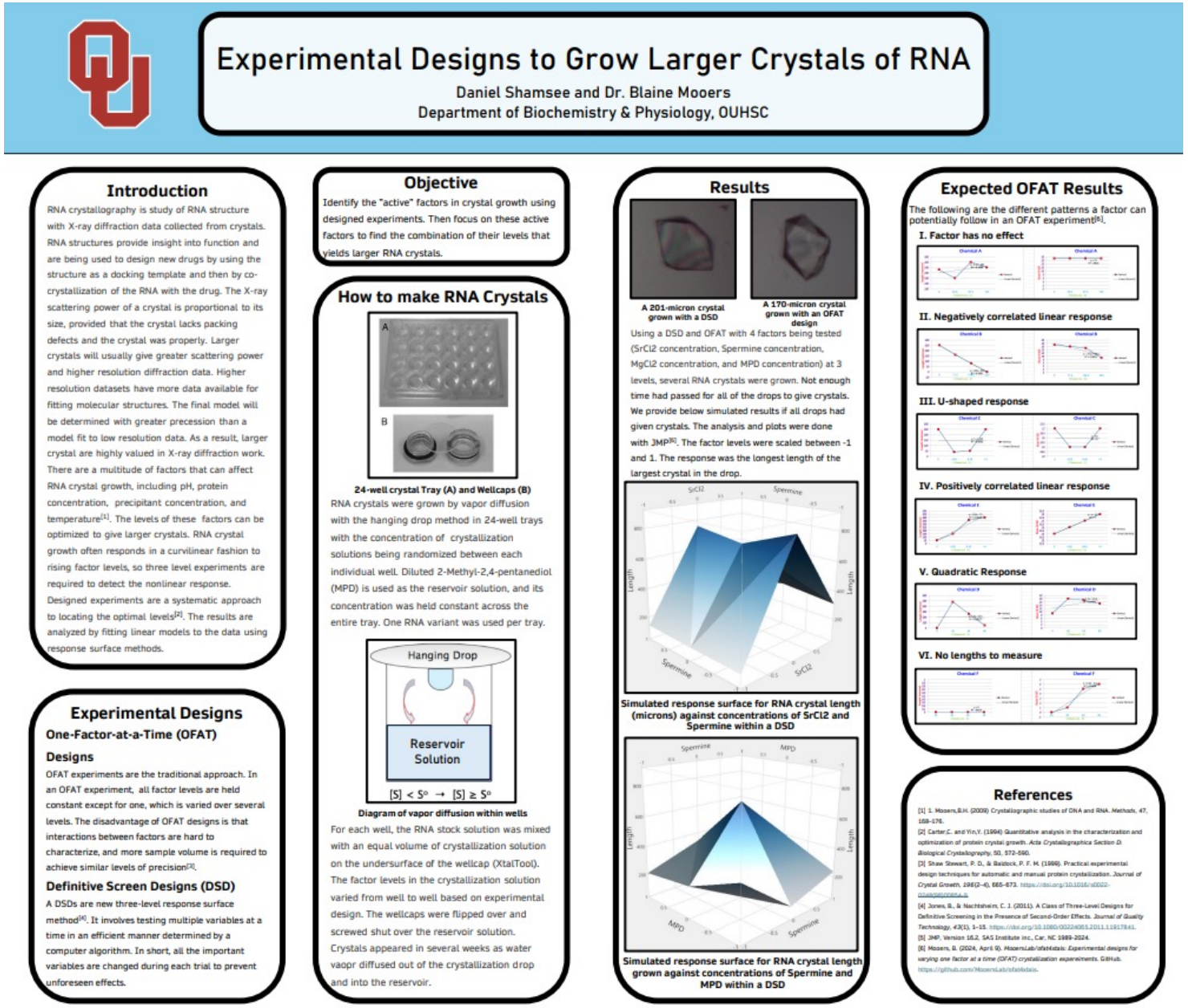
Experimental Designs to Grow Larger Crystals of RNA

Daniel Shamsee and Dr. Blaine Mooers

Department of Biochemistry & Physiology, OUHSC



Experimental Designs to Grow Larger Crystals of RNA

Daniel Shamsee and Dr. Blaine Mooers
Department of Biochemistry & Physiology, OUHSC

Introduction

RNA crystallography is study of RNA structure with X-ray diffraction data collected from crystals. RNA structures provide insight into function and are being used to design new drugs by using the structure as a docking template and then by co-crystallization of the RNA with the drug. The X-ray scattering power of a crystal is proportional to its size, provided that the crystal lacks packing defects and the crystal was properly. Larger crystals will usually give greater scattering power and higher resolution diffraction data. Higher resolution datasets have more data available for fitting molecular structures. The final model will be determined with greater precession than a model fit to low resolution data. As a result, larger crystal are highly valued in X-ray diffraction work. There are a multitude of factors that can affect RNA crystal growth, including pH, protein concentration, precipitant concentration, and temperature[1]. The levels of these factors can be optimized to give larger crystals. RNA crystal growth often responds in a curvilinear fashion to rising factor levels, so three level experiments are required to detect the nonlinear response. Designed experiments are a systematic approach to locating the optimal levels[2]. The results are analyzed by fitting linear models to the data using response surface methods.

Experimental Designs

One-Factor-at-a-Time (OFAT) Designs

OFAT experiments are the traditional approach. In an OFAT experiment, all factor levels are held constant except for one, which is varied over several levels. The disadvantage of OFAT designs is that interactions between factors are hard to characterize, and more sample volume is required to achieve similar levels of precision[2].

Definitive Screen Designs (DSD)

A DSDs are new three-level response surface method[4]. It involves testing multiple variables at a time in an efficient manner determined by a computer algorithm. In short, all the important variables are changed during each trial to prevent unforeseen effects.

Objective

Identify the "active" factors in crystal growth using designed experiments. Then focus on these active factors to find the combination of their levels that yields larger RNA crystals.

How to make RNA Crystals

24-well crystal Tray (A) and Wellcaps (B)

RNA crystals were grown by vapor diffusion with the hanging drop method in 24-well trays with the concentration of crystallization solutions being randomized between each individual well. Diluted 2-Methyl-2,4-pentanediol (MPD) is used as the reservoir solution, and its concentration was held constant across the entire tray. One RNA variant was used per tray.

Diagram of vapor diffusion within wells

For each well, the RNA stock solution was mixed with an equal volume of crystallization solution on the undersurface of the wellcap (XtalTool). The factor levels in the crystallization solution varied from well to well based on experimental design. The wellcaps were flipped over and screwed shut over the reservoir solution. Crystals appeared in several weeks as water vaopr diffused out of the crystallization drop and into the reservoir.

Results

A 201-micron crystal grown with a DSD

A 170-micron crystal grown with an OFAT design

Using a DSD and OFAT with 4 factors being tested (SrCl2 concentration, Spermine concentration, MgCl2 concentration, and MPD concentration) at 3 levels, several RNA crystals were grown. Not enough time had passed for all of the drops to give crystals. We provide below simulated results if all drops had given crystals. The analysis and plots were done with JMP[6]. The factor levels were scaled between -1 and 1. The response was the longest length of the largest crystal in the drop.

Simulated response surface for RNA crystal length (microns) against concentrations of SrCl2 and Spermine within a DSD

Simulated response surface for RNA crystal length grown against concentrations of Spermine and MPD within a DSD

Expected OFAT Results

The following are the different patterns a factor can potentially follow in an OFAT experiment[5].

I. Factor has no effect

II. Negatively correlated linear response

III. U-shaped response

IV. Positively correlated linear response

V. Quadratic Response

VI. No lengths to measure

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Interfacial Behavior of Aqueous PFAS Solutions During Droplet Pinch-Off

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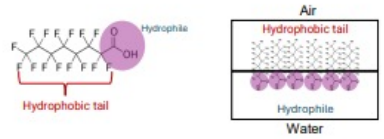
School of Sustainable Chemical, Biological and Materials Engineering, The University of Oklahoma

Interfacial Behavior of Aqueous PFAS Solutions During Droplet Pinch-Off

Ethan Klein, Daniel Park, Babak Valipourgoodarzi, Reza Foudazi
School of Sustainable Chemical, Biological and Materials Engineering, The University of Oklahoma

Introduction

- Poly and perfluoroalkyl substances (PFAS), also known as forever chemicals, are a class of chemicals that comes from plastics and synthetics that is harmful to the environment and humans. It is linked to cancer, diabetes, poorer immune systems, etc. (2)
- Promising filtration is remediation through foaming away PFAS
- We are researching the viscoelastic properties of samples to help better understand how "foaming" can help filter and get rid of PFAS from various water sources.

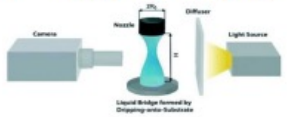


Objectives

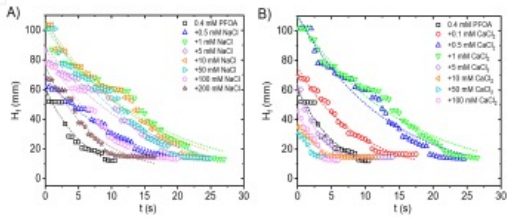
- Check for correlation of foaming stability through analyzing various samples of PFAS
- Find other ways to observe and extract more information on the properties of PFAS

Methods

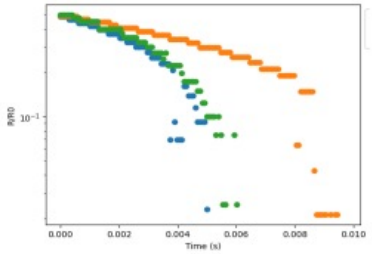
Dripping onto Substrate (DoS)



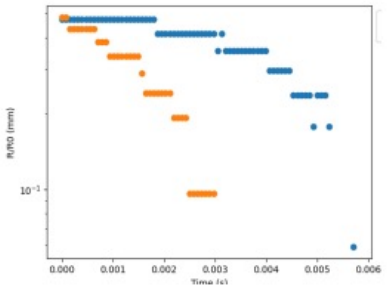
(1)



Results



- 4000 PPM PFOA (L/D= 1.64)
- 4000 PPM PFOA + 0.1M NaCl (L/D= 1.088)
- 4000 PPM PFOA + 0.01M NaCl (L/D= 1.531)



- 150ppm PFOA_DoS1 (L/D= 1.442)
- 150ppm PFOA_DoF2 (L/D= 1.789)

Conclusion

- Experiments show a relationship between the concentration of sodium chloride salt and the neck stability of a droplet containing 4000 ppm of PFOA. We see that a concentration of 0.1M increases the neck-stability of the droplet by increasing its necking time by almost 2-times.
- Experiments also show that adding lower concentrations of NaCl is irrelevant , matching closely with the 4000 ppm PFOA sample.
- DoF method is promising; however, is not ready for broad testing yet (consistent testing and recording methods are still being evaluated).
- When tested with DoF, the 150 ppm PFOA necking time appears similar to the 4000 ppm PFOA necking time, tested with DoS. This may show that DoF is a more accurate method of measuring necking properties compared to DoS.

Moving Forward

- One of our biggest goals is to refine the DoF method to gather more accurate and replicable data. DoF could replicate the conditions of PFOA removal methods, providing a tangible link between the two studies.
- Continue to test DoS method while refining the DoF method. DoS is the more published and established method, making it more reliable.
- Obtain results about removal of PFOA from samples and cross reference it with our own to find a possible correlation.

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- Mewbourne College of Earth and Energy

Developing an Escape Room Technique in the Chemical Engineering Curriculum

Frank Abbeduto, Professor Jie Gao

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The UNIVERSITY of OKLAHOMA

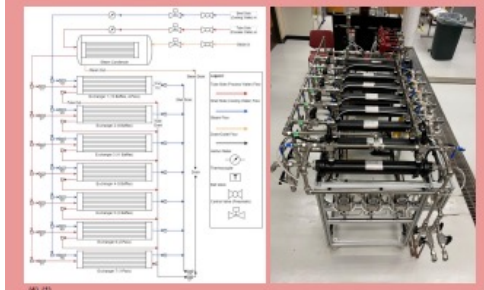
Developing an Escape Room Technique in the Chemical Engineering Curriculum

Frank Abbeduto, Prof. Jie Gao

Background

In the classroom, rote memorization and lectures often exhaust students. This includes topics like lab safety precautions, which are essential, if not abstract and tedious to study. A way of teaching the students this material while keeping them engaged would be beneficial to the classroom.

In the CH E-3432 class, students will learn how to operate several different pieces of equipment in their laboratory classes. Students only learn how to operate the equipment from textbooks and lectures before they record data from them, so an intermediary step between these two could better the learning experience.



The Heat Exchanger is a series of black metal pipes, containing inner tubes surrounded by an outer shell. The tubes run water through, while being heated by the water in the shell around them. The drop of the water pressure between the beginning of the pipe and the release is measured. The shells contain varying amounts of baffles, increasing the amount of time the two fluids are in contact with each other.

Introduction

Escape Room Teaching Method

The intention of an escape room activity is to captivate the student's imagination, causing them to think independently about a subject. By making the students solve puzzles about the material, they will be forced to analyze it in a new way, strengthening their knowledge and their self-efficacy (3).

The Classroom

This research will be focusing on the instructions for machinery necessary for the CH E-3432. The Laboratory setting is specifically the Huntington Laboratory in the Sarkeys Energy Center.

The Machinery

The two machines that were analyzed in this study were the Heat Exchanger and the Tray Hydraulics. While both machines were studied, the focus will be mostly placed on the Heat Exchanger, as it was the only machine to have a puzzle designed from it (2).

Methods

The puzzle will need to be cheap, as it should be replicable in other classrooms.

A rough draft of the puzzles were produced for testing. These drafts were solely paper questions, designed to replicate the function of combination lock that use numbers or letters. This means that every puzzle should result in a final answer of a string of letters or numbers, replicating turning the dials of a combination lock.

Puzzle Design

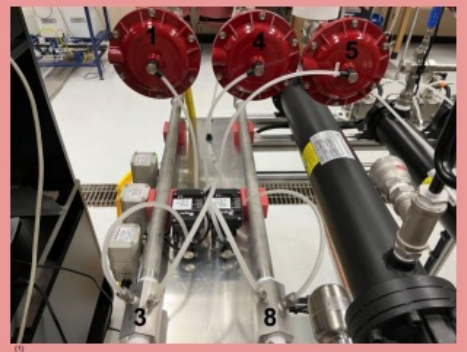
Three puzzles were made in the model tested on the day of testing. The first was a matching puzzle, connecting descriptions and images of various locations in the room and on the machine. The descriptions were in rhyming clues in the form of the question–

"Build up too much steam and your end is nigh, How can you check if the pressure is too high?"

The answer to this question was a picture of the pressure gauge.

The second of these puzzles involved marking the machine with tape, labelling the numbers. The paper guide to the puzzles also contained a picture of the heat exchanger, labelled with the numbers in the same positions of the machine.

The third of these puzzles involved selecting true-or-false statements about the machine's function. Every statement had a letter next to it, and the students were instructed to cross of the letters next to the incorrect sentences. The leftover letters from the correct facts would spell out the correct password, BAFFLE.



An image used in the second puzzle, students were to identify parts of the machine from their function. On the actual machine, labeled tape was also placed on these parts.

Results

Three groups of three to four students took the test and later reported the experience to a student volunteer of the experiment. They agreed that the puzzles were fun, and made them think about the heat exchanger in a new way. The challenge of the material was, if anything, too easy, each completing the tests in under 25 minutes total.

Discussion

The students that ended up taking the mock puzzles

The puzzles were, at times, ambiguous. The second puzzle had some numbers that were hard to read. This was a flaw noticed in development, and in any possible future versions of the design,

Only a three trial runs of a model of these puzzles was performed. This was due to the student researchers having to learn the material before making the puzzles based around it. By the time of the final lab of this class, there was only any time to make puzzles of one of the two machines. The tray hydraulics machine was studied, but no puzzles would end up being produced from it. If this research was extended into the next fall semester, both pieces of equipment could be tested, as well as more finalized products of the puzzles.

In the future, the following steps could be made to improve the puzzles already produced:

- Include physical combination locks in the next version
- Label the numbers in the second puzzle more clearly
- Scramble the letters in the third puzzle

Conclusion

The trial runs showed that the escape room method can work in this laboratory setting. It can turn safety and lab procedures into a fun experience for the student, and in turn, the student is more active and aware of their learning.

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Effect of Temperature on Contact Angle of Liquids on Particulates

Jonah Buyten, Brian. P. Grady Ph.D.

School of Sustainable Chemical Biological and Materials Engineering Panel

Effect of Temperature on Contact Angle of Liquids on Particulates

FYRE 2024

Jonah Buyten, Brian. P. Grady Ph.D.
School of Sustainable Chemical Biological and Materials Engineering
Panel Presentation for the 2024 FYRE Research Symposium

Goal and Hypothesis

The goal of my project is to standardize the secant slopes of different types of powdered silicas at varying temperatures. This is for a point of comparison against the heat of immersion experiments that will be conducted with a Setaram calorimeter later in the project process. This is to verify the values from a previous publication from the Grady group comparing the wettability of different particles.

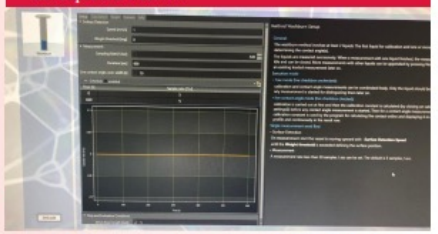
DCAT Tensiometer (Left) and Washburn Method Measurement Tool (Right)

Background Information

- Heat of Immersion was proven to be an appropriate method of measurement for wettability in a previous publication [1].
- The Washburn Method is most often used to measure the contact angle of liquids on particles.
- Cross comparison of the contact angle slopes to the wettability values measured using the heat of immersion at high temperatures (75° C) is the goal of this project [2].

Methods

- First, 20mm of one of three dehydrated silica powders (R300, R380, and R974) is packed into a test tube for measurement in the DCAT Tensiometer.
- Water supply to the DCAT Tensiometer is set to 40ºC, 75ºC, 115 ºC, or 145 ºC for standardization of slopes at each temperature.
- The Tensiometer is set to measure with the Washburn method for a period of 900 seconds.
- Afterwards the data is stored for figure creation, as depicted below:



Measurement and Results

- DCAT Tensiometer liquid well
- A test tube is slightly submerged in liquid for contact angle measurement via the Washburn method
- Standardized slopes for R380 at 40° C: 0.008496
- R974 at 40° C: 0.006995

Applications

This data is being collected for comparison with heat of immersion data that has yet to be collected. This project is still underway but aims to affirm that heat of immersion is the best method for measuring the wettability of particles.
This proving this method is the most appropriate for wettability measurement has many implications for surfactant research and would allow for new cleaning supplies to be developed that would be more effective overall.

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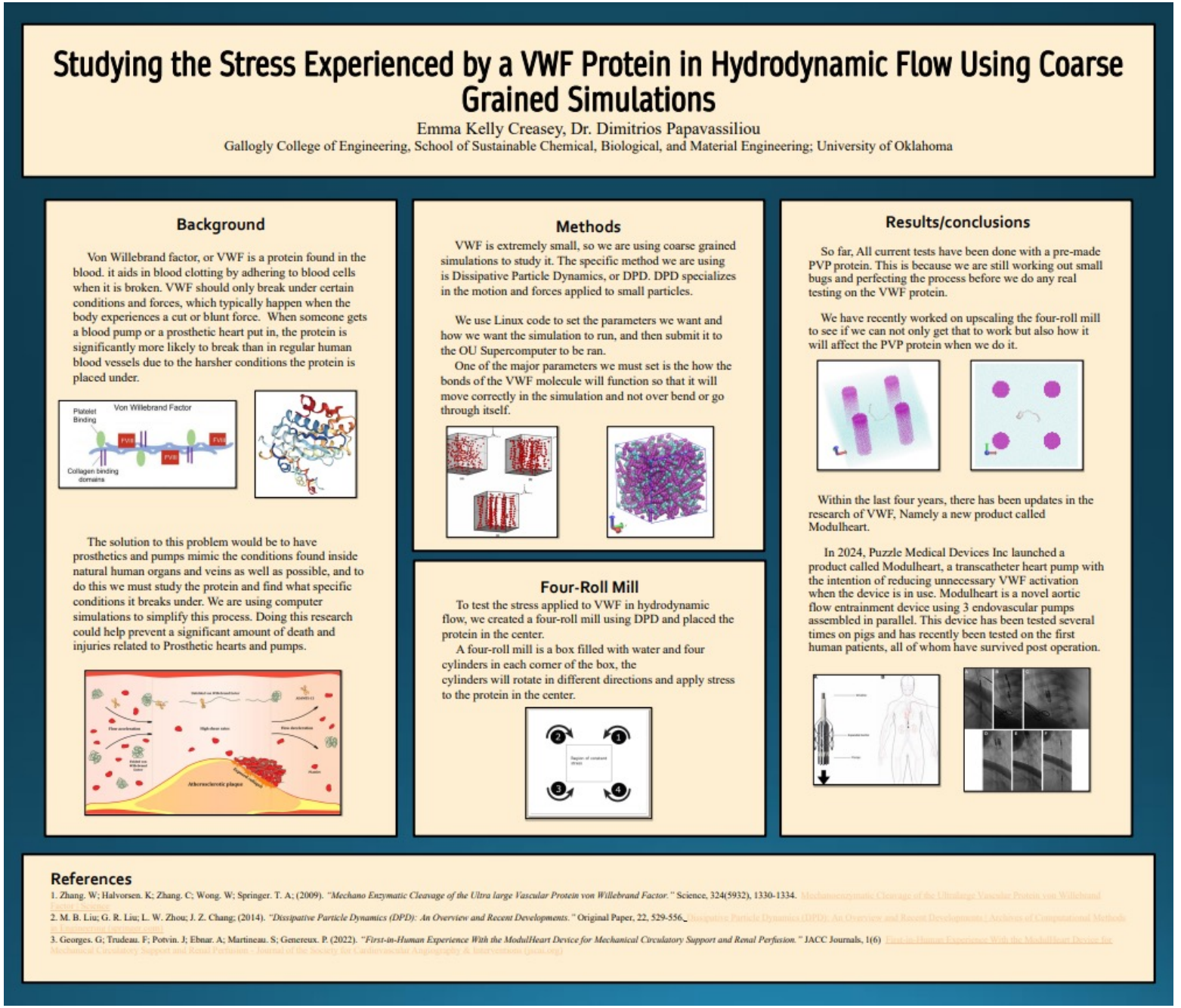
Acknowledgments

I would like to acknowledge the Grady Research Group from the School of Chemical Engineering here at OU, and in particular Dr. Brian P. Grady for all of his guidance and help. It has been an honor to work under him this semester.

Studying the Stress Experienced by a VWF Protein in Hydrodynamic Flow Using Coarse Grained Simulations

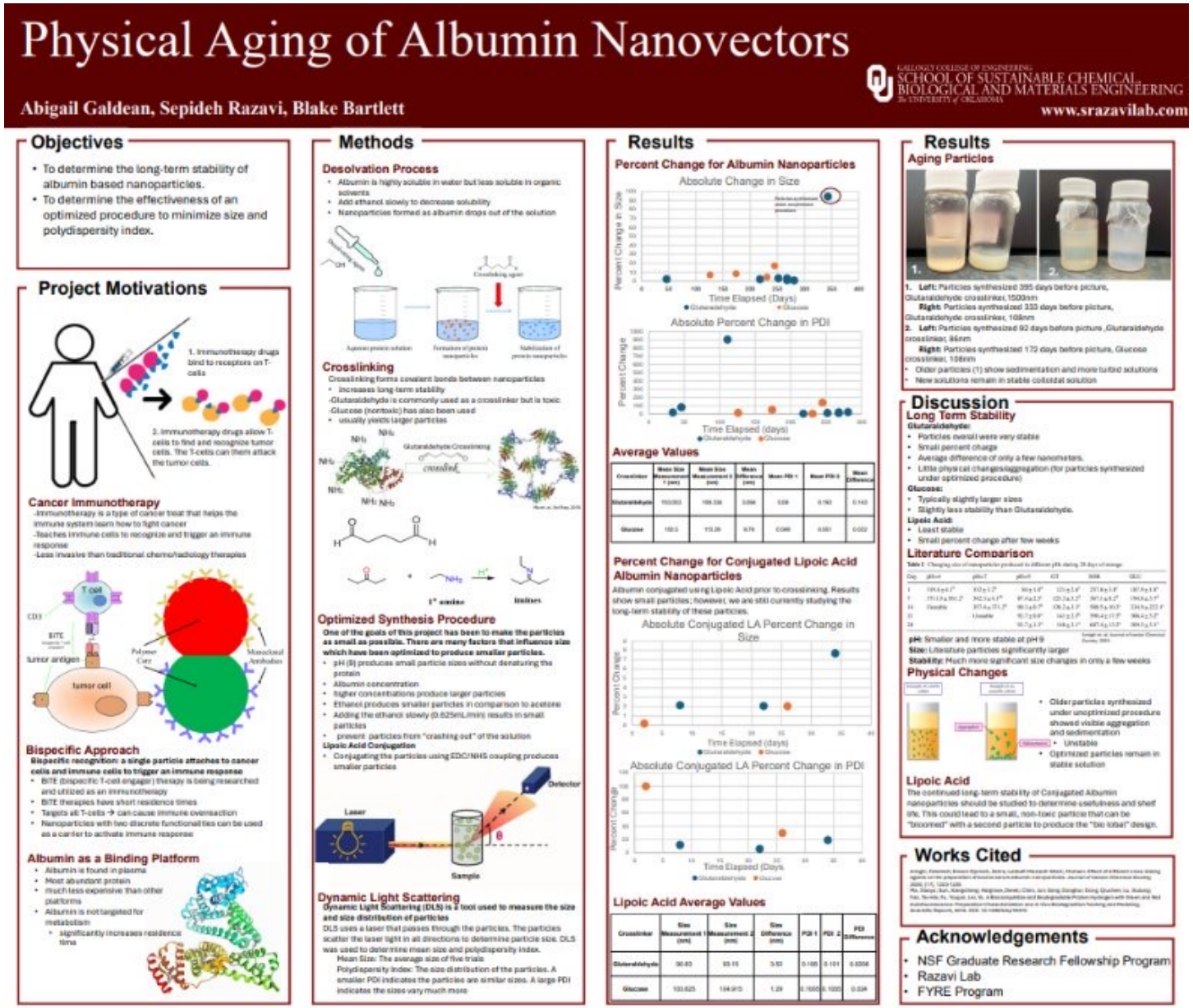
Emma Kelly Creasey, Dr. Dimitrios Papavassiliou

Gallogly College of Engineering, School of Sustainable Chemical, Biological, and Material Engineering; University of Oklahoma



Physical Aging of Albumin Nanovectors

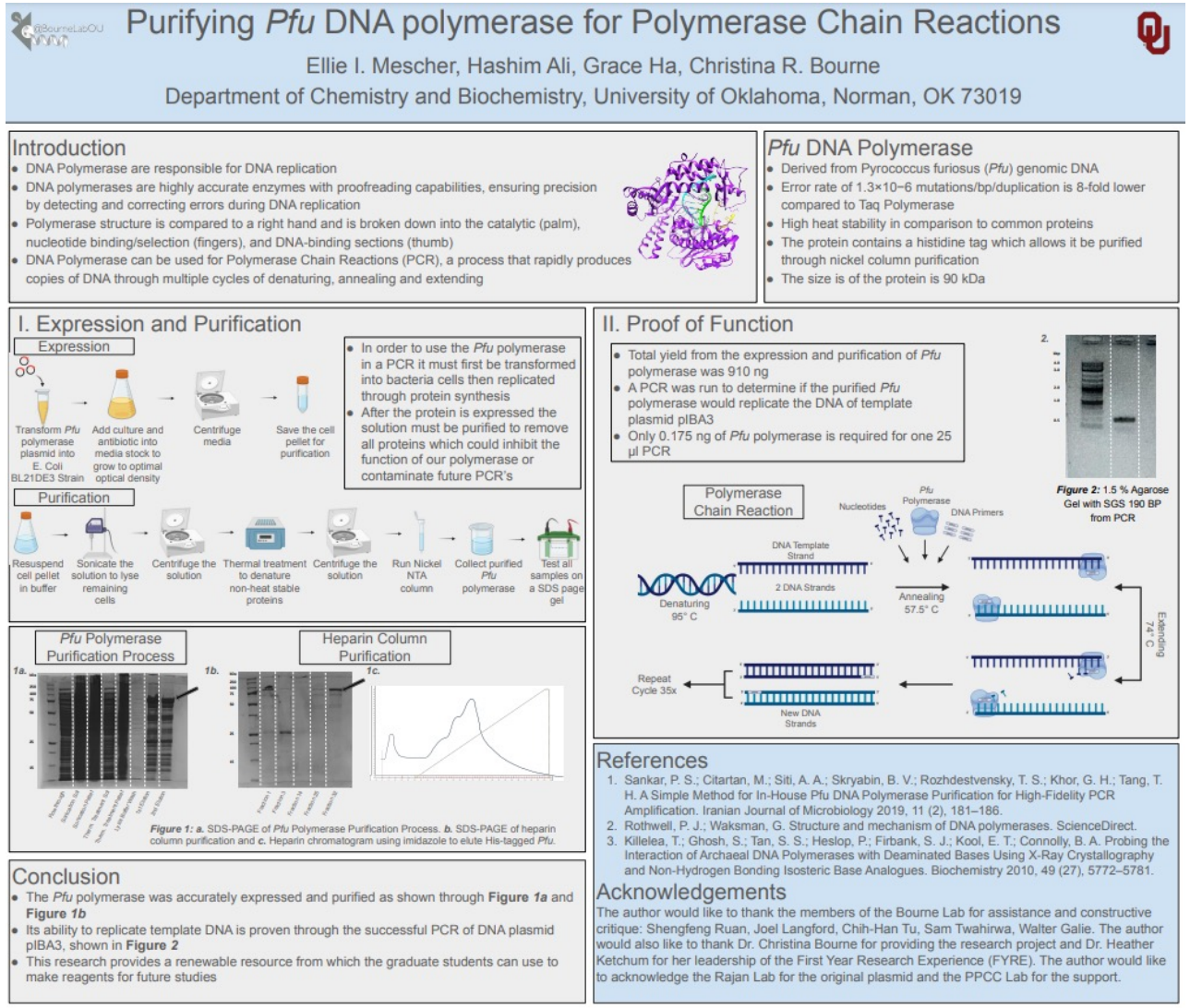
Abigail Galdean, Sepideh Razavi, Blake Bartlett



Purifying Pfu DNA polymerase for Polymerase Chain Reactions

Ellie I. Mescher, Hashim Ali, Grace Ha, Christina R. Bourne

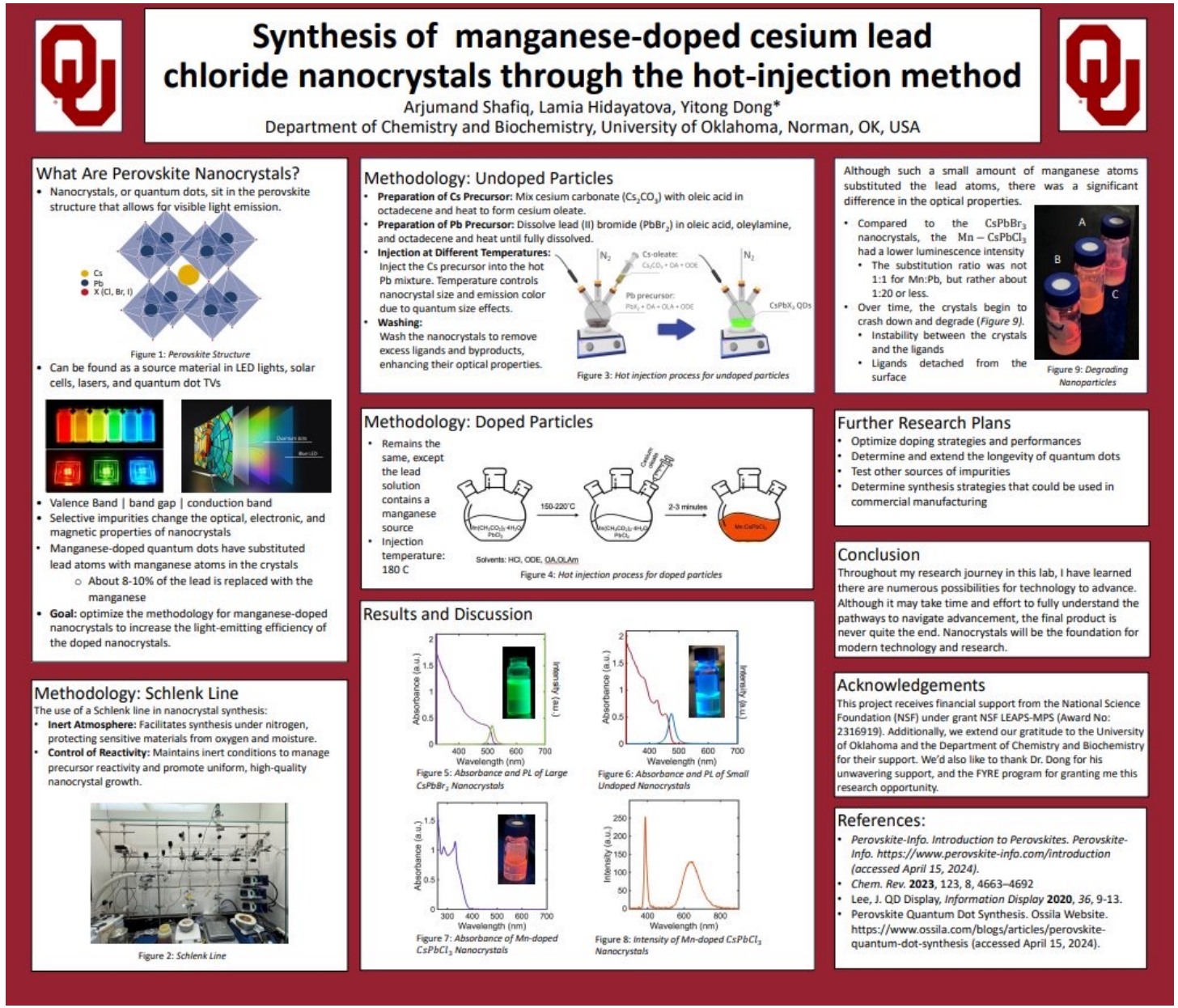
Department of Chemistry and Biochemistry, University of Oklahoma, Norman, OK 73019



Synthesis of manganese-doped cesium lead chloride nanocrystals through the hot-injection method

Arjumand Shafiq, Lamia Hidayatova, Yitong Dong*

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



Synthesis of Formamidinium Lead Halide Perovskite Nanocrystals on a Liquid-Liquid Interface

Jack Wilton, Sohom Chandra, Yitong Dong

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

Synthesis of Formamidinium Lead Halide Perovskite Nanocrystals on a Liquid-Liquid Interface

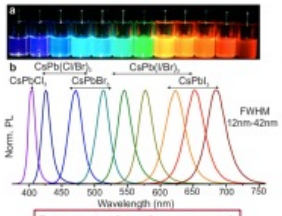
Jack Wilton, Sohom Chandra, Yitong Dong*

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

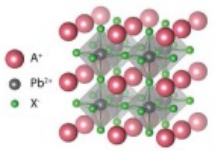
DODGE FAMILY COLLEGE OF ARTS AND SCIENCES
DEPARTMENT OF CHEMISTRY AND BIOCHEMISTRY
The UNIVERSITY of OKLAHOMA

What are Perovskite Nanocrystals

Metal halide-based perovskite nanocrystals, also referred to as quantum dots, are nanometer scale crystals which have a wide variety of potential applications, highlighted by LEDs and solar cells. They can be created with a wide range of inputs and their properties can be adjusted through the environment they are created in. When stimulated, nanocrystals can emit light across the visible wavelengths in intensities generally determined by their size.



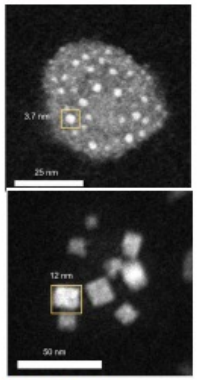
Demonstration of nanocrystal emissions across the visible wavelengths achieved using different precursors



Basic structure of Pb^{2+} based Nanocrystals

Why Liquid-Liquid Interface Generation

- Current nanocrystal growth is largely done in flasks generating large crystals which can be homogeneous, but have formation kinetics that are too rapid for proper testing
- Through this method we can slow crystal growth, reduce crystal sizes, and control growth location



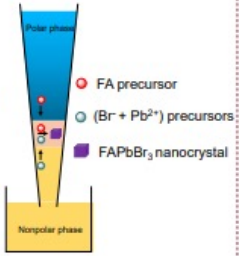
Nanocrystal growth using Liquid-Liquid interface method. $CsPbBr_3$ sample exhibited

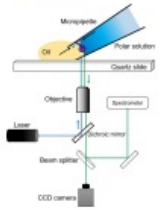
This method has been proven to work with $CsPbX_3$ based dots, and we have applied it organic-inorganic hybrid nanocrystals

L-L synthesis method

- Polar and Nonpolar Prerequisite solutions
- Nonpolar: Lead (II) acetate, Trioctylphosphine oxide, and 1-Octadecene
- Polar: Formamidine acetate, Dimethylformamide, and Zinc Bromide

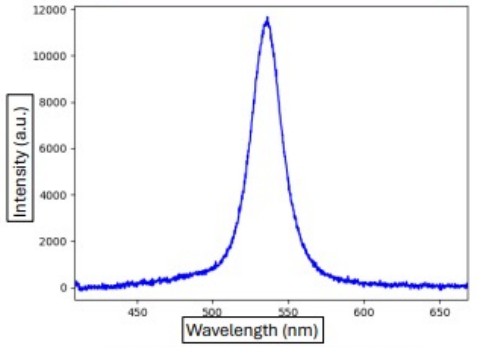
- To achieve QD generation in a desired location and size, an interface created at the tip of a glass microneedle
- Needle is filled with polar solution and dipped into a small sample of nonpolar solution





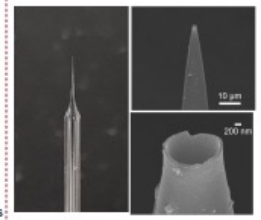
- Measurement of QD Emissions were taken by using a laser setup
- Laser was shone through the needle tip onto the dot, with the dot's emission wavelength and intensity recorded

$FAPbBr_3$ Nanocrystal Emission Data



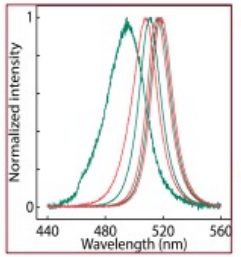
Sample intensity peaks at wavelength of 540 nm

Results



- Laser pulling method was used to generate our microneedles
- Generation of organic-inorganic hybrid nanocrystals was successful
- Resulting NCs were in the green wavelengths

Future aims



- Fine changes to needle tip diameter to measure more closely differences in formation caused by interface size
- Observations of Nanocrystal emission wavelength shifts over time

Acknowledgements

DODGE FAMILY COLLEGE OF ARTS AND SCIENCES
DEPARTMENT OF CHEMISTRY AND BIOCHEMISTRY
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CENTER FOR QUANTUM RESEARCH AND TECHNOLOGY
The UNIVERSITY of OKLAHOMA

SAMUEL ROBERTS NOBLE MICROSCOPY LABORATORY
The UNIVERSITY of OKLAHOMA

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Using Spectroscopy to Understand $CsPbBr_3$ Quantum Dots as Single Photon Emitters

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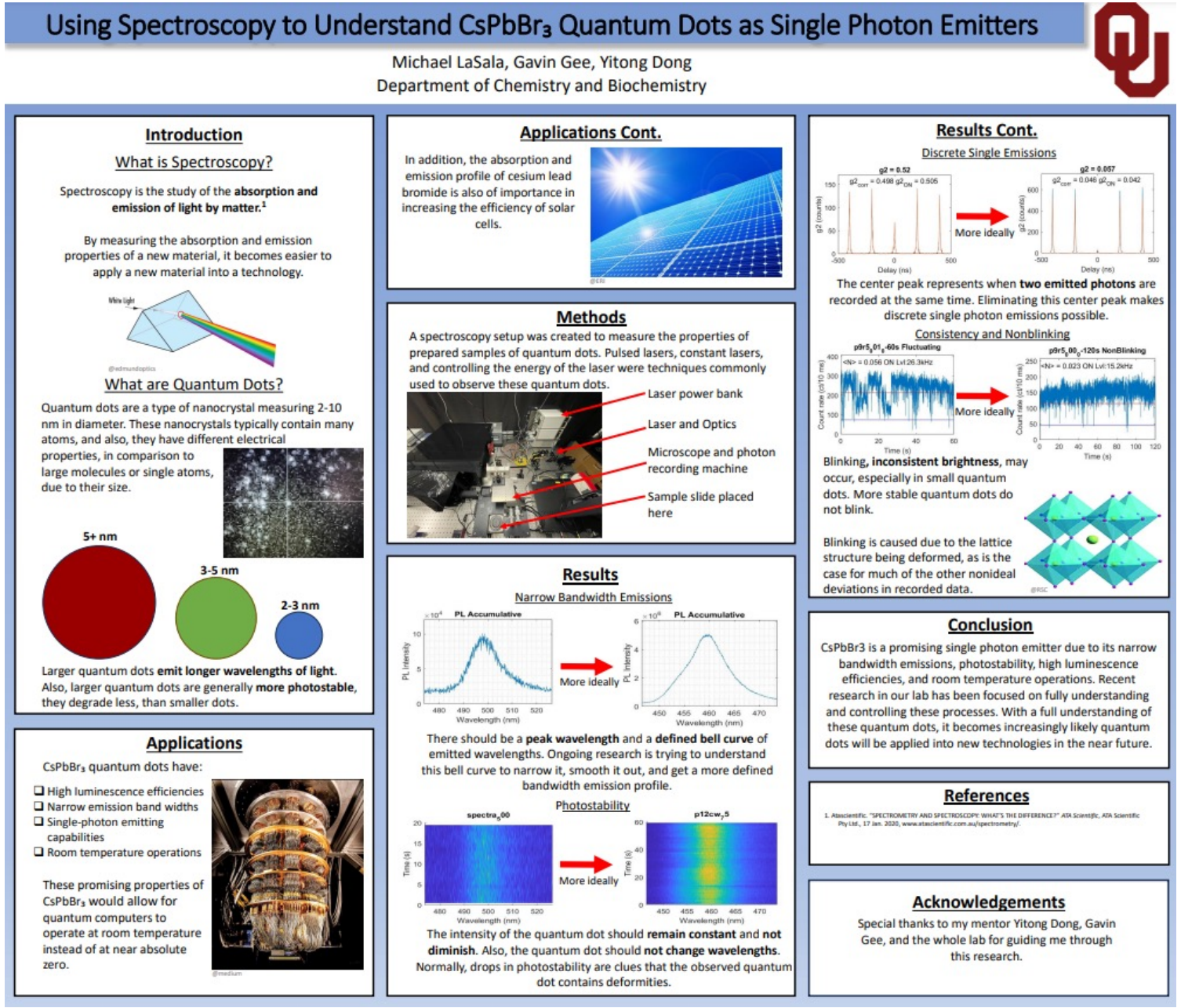
Department of Chemistry and Biochemistry



Synthesis of a 5-membered Cyclophane

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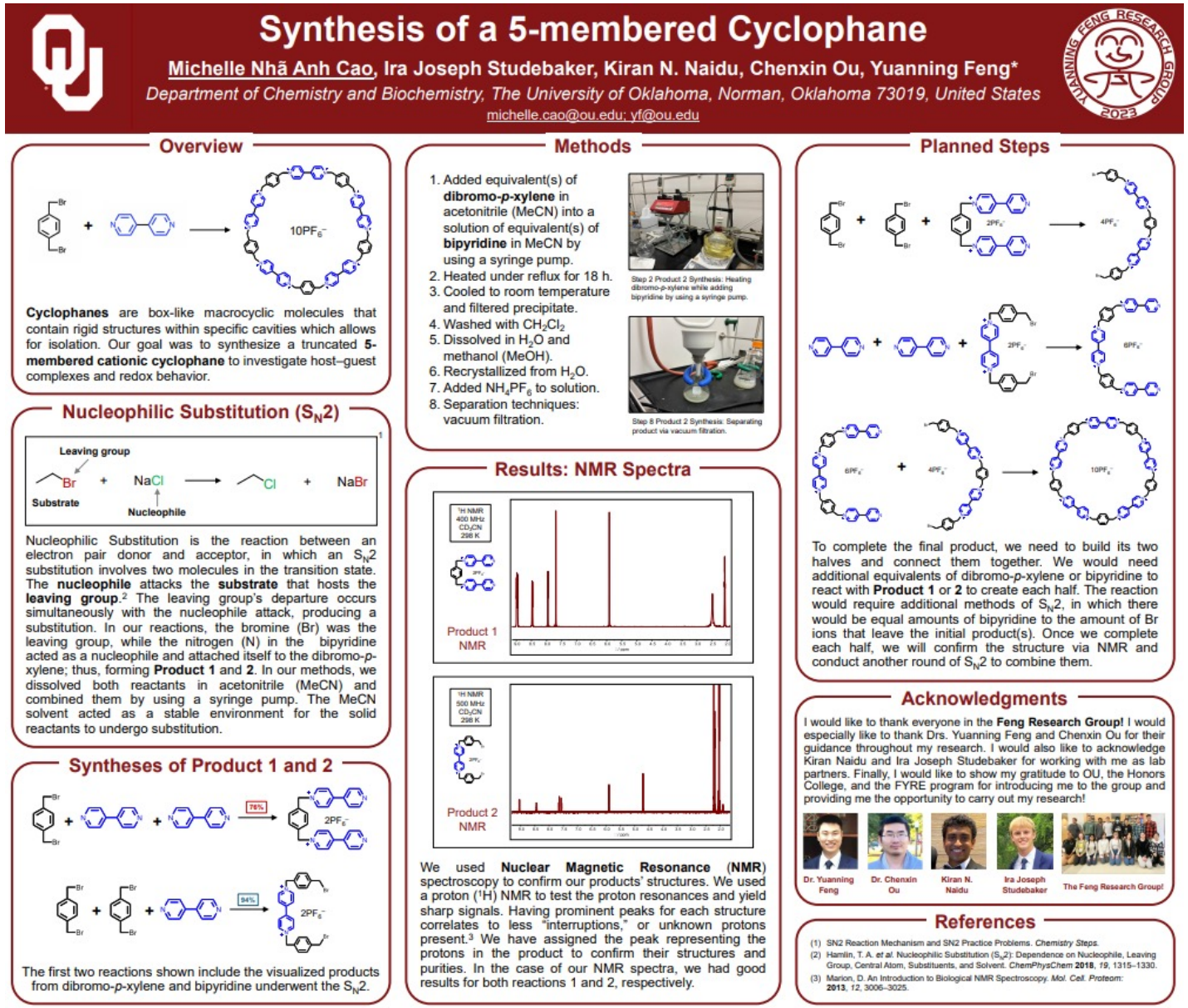

Supramolecular Antenna Effect in Fluorescent Dyes

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Synthesis of the Pentagonal Cyclophane

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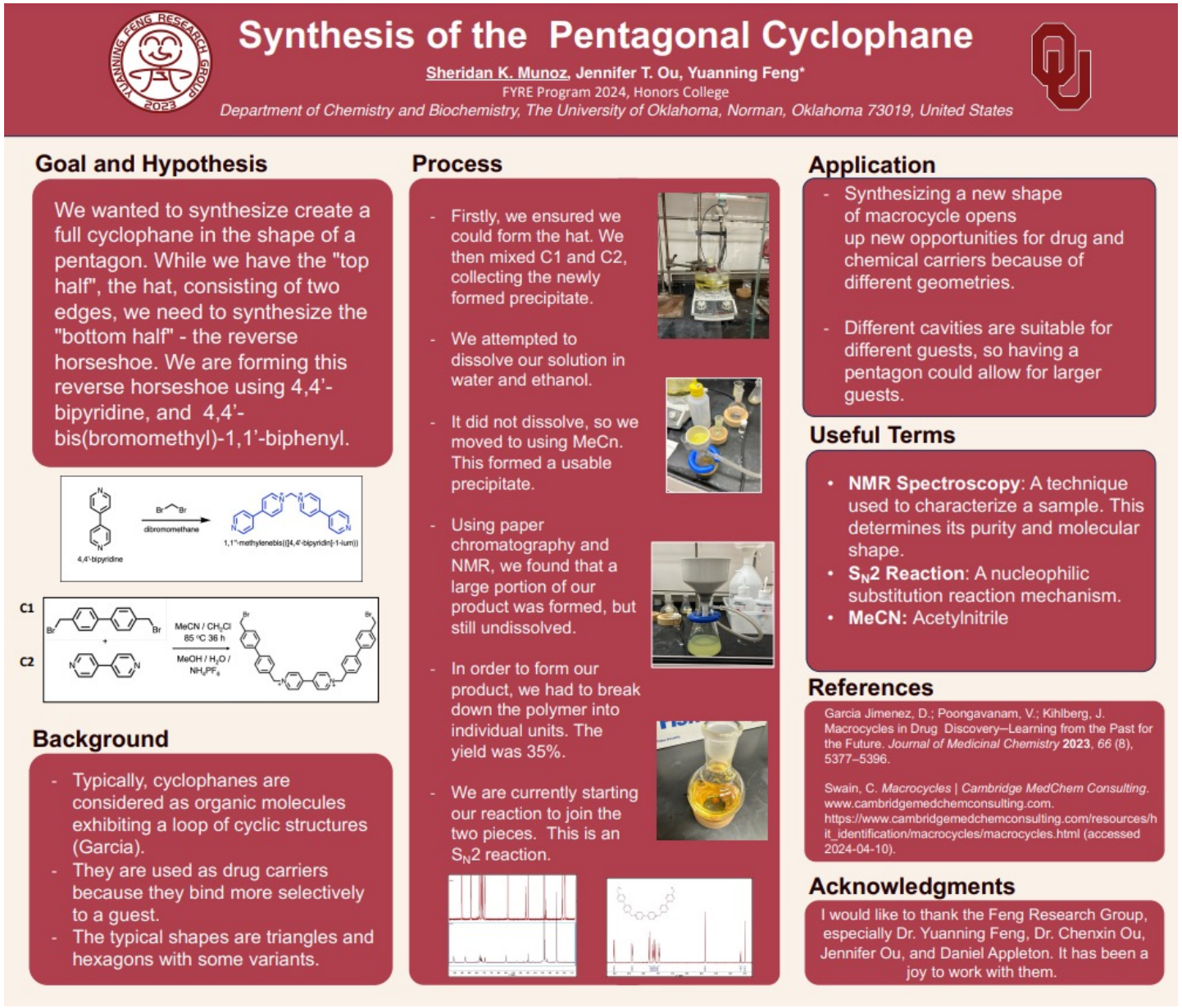
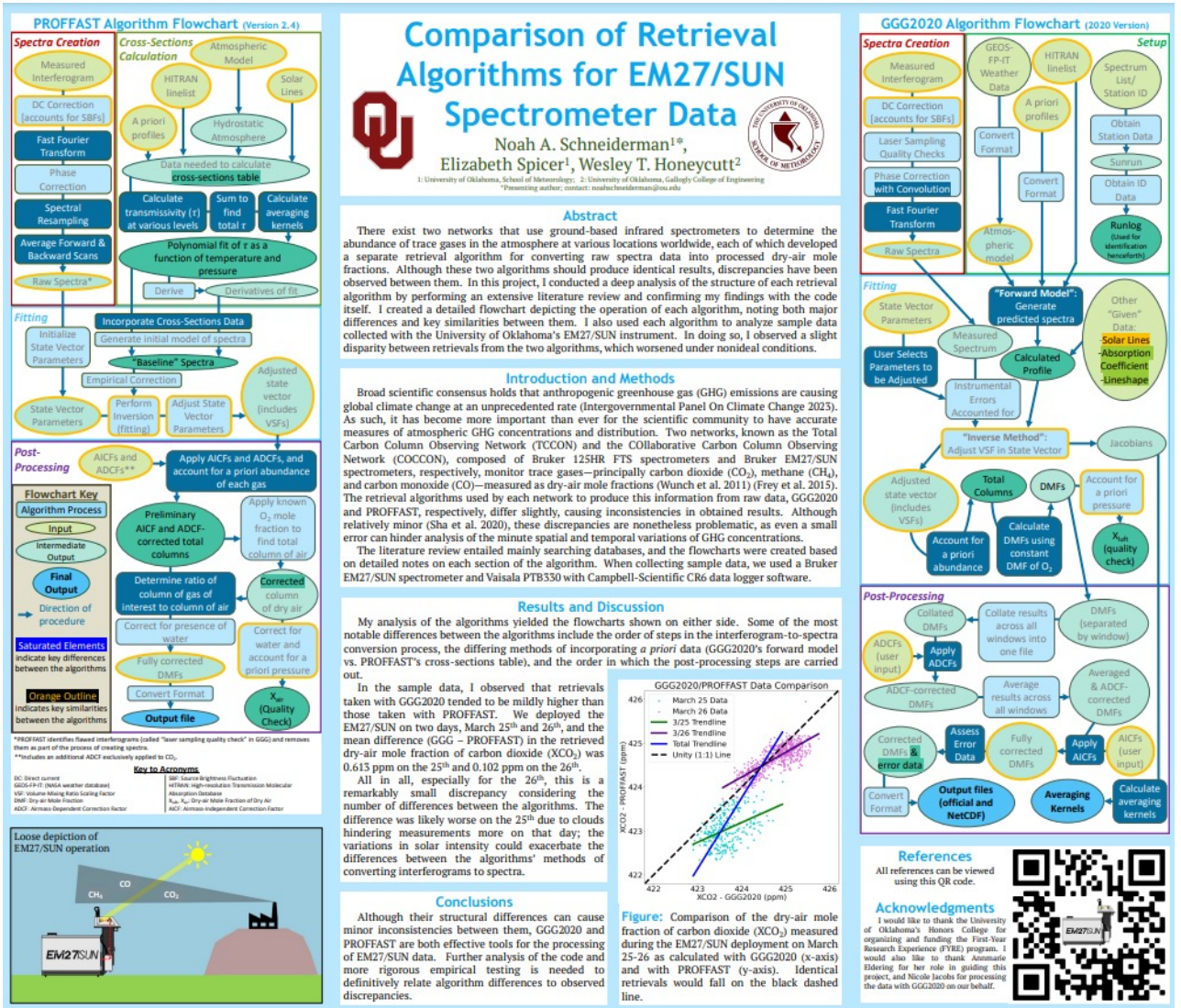


Comparison of Retrieval Algorithms for EM27/SUN Spectrometer Data

Noah A. Schneiderman 1*, Elizabeth Spicer 1, Wesley T. Honeycutt 2

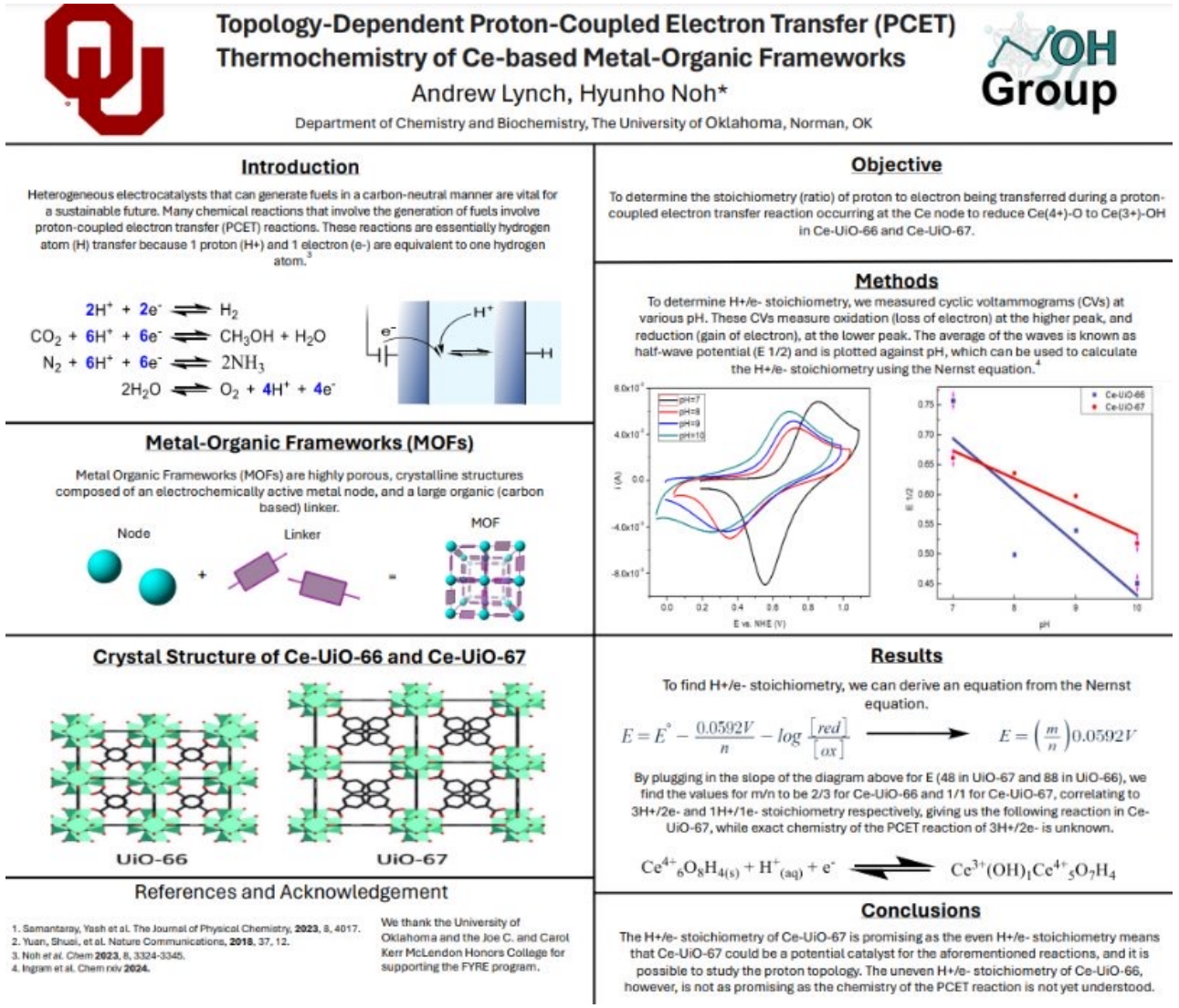
1 University of Oklahoma, School of Meteorology, 2 University of Oklahoma, Gallogly College of Engineering, *Presenting author



Topology-Dependent Proton-Coupled Electron Transfer (PCET) Thermochemistry of Ce-based Metal Organic Frameworks

Andrew Lynch and Hyunho Noh

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



Topology-Dependent Proton-Coupled Electron Transfer (PCET) Thermochemistry of Ce-based Metal-Organic Frameworks

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

OH Group

Introduction

Heterogeneous electrocatalysts that can generate fuels in a carbon-neutral manner are vital for a sustainable future. Many chemical reactions that involve the generation of fuels involve proton-coupled electron transfer (PCET) reactions. These reactions are essentially hydrogen atom (H) transfer because 1 proton (H+) and 1 electron (e-) are equivalent to one hydrogen atom.[3]

$2H^+ + 2e^- \rightleftharpoons H_2$

$CO_2 + 6H^+ + 6e^- \rightleftharpoons CH_3OH + H_2O$

$N_2 + 6H^+ + 6e^- \rightleftharpoons 2NH_3$

$2H_2O \rightleftharpoons O_2 + 4H^+ + 4e^-$

Metal-Organic Frameworks (MOFs)

Metal Organic Frameworks (MOFs) are highly porous, crystalline structures composed of an electrochemically active metal node, and a large organic (carbon based) linker.

Node + Linker = MOF

Crystal Structure of Ce-UiO-66 and Ce-UiO-67

UiO-66 UiO-67

References and Acknowledgement

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4. Ingram et al. Chem rxiv **2024**.

We thank the University of Oklahoma and the Joe C. and Carol Kerr McLendon Honors College for supporting the FYRE program.

Objective

To determine the stoichiometry (ratio) of proton to electron being transferred during a proton-coupled electron transfer reaction occurring at the Ce node to reduce Ce(4+)-O to Ce(3+)-OH in Ce-UiO-66 and Ce-UiO-67.

Methods

To determine H+/e- stoichiometry, we measured cyclic voltammograms (CVs) at various pH. These CVs measure oxidation (loss of electron) at the higher peak, and reduction (gain of electron), at the lower peak. The average of the waves is known as half-wave potential (E 1/2) and is plotted against pH, which can be used to calculate the H+/e- stoichiometry using the Nernst equation.[4]

Results

To find H+/e- stoichiometry, we can derive an equation from the Nernst equation.

$$E = E^\circ - \frac{0.0592V}{n} - \log\frac{[red]}{[ox]} \longrightarrow E = \left(\frac{m}{n}\right)0.0592V$$

By plugging in the slope of the diagram above for E (48 in UiO-67 and 88 in UiO-66), we find the values for m/n to be 2/3 for Ce-UiO-66 and 1/1 for Ce-UiO-67, correlating to 3H+/2e- and 1H+/1e- stoichiometry respectively, giving us the following reaction in Ce-UiO-67, while exact chemistry of the PCET reaction of 3H+/2e- is unknown.

$$Ce^{4+}{}_6O_8H_{4(s)} + H^+_{(aq)} + e^- \rightleftharpoons Ce^{3+}(OH)_1Ce^{4+}{}_5O_7H_4$$

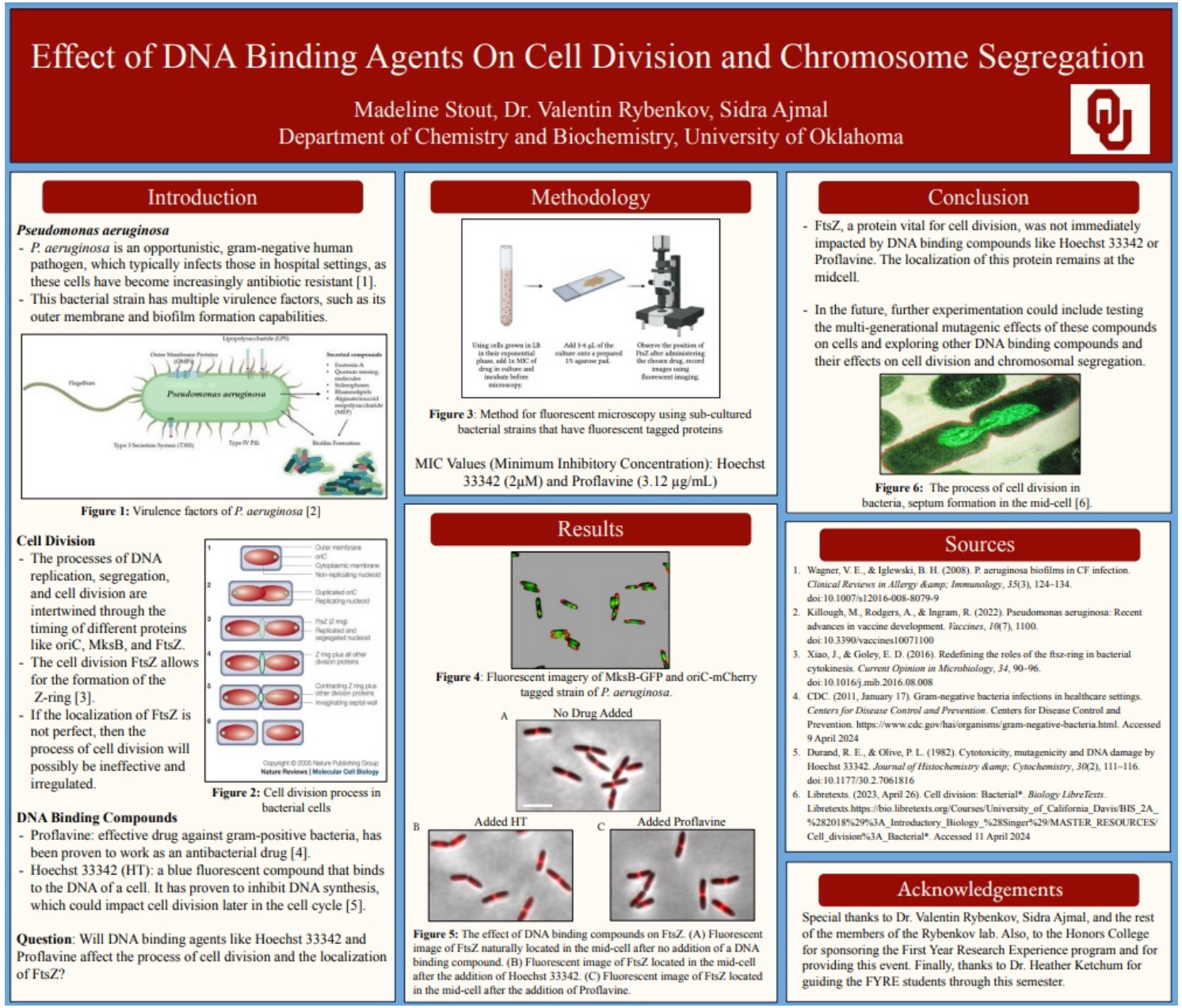
Conclusions

The H+/e- stoichiometry of Ce-UiO-67 is promising as the even H+/e- stoichiometry means that Ce-UiO-67 could be a potential catalyst for the aforementioned reactions, and it is possible to study the proton topology. The uneven H+/e- stoichiometry of Ce-UiO-66, however, is not as promising as the chemistry of the PCET reaction is not yet understood.

Effect of DNA Binding Agents On Cell Division and Chromosome Segregation

Madeline Stout, Dr. Valentin Rybenkov, Sidra Ajmal

Department of Chemistry and Biochemistry, University of Oklahoma



Effect of DNA Binding Agents On Cell Division and Chromosome Segregation

Madeline Stout, Dr. Valentin Rybenkov, Sidra Ajmal
Department of Chemistry and Biochemistry, University of Oklahoma

Introduction

Pseudomonas aeruginosa

- *P. aeruginosa* is an opportunistic, gram-negative human pathogen, which typically infects those in hospital settings, as these cells have become increasingly antibiotic resistant [1].
- This bacterial strain has multiple virulence factors, such as its outer membrane and biofilm formation capabilities.

Figure 1: Virulence factors of *P. aeruginosa* [2]

Cell Division

- The processes of DNA replication, segregation, and cell division are intertwined through the timing of different proteins like oriC, MksB, and FtsZ.
- The cell division FtsZ allows for the formation of the Z-ring [3].
- If the localization of FtsZ is not perfect, then the process of cell division will possibly be ineffective and irregulated.

Figure 2: Cell division process in bacterial cells

DNA Binding Compounds

- Proflavine: effective drug against gram-positive bacteria, has been proven to work as an antibacterial drug [4].
- Hoechst 33342 (HT): a blue fluorescent compound that binds to the DNA of a cell. It has proven to inhibit DNA synthesis, which could impact cell division later in the cell cycle [5].

Question: Will DNA binding agents like Hoechst 33342 and Proflavine affect the process of cell division and the localization of FtsZ?

Methodology

Figure 3: Method for fluorescent microscopy using sub-cultured bacterial strains that have fluorescent tagged proteins

MIC Values (Minimum Inhibitory Concentration): Hoechst 33342 (2µM) and Proflavine (3.12 µg/mL)

Results

Figure 4: Fluorescent imagery of MksB-GFP and oriC-mCherry tagged strain of *P. aeruginosa*.

Figure 5: The effect of DNA binding compounds on FtsZ. (A) Fluorescent image of FtsZ naturally located in the mid-cell after no addition of a DNA binding compound. (B) Fluorescent image of FtsZ located in the mid-cell after the addition of Hoechst 33342. (C) Fluorescent image of FtsZ located in the mid-cell after the addition of Proflavine.

Conclusion

- FtsZ, a protein vital for cell division, was not immediately impacted by DNA binding compounds like Hoechst 33342 or Proflavine. The localization of this protein remains at the midcell.
- In the future, further experimentation could include testing the multi-generational mutagenic effects of these compounds on cells and exploring other DNA binding compounds and their effects on cell division and chromosomal segregation.

Figure 6: The process of cell division in bacteria, septum formation in the mid-cell [6].

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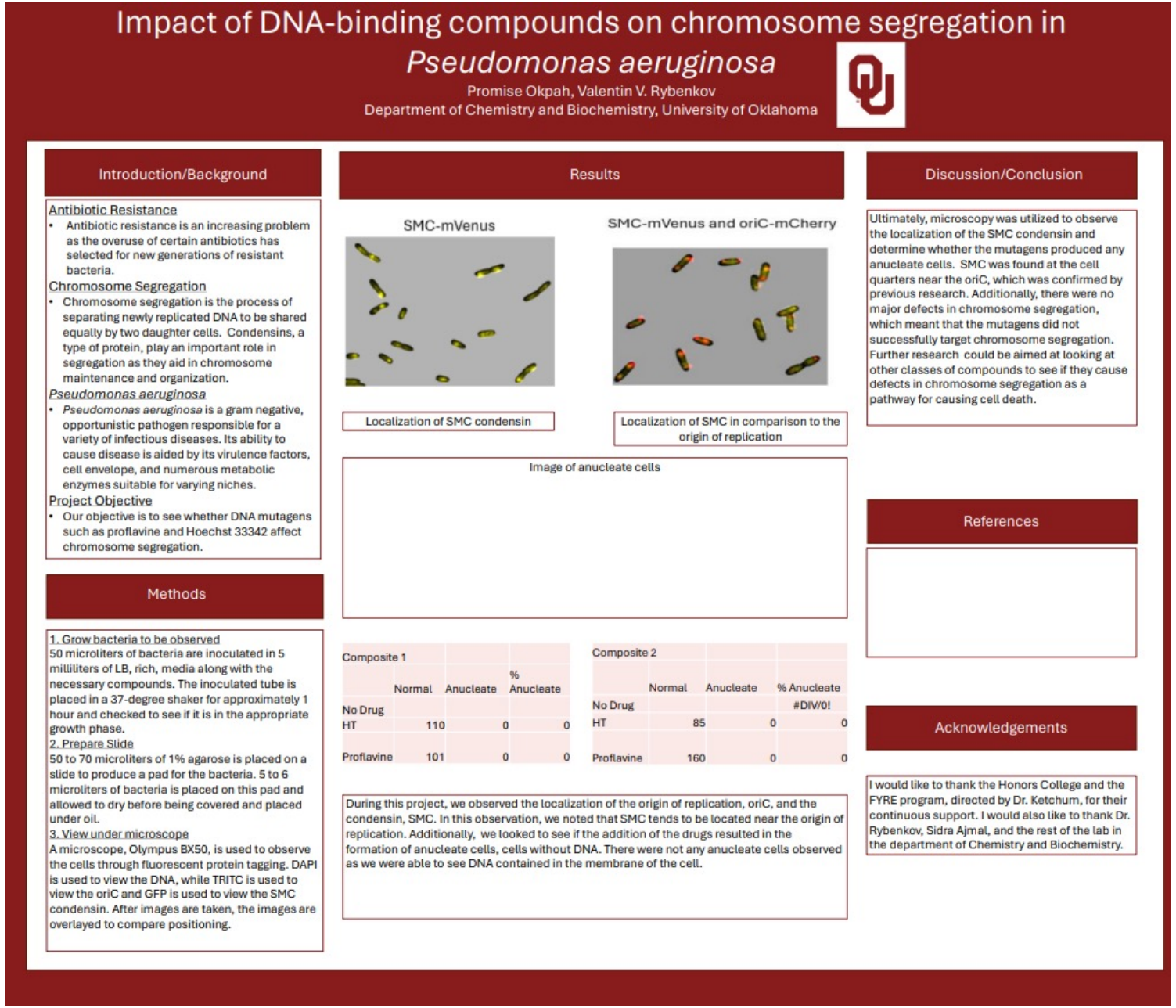
Impact of DNA-binding compounds on chromosome segregation in Pseudomonas aeruginosa

Promise Okpah, Valentin V. Rybenkov

Department of Chemistry and Biochemistry, University of Oklahoma



Impact of DNA-binding compounds on chromosome segregation in *Pseudomonas aeruginosa*

Promise Okpah, Valentin V. Rybenkov
Department of Chemistry and Biochemistry, University of Oklahoma

Introduction/Background

Antibiotic Resistance

- Antibiotic resistance is an increasing problem as the overuse of certain antibiotics has selected for new generations of resistant bacteria.

Chromosome Segregation

- Chromosome segregation is the process of separating newly replicated DNA to be shared equally by two daughter cells. Condensins, a type of protein, play an important role in segregation as they aid in chromosome maintenance and organization.

Pseudomonas aeruginosa

- *Pseudomonas aeruginosa* is a gram negative, opportunistic pathogen responsible for a variety of infectious diseases. Its ability to cause disease is aided by its virulence factors, cell envelope, and numerous metabolic enzymes suitable for varying niches.

Project Objective

- Our objective is to see whether DNA mutagens such as proflavine and Hoechst 33342 affect chromosome segregation.

Methods

1. Grow bacteria to be observed
50 microliters of bacteria are inoculated in 5 milliliters of LB, rich, media along with the necessary compounds. The inoculated tube is placed in a 37-degree shaker for approximately 1 hour and checked to see if it is in the appropriate growth phase.
2. Prepare Slide
50 to 70 microliters of 1% agarose is placed on a slide to produce a pad for the bacteria. 5 to 6 microliters of bacteria is placed on this pad and allowed to dry before being covered and placed under oil.
3. View under microscope
A microscope, Olympus BX50, is used to observe the cells through fluorescent protein tagging. DAPI is used to view the DNA, while TRITC is used to view the oriC and GFP is used to view the SMC condensin. After images are taken, the images are overlayed to compare positioning.

Results

SMC-mVenus

Localization of SMC condensin

SMC-mVenus and oriC-mCherry

Localization of SMC in comparison to the origin of replication

Image of anucleate cells

Composite 1

	Normal	Anucleate	% Anucleate
No Drug			
HT	110	0	0
Proflavine	101	0	0

Composite 2

	Normal	Anucleate	% Anucleate
No Drug			#DIV/0!
HT	85	0	0
Proflavine	160	0	0

During this project, we observed the localization of the origin of replication, oriC, and the condensin, SMC. In this observation, we noted that SMC tends to be located near the origin of replication. Additionally, we looked to see if the addition of the drugs resulted in the formation of anucleate cells, cells without DNA. There were not any anucleate cells observed as we were able to see DNA contained in the membrane of the cell.

Discussion/Conclusion

Ultimately, microscopy was utilized to observe the localization of the SMC condensin and determine whether the mutagens produced any anucleate cells. SMC was found at the cell quarters near the oriC, which was confirmed by previous research. Additionally, there were no major defects in chromosome segregation, which meant that the mutagens did not successfully target chromosome segregation. Further research could be aimed at looking at other classes of compounds to see if they cause defects in chromosome segregation as a pathway for causing cell death.

References

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I would like to thank the Honors College and the FYRE program, directed by Dr. Ketchum, for their continuous support. I would also like to thank Dr. Rybenkov, Sidra Ajmal, and the rest of the lab in the department of Chemistry and Biochemistry.

Investigating the Role of m6A Methylation in Regulating Secondary Structure and Stress Response of the SlPP2C3 mRNA Transcript in Tomato Anthers

Kara Meloni and Anayat Yousuf Lab of Dr. Susan Schroeder PhD.

Department of Chemistry and Biochemistry, University of Oklahoma, OK

Investigating the Role of m6A Methylation in Regulating Secondary Structure and Stress Response of the *SlPP2C3* mRNA Transcript in Tomato Anthers

Kara Meloni and Anayat Yousuf
Lab of Dr. Susan Schroeder PhD. *Department of Chemistry and Biochemistry, University of Oklahoma, OK*

Background

- Methylation is the addition of a methyl group (CH_3) to a nucleic acid usually due to environmental factor such as stress, hormone levels. etc.

m6A RNA Methylation

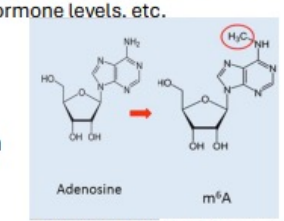

Figure 1. Romano, G. (2018, July 12). *A schematic representation of the Principal methylation modifications in eukaryotic RNA.*

- m6A methylation may also alter the 3D structures of 3' untranslated regions of RNA, and while these sites do not code for proteins, they play a role in regulation of gene expression
- Changing 3D structure changes interaction with other molecules
- *SlPP2C3* is an mRNA strand that signals the transduction of abscisic acid (ABA) into cells
- ABA regulates stress response in plants, and *SlPP2C3* was found to be upregulated in tomato anthers in times of high stress.

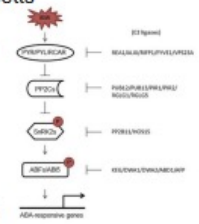

Figure 2. Ali, A. (2020, April 21). *ABA signaling core proteins and their correspondent E3 ligases.*

- Increased ABA in anthers leads to reproductive dormancy and increased focus on sustaining homeostasis within the plant
- 3D structures are not necessarily changed due to methylation

Hypothesis

The m6A methylation of the SlPP2C2 transcript in tomato anthers changes under moderate low-temperature (MLT) stress, and these changes affect the secondary structure of the RNA, potentially influencing its interaction with proteins and its translation by the ribosome.

2D structure of *SlPP2C3*

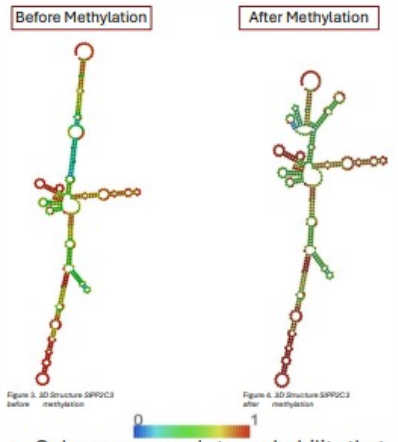

Figure 3. 2D Structure *SlPP2C3* before methylation

Figure 4. 2D Structure *SlPP2C3* after methylation

- Color corresponds to probability that the region is folded correctly.
- Warmer colors- More probable.
- Cooler colors- Less probable.

Results

- Analysis of the 2D diagrams of *SlPP2C3* before and after methylation shows very little difference in secondary structure in high probability regions.
- The difference in structure in lower probability regions of the diagram is not reliable data.

Results (cont.)

- Let it be known, the graphic representation of the mRNA structure is not exact.
- The secondary structure prediction does not account for variables such as protein interactions or multiple functional structures.
- RNA can change shape on its own, without the introduction of methylation.

Therefore, with the data presented, we are unable to confirm or reject our initial hypothesis at this time.

Effect on Future

- Although our results were inconclusive for this specific mRNA strand, this is not the case for all stress responsive mRNA strands.
- Understanding how different stressors and resulting methylation effect plant development and gene regulation is the key to understanding, more accurately, what environment plants, tomatoes in this case, grow best in.
- This leads to higher crop yields and higher quality crop overall, which is so important in a time of food insecurity for billions of people across the globe.
- Additionally, further study into temperature and drought methylation effects can be used to our advantage when dealing with issues like climate change.
- If we can understand what causes the tomatoes to fail in certain environments, we can understand what we need to do to combat it.

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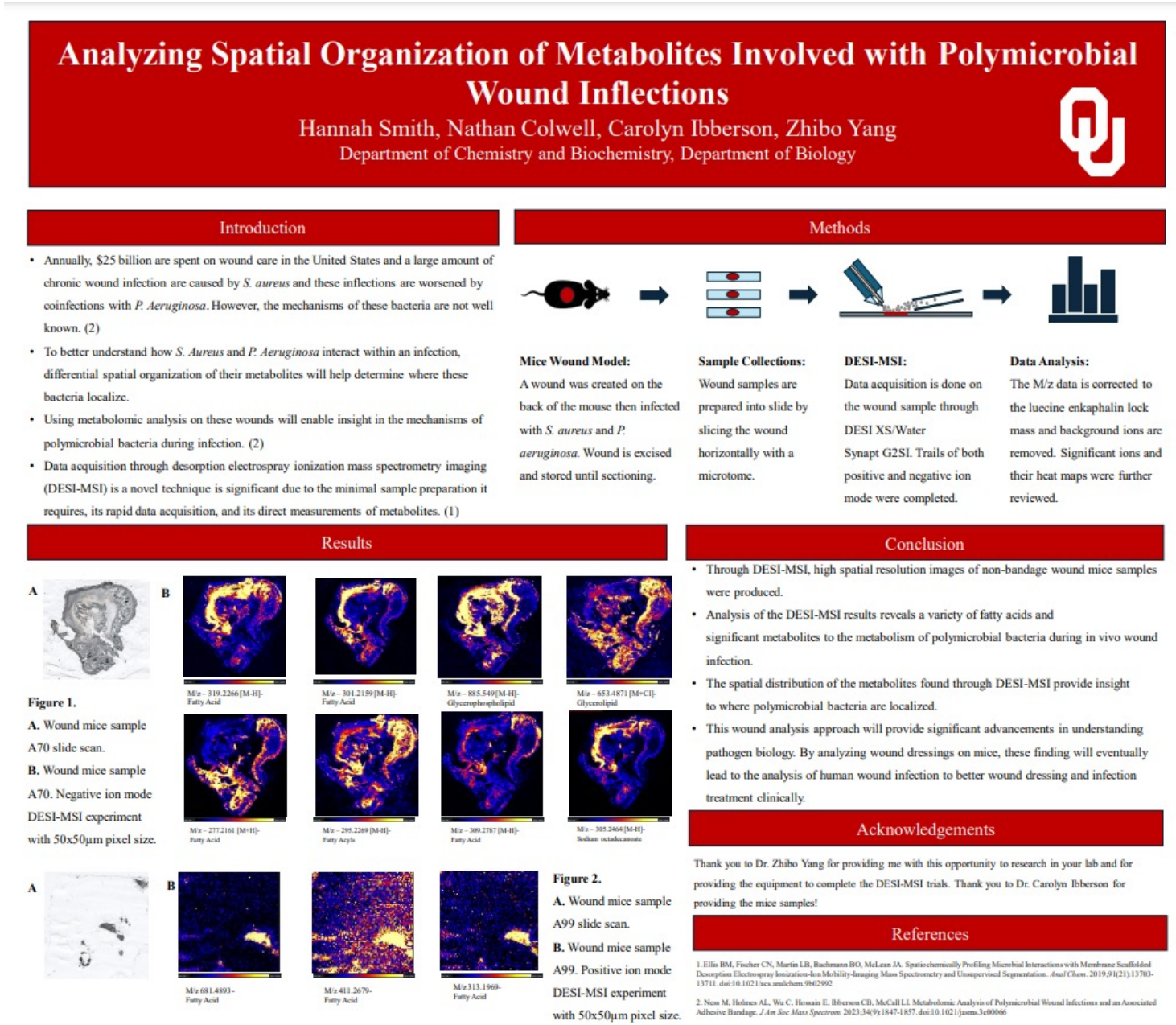
Analyzing Spatial Organization of Metabolites Involved with Polymicrobial Wound Inflections

Hannah Smith, Nathan Colwell, Carolyn Ibberson, Zhibo Yang

Department of Chemistry and Biochemistry, Department of Biology



Analyzing Spatial Organization of Metabolites Involved with Polymicrobial Wound Inflections

Hannah Smith, Nathan Colwell, Carolyn Ibberson, Zhibo Yang
Department of Chemistry and Biochemistry, Department of Biology

Introduction

- Annually, $25 billion are spent on wound care in the United States and a large amount of chronic wound infection are caused by *S. aureus* and these inflections are worsened by coinfections with *P. Aeruginosa*. However, the mechanisms of these bacteria are not well known. (2)
- To better understand how *S. Aureus* and *P. Aeruginosa* interact within an infection, differential spatial organization of their metabolites will help determine where these bacteria localize.
- Using metabolomic analysis on these wounds will enable insight in the mechanisms of polymicrobial bacteria during infection. (2)
- Data acquisition through desorption electrospray ionization mass spectrometry imaging (DESI-MSI) is a novel technique is significant due to the minimal sample preparation it requires, its rapid data acquisition, and its direct measurements of metabolites. (1)

Methods

Mice Wound Model: A wound was created on the back of the mouse then infected with *S. aureus* and *P. aeruginosa*. Wound is excised and stored until sectioning.

Sample Collections: Wound samples are prepared into slide by slicing the wound horizontally with a microtome.

DESI-MSI: Data acquisition is done on the wound sample through DESI XS/Water Synapt G2SI. Trails of both positive and negative ion mode were completed.

Data Analysis: The M/z data is corrected to the luecine enkaphalin lock mass and background ions are removed. Significant ions and their heat maps were further reviewed.

Results

A B

M/z – 319.2266 [M-H]- Fatty Acid
M/z – 301.2159 [M-H]- Fatty Acid
M/z – 885.549 [M-H]- Glycerophospholipid
M/z – 653.4871 [M+Cl]- Glycerolipid
M/z – 277.2161 [M+H]- Fatty Acid
M/z – 295.2269 [M-H]- Fatty Acyls
M/z – 309.2787 [M-H]- Fatty Acid
M/z – 305.2464 [M-H]- Sodium octadecanoate

Figure 1.
A. Wound mice sample A70 slide scan.
B. Wound mice sample A70. Negative ion mode DESI-MSI experiment with 50x50µm pixel size.

A B

M/z 681.4893 - Fatty Acid
M/z 411.2679- Fatty Acid
M/z 313.1969- Fatty Acid

Figure 2.
A. Wound mice sample A99 slide scan.
B. Wound mice sample A99. Positive ion mode DESI-MSI experiment with 50x50µm pixel size.

Conclusion

- Through DESI-MSI, high spatial resolution images of non-bandage wound mice samples were produced.
- Analysis of the DESI-MSI results reveals a variety of fatty acids and significant metabolites to the metabolism of polymicrobial bacteria during in vivo wound infection.
- The spatial distribution of the metabolites found through DESI-MSI provide insight to where polymicrobial bacteria are localized.
- This wound analysis approach will provide significant advancements in understanding pathogen biology. By analyzing wound dressings on mice, these finding will eventually lead to the analysis of human wound infection to better wound dressing and infection treatment clinically.

Acknowledgements

Thank you to Dr. Zhibo Yang for providing me with this opportunity to research in your lab and for providing the equipment to complete the DESI-MSI trials. Thank you to Dr. Carolyn Ibberson for providing the mice samples!

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Quantification of Benznidazole in Single Cells Using Single-Probe Mass Spectrometry Technique

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Quantification of Benznidazole in Single Cells Using Single-Probe Mass Spectrometry Technique

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***Corresponding author email: Zhibo.Yang@ou.edu**

Introduction

- Single cell mass spectrometry (SCMS) can analyze molecular features of individual cells and quantify small molecules after the treatment condition.
- Chagas disease is a neglected infectious disease that started in South America, which is caused by the parasite *Trypanosoma cruzi*.
- Benznidazole is an anti-parasitic medication used to treat Chagas disease by damaging the DNA of *Trypanosoma cruzi*.
- Due to cell heterogeneity, the Benznidazole-treated cells will have different amounts of Benznidazole from cell-to-cell, therefore a study needs to be conducted at single cell levels.
- SCMS is a very powerful tool to sensitively detect and identify molecules at low abundance. Therefore, SCMS is employed to study the quantification of small molecules, Benznidazole, at the single cell level.

Methods

Single-probe SCMS technique

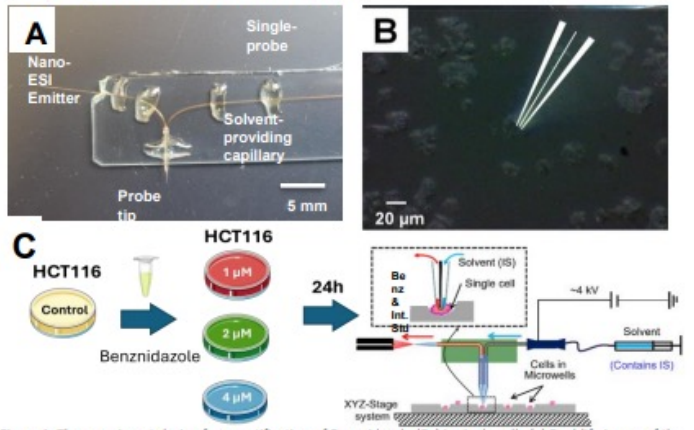


Figure 1. The experiment design for quantification of Benznidazole (Bz) in single cell. (a) Real-life image of the Single-probe device and their components; (b) Microscopic image of HCT116 during SCMS analysis; (c) Experimental workflow of quantification of Benznidazole.

Acknowledgement

- Advisor: Professor Dr. Zhibo Yang
- Yang lab members: Tra D. Nguyen, Zongkai Peng, Yunpeng Lan, Dan Chen, Amit Singh, Shakya Munige, Deepti Bhusal, Nathan Colwell, Christina Chau, Annalise Huynh
- Funding: National Institute of Health (NIH) and National Science Foundation (NSF)

Results

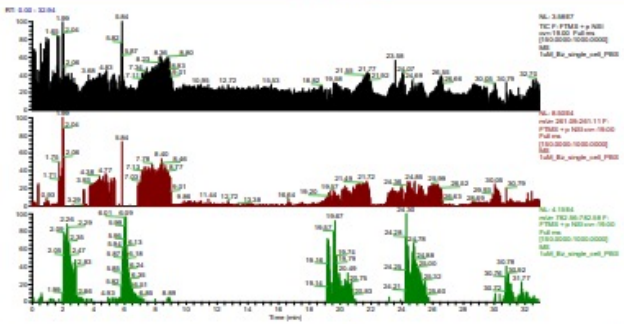


Figure 2: The chromatogram indicates the successful detection of Benznidazole in 5 individual treated cells (1 μM Benznidazole, 24h)

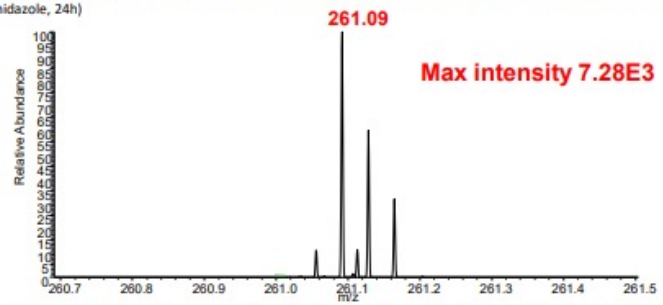


Figure 3: A representative mass spectrum shows the detection of Benznidazole in an individual treated cells (1 μM Benznidazole, 24h). The detected molecule is [Benznidazole + H]⁺ at m/z of 261.0988.

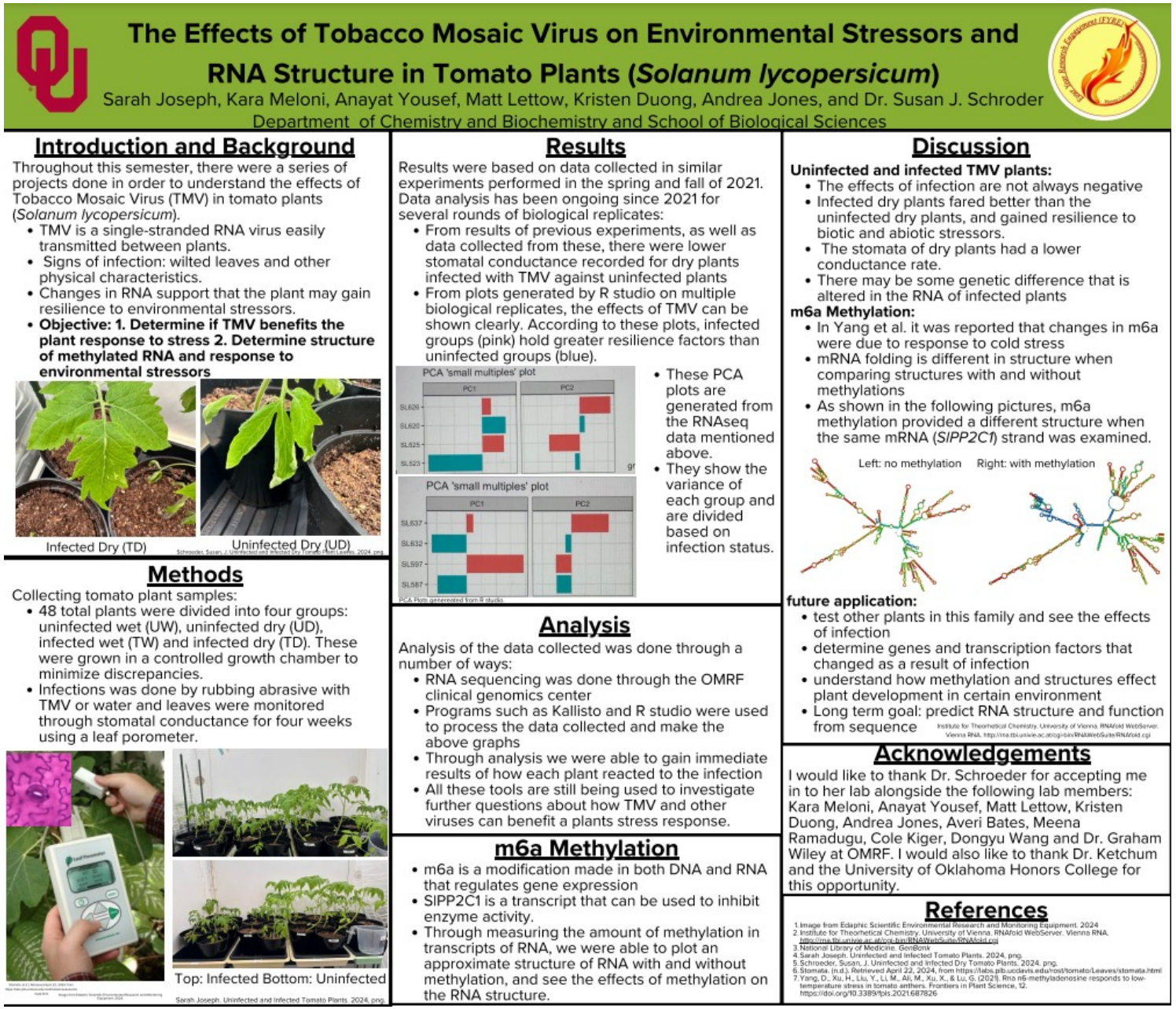
Conclusion

- The drug Benznidazole was successfully detected in cells using the mass spectrometry technique and MSI machine.
- Thus, the limit of detection for Benznidazole in cells in different concentrations was found, optimized, and will be used in future experiments.
- The next step of the experiment will be to test in individual HCT116 cells to further test the effects and quantification of the drug on cancer cells.

The Effects of Tobacco Mosaic Virus on Environmental Stressors and RNA Structure in Tomato Plants (Solanum lycopersicum)

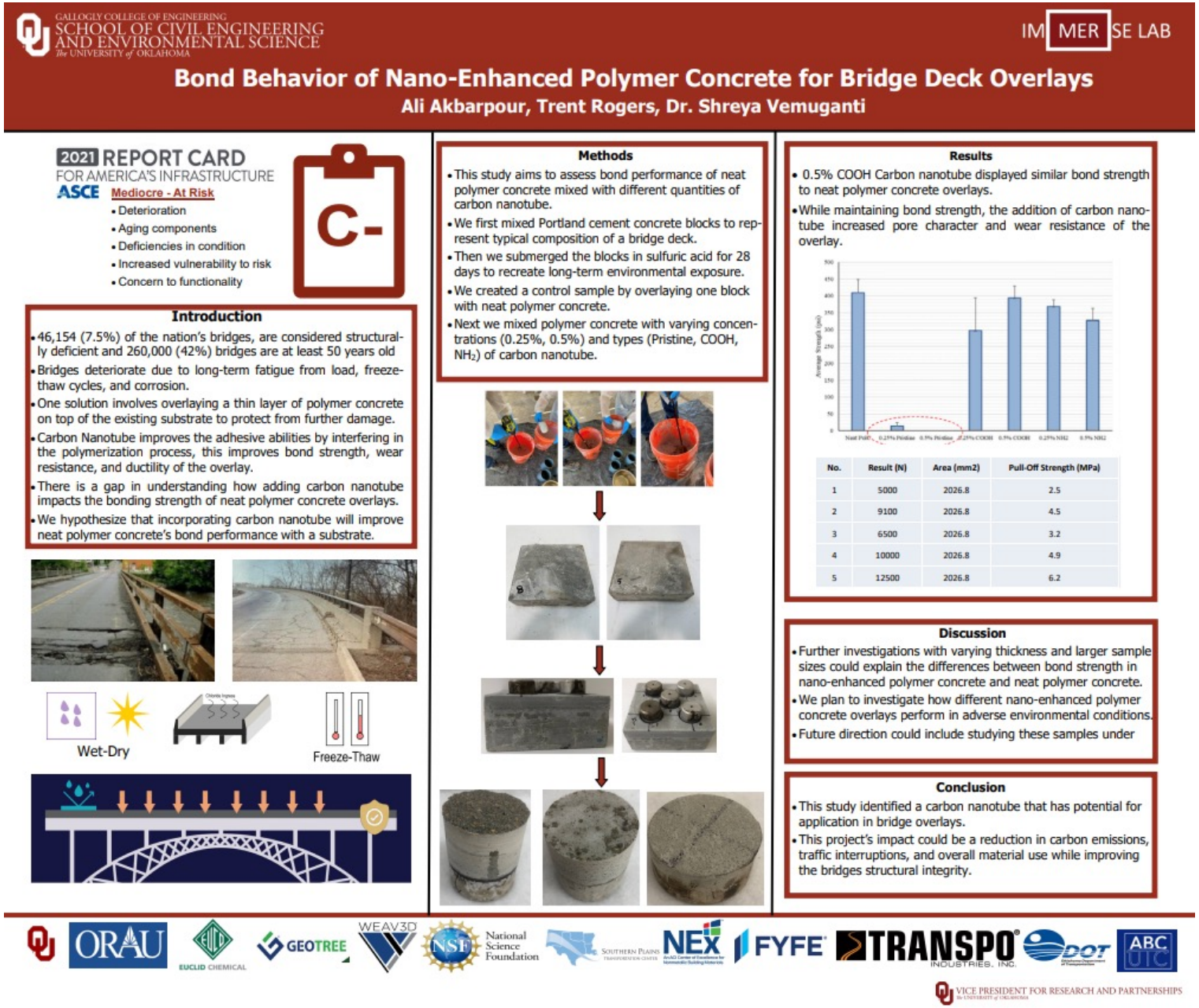
Sarah Joseph, Kara Meloni, Anayat Yousef, Matt Lettow, Kristen Duong, Andrea Jones, and Dr. Susan J. Schroder

Department of Chemistry and Biochemistry and School of Biological Sciences



Bond Behavior of Nano-Enhanced Polymer Concrete for Bridge Deck Overlays

Ali Akbarpour, Trent Rogers, Dr. Shreya Vemuganti

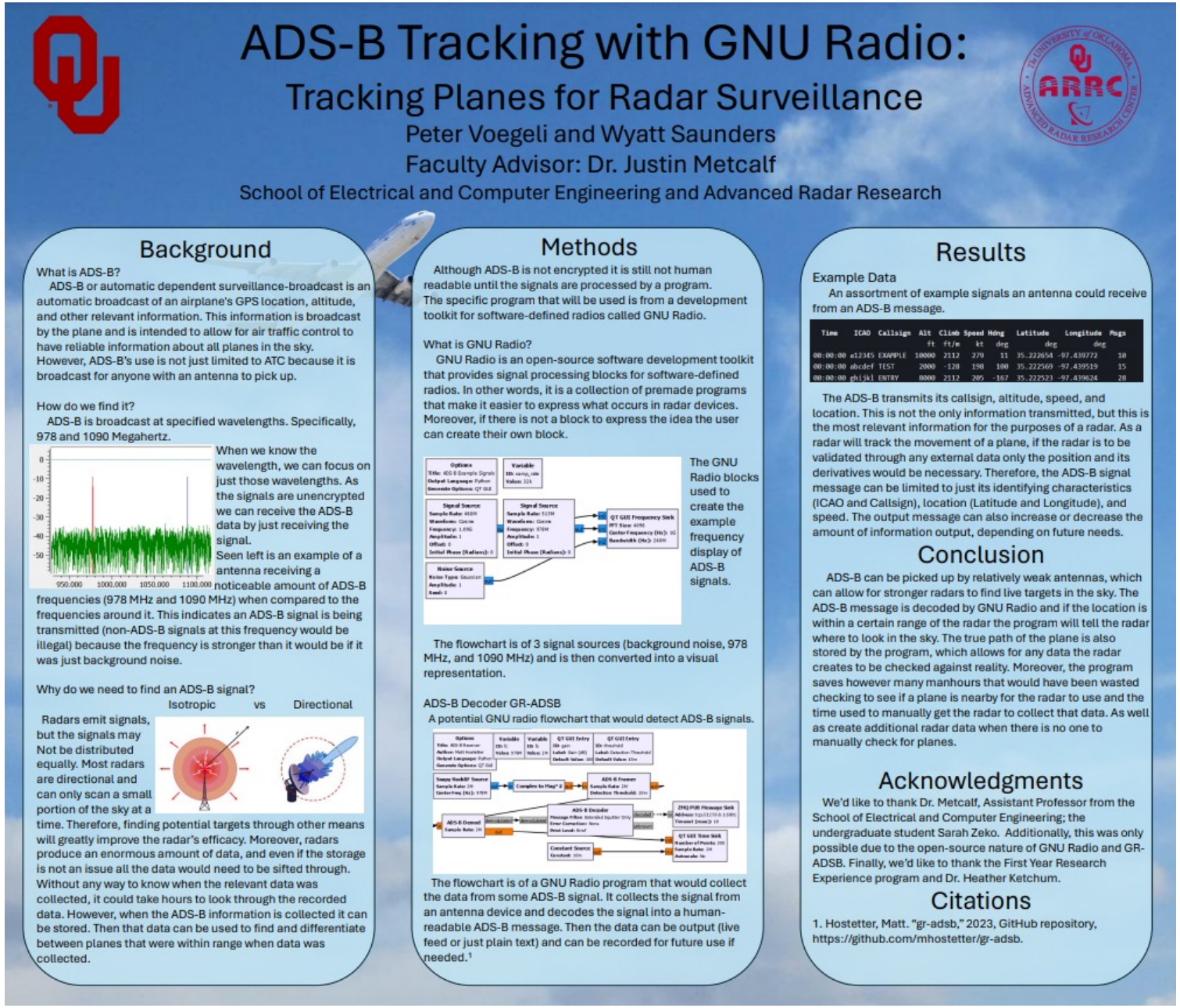


ADS-B Tracking with GNU Radio: Tracking Planes for Radar Surveillance

Peter Voegeli and Wyatt Saunders

Faculty Advisor: Dr. Justin Metcalf

School of Electrical and Computer Engineering and Advanced Radar Research



Foundations of Discovery: Delving into Lab Techniques on the Path of Super-Resolution Ultrasound

Austin Shepherd and Billy Sweiger

University of Oklahoma, Molecular Ultrasound Imaging and Delivery Laboratory

Foundations of Discovery: Delving into Lab Techniques on the Path of Super-Resolution Ultrasound

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Background

Dr. Yoon's lab aims to develop better imaging systems to help diagnose and track cancer growth. His current focus is super-resolution ultrasound and using gas vesicles as a contrast agent[3].

M. U. I. D.

Goals

Our goals for this semester included:

- Developing a deeper understanding of processes behind Dr. Yoon's research
  - Learn about ultrasound technology
  - Observe/aid in cell transfection
  - Gain proficiency in basic laboratory skills

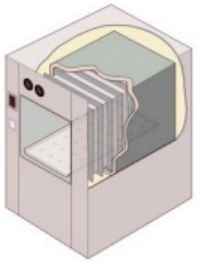
Future Work

We plan to continue working with Dr. Yoon through Summer/Fall 2024. Our next steps include:

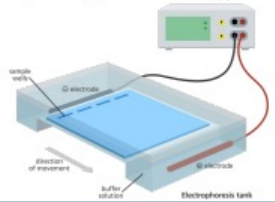
- Designing and building an ultrasound pressure-measurement system
- Understanding the code behind signal processing and continuing to improve it

Procedures

- Autoclaving
  - "Autoclaves use water, pressure, and heat to create superheated steam that kills microorganisms and spores[1]."
  - Necessary to sterilize our equipment
    - Otherwise, experiments could become contaminated and distort our results



- Polymerase Chain Reaction (PCR)
  - "Technique for rapidly amplifying millions to billions of copies of a specific segment of DNA[2]"
  - Our lab utilized PCR to aid in the manipulation of cells to produce gas vesicles.
- Gel Electrophoresis
  - A square gel is to be made and placed in the buffer solution
  - The wells in the gel are filled with solutions of DNA to be tested
  - Electrical current runs through from the cathode to the anode, pushing shorter fragments farther[4]



Procedures Cont.

- Cell Culture[5]
  - Cells are very delicate, so they must be kept in a specific environment to survive
  - HeLa cells are a specific kind of cancer cell that divide infinitely
  - If they divide too much, the plate becomes confluent, and they die
  - Before that happens, some cells get removed and replated

- Reading Relevant Literature
  - Start with important, succinct points
    - Scan title to see if it will have relevant info
    - Read abstract to understand scope of the data
    - Use conclusion to see if the results are helpful
  - Go to the rest of the paper if it is deemed useful to understand procedures and how to apply it

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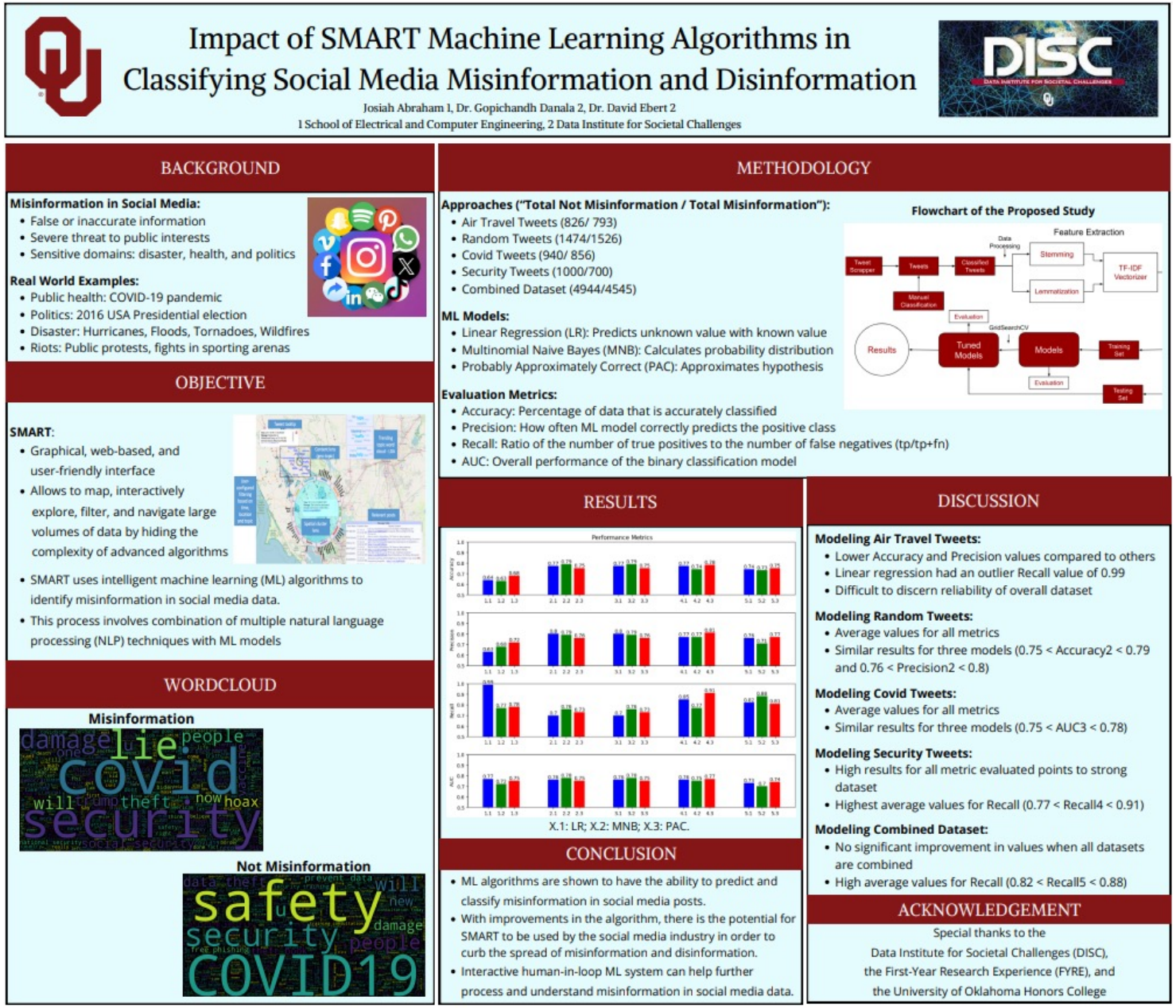
Impact of SMART Machine Learning Algorithms in Classifying Social Media Misinformation and Disinformation

Josiah Abraham 1, Dr. Gopichandh Danala 2, Dr. David Ebert 2

1 School of Electrical and Computer Engineering, 2 Data Institute for Societal Challenges



Impact of SMART Machine Learning Algorithms in Classifying Social Media Misinformation and Disinformation

Josiah Abraham 1, Dr. Gopichandh Danala 2, Dr. David Ebert 2
1 School of Electrical and Computer Engineering, 2 Data Institute for Societal Challenges

BACKGROUND

Misinformation in Social Media:
- False or inaccurate information
- Severe threat to public interests
- Sensitive domains: disaster, health, and politics

Real World Examples:
- Public health: COVID-19 pandemic
- Politics: 2016 USA Presidential election
- Disaster: Hurricanes, Floods, Tornadoes, Wildfires
- Riots: Public protests, fights in sporting arenas

OBJECTIVE

SMART:
- Graphical, web-based, and user-friendly interface
- Allows to map, interactively explore, filter, and navigate large volumes of data by hiding the complexity of advanced algorithms
- SMART uses intelligent machine learning (ML) algorithms to identify misinformation in social media data.
- This process involves combination of multiple natural language processing (NLP) techniques with ML models

WORDCLOUD

Misinformation

Not Misinformation

METHODOLOGY

Approaches ("Total Not Misinformation / Total Misinformation"):
- Air Travel Tweets (826/ 793)
- Random Tweets (1474/1526)
- Covid Tweets (940/ 856)
- Security Tweets (1000/700)
- Combined Dataset (4944/4545)

ML Models:
- Linear Regression (LR): Predicts unknown value with known value
- Multinomial Naive Bayes (MNB): Calculates probability distribution
- Probably Approximately Correct (PAC): Approximates hypothesis

Flowchart of the Proposed Study

Evaluation Metrics:
- Accuracy: Percentage of data that is accurately classified
- Precision: How often ML model correctly predicts the positive class
- Recall: Ratio of the number of true positives to the number of false negatives (tp/tp+fn)
- AUC: Overall performance of the binary classification model

RESULTS

X.1: LR; X.2: MNB; X.3: PAC.

CONCLUSION

- ML algorithms are shown to have the ability to predict and classify misinformation in social media posts.
- With improvements in the algorithm, there is the potential for SMART to be used by the social media industry in order to curb the spread of misinformation and disinformation.
- Interactive human-in-loop ML system can help further process and understand misinformation in social media data.

DISCUSSION

Modeling Air Travel Tweets:
- Lower Accuracy and Precision values compared to others
- Linear regression had an outlier Recall value of 0.99
- Difficult to discern reliability of overall dataset

Modeling Random Tweets:
- Average values for all metrics
- Similar results for three models (0.75 < Accuracy2 < 0.79 and 0.76 < Precision2 < 0.8)

Modeling Covid Tweets:
- Average values for all metrics
- Similar results for three models (0.75 < AUC3 < 0.78)

Modeling Security Tweets:
- High results for all metric evaluated points to strong dataset
- Highest average values for Recall (0.77 < Recall4 < 0.91)

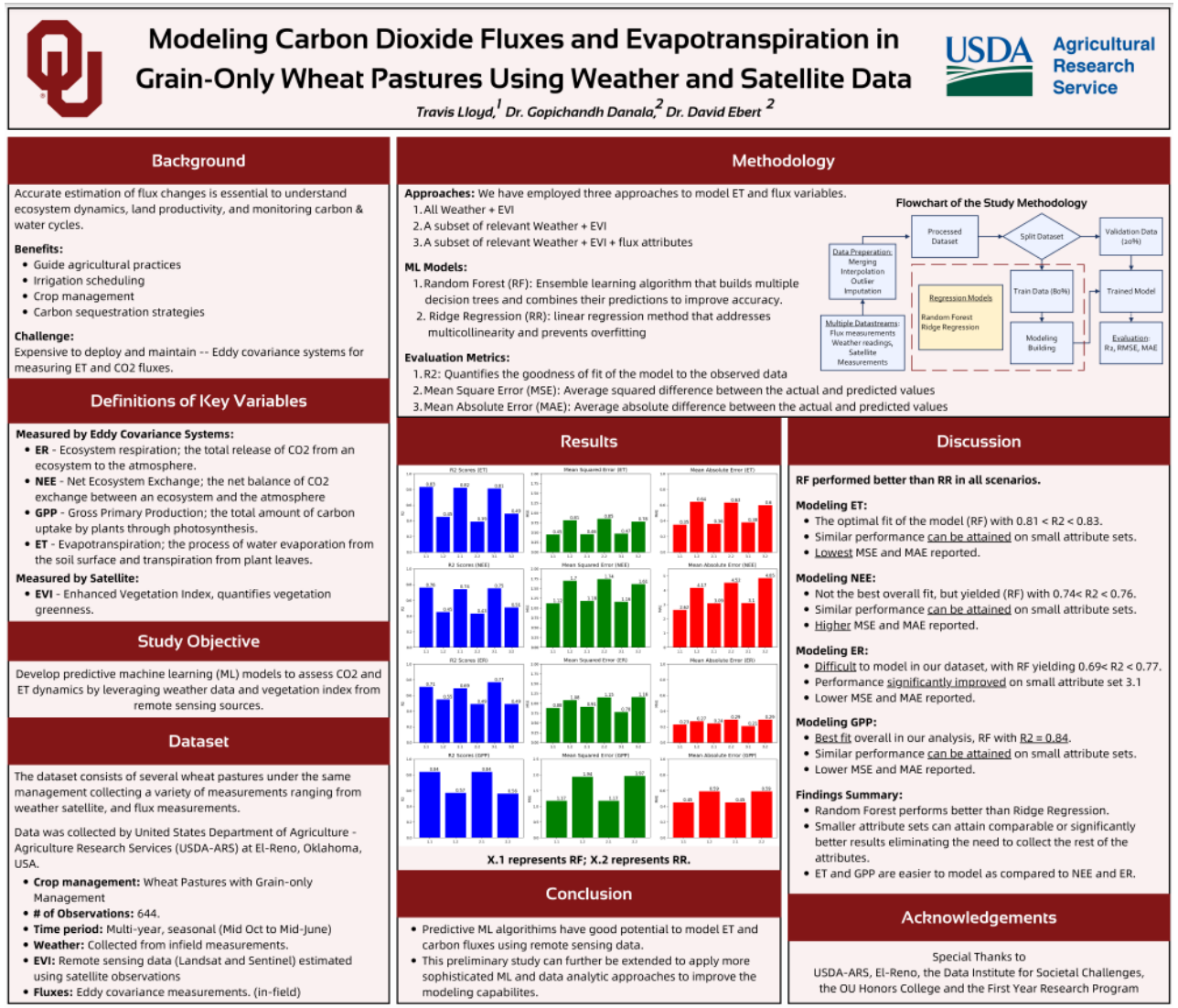
Modeling Combined Dataset:
- No significant improvement in values when all datasets are combined
- High average values for Recall (0.82 < Recall5 < 0.88)

ACKNOWLEDGEMENT

Special thanks to the Data Institute for Societal Challenges (DISC), the First-Year Research Experience (FYRE), and the University of Oklahoma Honors College

Modeling Carbon Dioxide Fluxes and Evapotranspiration in Grain-Only Wheat Pastures Using Weather and Satellite Data

Travis Lloyd, Dr. Gopichandh Danala, Dr. David Ebert



Modeling Carbon Dioxide Fluxes and Evapotranspiration in Grain-Only Wheat Pastures Using Weather and Satellite Data

Travis Lloyd,[1] Dr. Gopichandh Danala,[2] Dr. David Ebert [2]

USDA Agricultural Research Service

Background

Accurate estimation of flux changes is essential to understand ecosystem dynamics, land productivity, and monitoring carbon & water cycles.

Benefits:
- Guide agricultural practices
- Irrigation scheduling
- Crop management
- Carbon sequestration strategies

Challenge:
Expensive to deploy and maintain -- Eddy covariance systems for measuring ET and CO2 fluxes.

Definitions of Key Variables

Measured by Eddy Covariance Systems:
- **ER** - Ecosystem respiration; the total release of CO2 from an ecosystem to the atmosphere.
- **NEE** - Net Ecosystem Exchange; the net balance of CO2 exchange between an ecosystem and the atmosphere
- **GPP** - Gross Primary Production; the total amount of carbon uptake by plants through photosynthesis.
- **ET** - Evapotranspiration; the process of water evaporation from the soil surface and transpiration from plant leaves.

Measured by Satellite:
- **EVI** - Enhanced Vegetation Index, quantifies vegetation greenness.

Study Objective

Develop predictive machine learning (ML) models to assess CO2 and ET dynamics by leveraging weather data and vegetation index from remote sensing sources.

Dataset

The dataset consists of several wheat pastures under the same management collecting a variety of measurements ranging from weather satellite, and flux measurements.

Data was collected by United States Department of Agriculture - Agriculture Research Services (USDA-ARS) at El-Reno, Oklahoma, USA.
- **Crop management:** Wheat Pastures with Grain-only Management
- **# of Observations:** 644.
- **Time period:** Multi-year, seasonal (Mid Oct to Mid-June)
- **Weather:** Collected from infield measurements.
- **EVI:** Remote sensing data (Landsat and Sentinel) estimated using satellite observations
- **Fluxes:** Eddy covariance measurements. (in-field)

Methodology

Approaches: We have employed three approaches to model ET and flux variables.
1. All Weather + EVI
2. A subset of relevant Weather + EVI
3. A subset of relevant Weather + EVI + flux attributes

ML Models:
1. Random Forest (RF): Ensemble learning algorithm that builds multiple decision trees and combines their predictions to improve accuracy.
2. Ridge Regression (RR): linear regression method that addresses multicollinearity and prevents overfitting

Evaluation Metrics:
1. R2: Quantifies the goodness of fit of the model to the observed data
2. Mean Square Error (MSE): Average squared difference between the actual and predicted values
3. Mean Absolute Error (MAE): Average absolute difference between the actual and predicted values

Flowchart of the Study Methodology

Results

X.1 represents RF; X.2 represents RR.

Conclusion

- Predictive ML algorithims have good potential to model ET and carbon fluxes using remote sensing data.
- This preliminary study can further be extended to apply more sophisticated ML and data analytic approaches to improve the modeling capabilites.

Discussion

RF performed better than RR in all scenarios.

Modeling ET:
- The optimal fit of the model (RF) with 0.81 < R2 < 0.83.
- Similar performance can be attained on small attribute sets.
- Lowest MSE and MAE reported.

Modeling NEE:
- Not the best overall fit, but yielded (RF) with 0.74< R2 < 0.76.
- Similar performance can be attained on small attribute sets.
- Higher MSE and MAE reported.

Modeling ER:
- Difficult to model in our dataset, with RF yielding 0.69< R2 < 0.77.
- Performance significantly improved on small attribute set 3.1
- Lower MSE and MAE reported.

Modeling GPP:
- Best fit overall in our analysis, RF with R2 = 0.84.
- Similar performance can be attained on small attribute sets.
- Lower MSE and MAE reported.

Findings Summary:
- Random Forest performs better than Ridge Regression.
- Smaller attribute sets can attain comparable or significantly better results eliminating the need to collect the rest of the attributes.
- ET and GPP are easier to model as compared to NEE and ER.

Acknowledgements

Special Thanks to
USDA-ARS, El-Reno, the Data Institute for Societal Challenges, the OU Honors College and the First Year Research Program

The Effect of EDHF on the Resistance of Sympathetic Vasoconstriction In Healthy Young Adults

Ria M. Sachdev, Alexander A. Buelow, Matt Stanford, Jacob E. Matney, Sarah Skillett, John D. Ashley, Jiwon Song, Chris Mixon, Debra A. Bemben, Daniel J. Larson, J. Mikhail Kellawan

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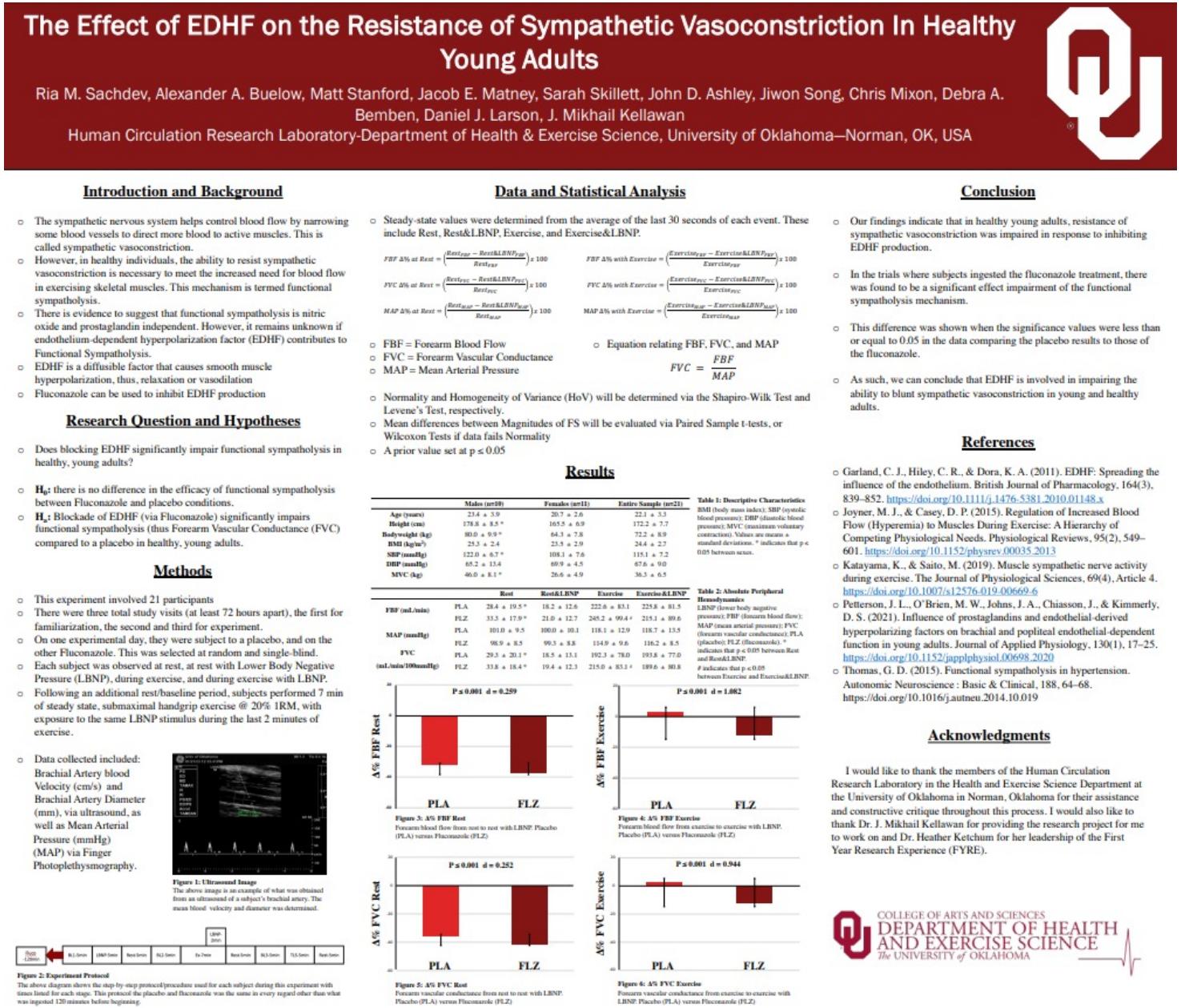

The Effect of EDHF on the Resistance of Sympathetic Vasoconstriction In Healthy Young Adults

Ria M. Sachdev, Alexander A. Buelow, Matt Stanford, Jacob E. Matney, Sarah Skillett, John D. Ashley, Jiwon Song, Chris Mixon, Debra A. Bemben, Daniel J. Larson, J. Mikhail Kellawan
Human Circulation Research Laboratory-Department of Health & Exercise Science, University of Oklahoma—Norman, OK, USA

Introduction and Background

- The sympathetic nervous system helps control blood flow by narrowing some blood vessels to direct more blood to active muscles. This is called sympathetic vasoconstriction.
- However, in healthy individuals, the ability to resist sympathetic vasoconstriction is necessary to meet the increased need for blood flow in exercising skeletal muscles. This mechanism is termed functional sympatholysis.
- There is evidence to suggest that functional sympatholysis is nitric oxide and prostaglandin independent. However, it remains unknown if endothelium-dependent hyperpolarization factor (EDHF) contributes to Functional Sympatholysis.
- EDHF is a diffusible factor that causes smooth muscle hyperpolarization, thus, relaxation or vasodilation
- Fluconazole can be used to inhibit EDHF production

Research Question and Hypotheses

- Does blocking EDHF significantly impair functional sympatholysis in healthy, young adults?
- H_0: there is no difference in the efficacy of functional sympatholysis between Fluconazole and placebo conditions.
- H_a: Blockade of EDHF (via Fluconazole) significantly impairs functional sympatholysis (thus Forearm Vascular Conductance (FVC) compared to a placebo in healthy, young adults.

Methods

- This experiment involved 21 participants
- There were three total study visits (at least 72 hours apart), the first for familiarization, the second and third for experiment.
- On one experimental day, they were subject to a placebo, and on the other Fluconazole. This was selected at random and single-blind.
- Each subject was observed at rest, at rest with Lower Body Negative Pressure (LBNP), during exercise, and during exercise with LBNP.
- Following an additional rest/baseline period, subjects performed 7 min of steady state, submaximal handgrip exercise @ 20% 1RM, with exposure to the same LBNP stimulus during the last 2 minutes of exercise.
- Data collected included: Brachial Artery blood Velocity (cm/s) and Brachial Artery Diameter (mm), via ultrasound, as well as Mean Arterial Pressure (mmHg) (MAP) via Finger Photoplethysmography.

Figure 1: Ultrasound Image
The above image is an example of what was obtained from an ultrasound of a subject's brachial artery. The mean blood velocity and diameter was determined.

Figure 2: Experiment Protocol
The above diagram shows the step-by-step protocol/procedure used for each subject during this experiment with times listed for each stage. This protocol the placebo and fluconazole was the same in every regard other than what was ingested 120 minutes before beginning.

Data and Statistical Analysis

- Steady-state values were determined from the average of the last 30 seconds of each event. These include Rest, Rest&LBNP, Exercise, and Exercise&LBNP.

$$FBF\ \Delta\%\ at\ Rest = \left(\frac{Rest_{FBF} - Rest\&LBNP_{FBF}}{Rest_{FBF}}\right) x\ 100 \qquad FBF\ \Delta\%\ with\ Exercise = \left(\frac{Exercise_{FBF} - Exercise\&LBNP_{FBF}}{Exercise_{FBF}}\right) x\ 100$$

$$FVC\ \Delta\%\ at\ Rest = \left(\frac{Rest_{FVC} - Rest\&LBNP_{FVC}}{Rest_{FVC}}\right) x\ 100 \qquad FVC\ \Delta\%\ with\ Exercise = \left(\frac{Exercise_{FVC} - Exercise\&LBNP_{FVC}}{Exercise_{FVC}}\right) x\ 100$$

$$MAP\ \Delta\%\ at\ Rest = \left(\frac{Rest_{MAP} - Rest\&LBNP_{MAP}}{Rest_{MAP}}\right) x\ 100 \qquad MAP\ \Delta\%\ with\ Exercise = \left(\frac{Exercise_{MAP} - Exercise\&LBNP_{MAP}}{Exercise_{MAP}}\right) x\ 100$$

- FBF = Forearm Blood Flow
- FVC = Forearm Vascular Conductance
- MAP = Mean Arterial Pressure
- Equation relating FBF, FVC, and MAP

$$FVC = \frac{FBF}{MAP}$$

- Normality and Homogeneity of Variance (HoV) will be determined via the Shapiro-Wilk Test and Levene's Test, respectively.
- Mean differences between Magnitudes of FS will be evaluated via Paired Sample t-tests, or Wilcoxon Tests if data fails Normality
- A prior value set at $p \leq 0.05$

Results

	Males (n=10)	Females (n=11)	Entire Sample (n=21)
Age (years)	23.4 ± 3.9	20.7 ± 2.6	22.1 ± 3.3
Height (cm)	178.8 ± 8.5 *	165.5 ± 6.9	172.2 ± 7.7
Bodyweight (kg)	80.0 ± 9.9 *	64.3 ± 7.8	72.2 ± 8.9
BMI (kg/m²)	25.3 ± 2.4	23.5 ± 2.9	24.4 ± 2.7
SBP (mmHg)	122.0 ± 6.7 *	108.1 ± 7.6	115.1 ± 7.2
DBP (mmHg)	65.2 ± 13.4	69.9 ± 4.5	67.6 ± 9.0
MVC (kg)	46.0 ± 8.1 *	26.6 ± 4.9	36.3 ± 6.5

Table 1: Descriptive Characteristics
BMI (body mass index); SBP (systolic blood pressure); DBP (diastolic blood pressure); MVC (maximum voluntary contraction). Values are means ± standard deviations. * indicates that $p < 0.05$ between sexes.

		Rest	Rest&LBNP	Exercise	Exercise&LBNP
FBF (mL/min)	PLA	28.4 ± 19.5 *	18.2 ± 12.6	222.6 ± 83.1	225.8 ± 81.5
	FLZ	33.3 ± 17.9 *	21.0 ± 12.7	245.2 ± 99.4 #	215.1 ± 89.6
MAP (mmHg)	PLA	101.0 ± 9.5	100.0 ± 10.1	118.1 ± 12.9	118.7 ± 13.5
	FLZ	98.9 ± 8.5	99.5 ± 8.8	114.9 ± 9.6	116.2 ± 8.5
FVC (mL/min/100mmHg)	PLA	29.3 ± 20.1 *	18.5 ± 13.1	192.3 ± 78.0	193.8 ± 77.0
	FLZ	33.8 ± 18.4 *	19.4 ± 12.3	215.0 ± 83.1 #	189.6 ± 80.8

Table 2: Absolute Peripheral Hemodynamics
LBNP (lower body negative pressure); FBF (forearm blood flow); MAP (mean arterial pressure); FVC (forearm vascular conductance); PLA (placebo); FLZ (fluconazole). * indicates that $p \leq 0.05$ between Rest and Rest&LBNP. # indicates that $p < 0.05$ between Exercise and Exercise&LBNP.

Figure 3: Δ% FBF Rest
Forearm blood flow from rest to rest with LBNP. Placebo (PLA) versus Fluconazole (FLZ)

Figure 4: Δ% FBF Exercise
Forearm blood flow from exercise to exercise with LBNP. Placebo (PLA) versus Fluconazole (FLZ)

Figure 5: Δ% FVC Rest
Forearm vascular conductance from rest to rest with LBNP. Placebo (PLA) versus Fluconazole (FLZ)

Figure 6: Δ% FVC Exercise
Forearm vascular conductance from exercise to exercise with LBNP. Placebo (PLA) versus Fluconazole (FLZ)

Conclusion

- Our findings indicate that in healthy young adults, resistance of sympathetic vasoconstriction was impaired in response to inhibiting EDHF production.
- In the trials where subjects ingested the fluconazole treatment, there was found to be a significant effect impairment of the functional sympatholysis mechanism.
- This difference was shown when the significance values were less than or equal to 0.05 in the data comparing the placebo results to those of the fluconazole.
- As such, we can conclude that EDHF is involved in impairing the ability to blunt sympathetic vasoconstriction in young and healthy adults.

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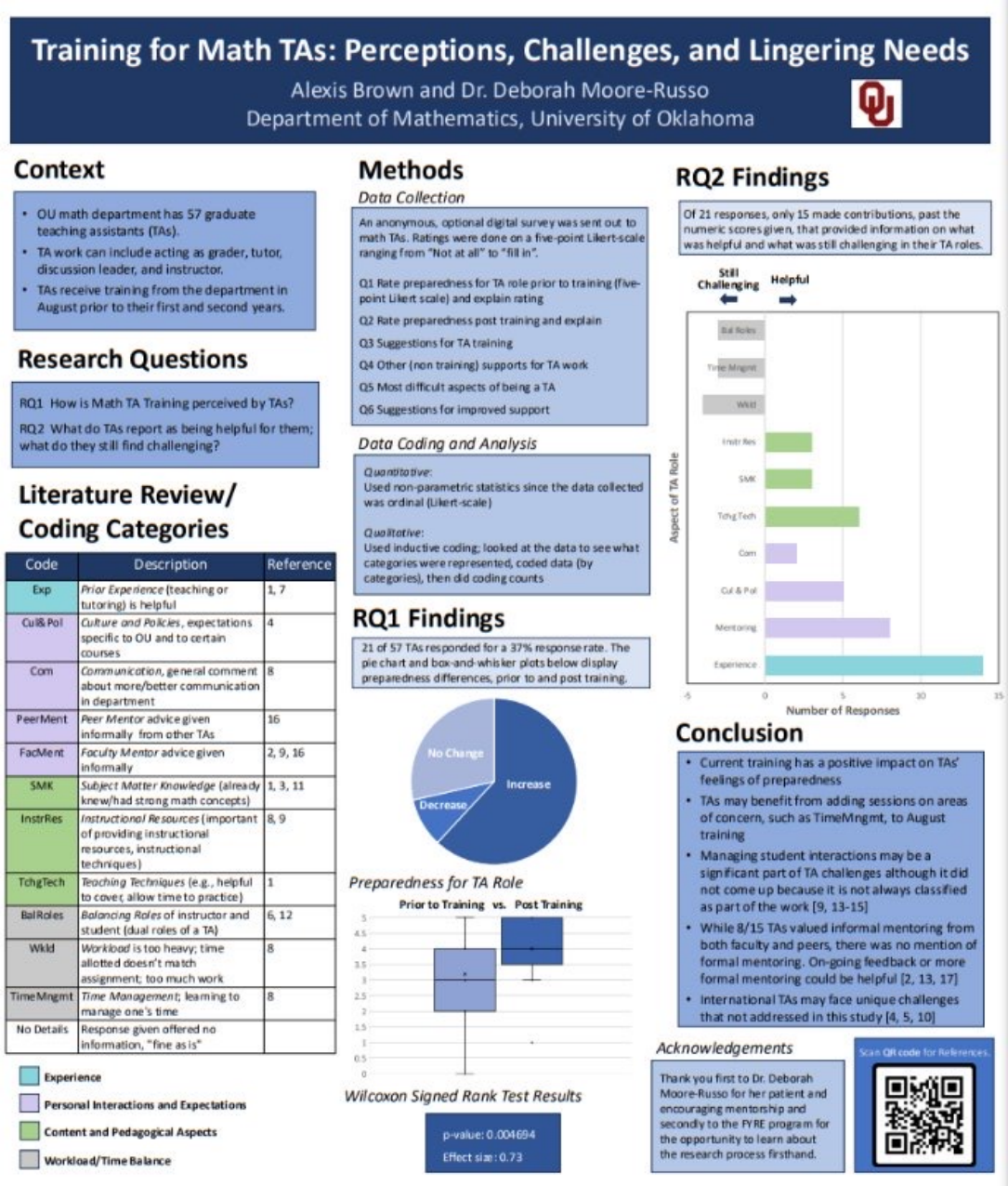
COLLEGE OF ARTS AND SCIENCES
DEPARTMENT OF HEALTH AND EXERCISE SCIENCE
The UNIVERSITY of OKLAHOMA

Training for Math TAs: Perceptions, Challenges, and Lingering Needs

Alexis Brown and Dr. Deborah Moore-Russo – Department of Mathematics, University of Oklahoma



Training for Math TAs: Perceptions, Challenges, and Lingering Needs

Alexis Brown and Dr. Deborah Moore-Russo
Department of Mathematics, University of Oklahoma

Context

- OU math department has 57 graduate teaching assistants (TAs).
- TA work can include acting as grader, tutor, discussion leader, and instructor.
- TAs receive training from the department in August prior to their first and second years.

Research Questions

RQ1 How is Math TA Training perceived by TAs?

RQ2 What do TAs report as being helpful for them; what do they still find challenging?

Literature Review/ Coding Categories

Code	Description	Reference
Exp	*Prior Experience* (teaching or tutoring) is helpful	1, 7
Cul&Pol	*Culture and Policies*, expectations specific to OU and to certain courses	4
Com	*Communication*, general comment about more/better communication in department	8
PeerMent	*Peer Mentor* advice given informally from other TAs	16
FacMent	*Faculty Mentor* advice given informally	2, 9, 16
SMK	*Subject Matter Knowledge* (already knew/had strong math concepts)	1, 3, 11
InstrRes	*Instructional Resources* (important of providing instructional resources, instructional techniques)	8, 9
TchgTech	*Teaching Techniques* (e.g., helpful to cover, allow time to practice)	1
BalRoles	*Balancing Roles* of instructor and student (dual roles of a TA)	6, 12
Wkld	*Workload* is too heavy; time allotted doesn't match assignment; too much work	8
TimeMngmt	*Time Management*; learning to manage one's time	8
No Details	Response given offered no information, "fine as is"	

Experience
Personal Interactions and Expectations
Content and Pedagogical Aspects
Workload/Time Balance

Methods

Data Collection

An anonymous, optional digital survey was sent out to math TAs. Ratings were done on a five-point Likert-scale ranging from "Not at all" to "fill in".

Q1 Rate preparedness for TA role prior to training (five-point Likert scale) and explain rating

Q2 Rate preparedness post training and explain

Q3 Suggestions for TA training

Q4 Other (non training) supports for TA work

Q5 Most difficult aspects of being a TA

Q6 Suggestions for improved support

Data Coding and Analysis

Quantitative:
Used non-parametric statistics since the data collected was ordinal (Likert-scale)

Qualitative:
Used inductive coding; looked at the data to see what categories were represented, coded data (by categories), then did coding counts

RQ1 Findings

21 of 57 TAs responded for a 37% response rate. The pie chart and box-and-whisker plots below display preparedness differences, prior to and post training.

Preparedness for TA Role

Wilcoxon Signed Rank Test Results

p-value: 0.004694
Effect size: 0.73

RQ2 Findings

Of 21 responses, only 15 made contributions, past the numeric scores given, that provided information on what was helpful and what was still challenging in their TA roles.

Conclusion

- Current training has a positive impact on TAs' feelings of preparedness
- TAs may benefit from adding sessions on areas of concern, such as TimeMngmt, to August training
- Managing student interactions may be a significant part of TA challenges although it did not come up because it is not always classified as part of the work [9, 13-15]
- While 8/15 TAs valued informal mentoring from both faculty and peers, there was no mention of formal mentoring. On-going feedback or more formal mentoring could be helpful [2, 13, 17]
- International TAs may face unique challenges that not addressed in this study [4, 5, 10]

Acknowledgements

Thank you first to Dr. Deborah Moore-Russo for her patient and encouraging mentorship and secondly to the FYRE program for the opportunity to learn about the research process firsthand.

Scan QR code for References

Deep Learning Linear Regression Experiment to Predict Housing Price

Caleb Smith, Iman Ghamarian

Gallogly College of Engineering | Accelerated Materials Development Lab

Deep Learning Linear Regression Experiment to Predict Housing Price

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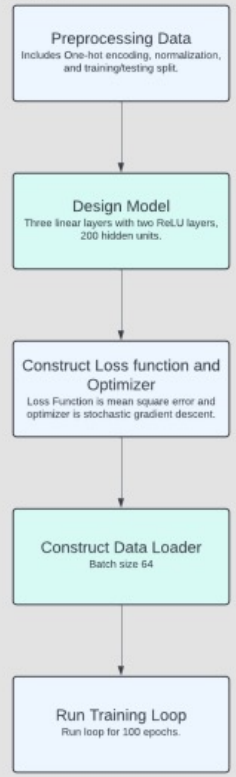
Introduction

Machine learning and its application are becoming increasingly important in today's world as it continues to integrate itself in various fields. Specifically, a field of machine learning known as deep learning which involves the use of neural networks has seen a rise in use cases across various industries as it has an unparalleled ability to learn off pre-existing data and perform various tasks. This research aims to explore deep learning at a fundamental level and to create a linear regression model that can be used to predict housing sale price based on a variety of variables.

Materials

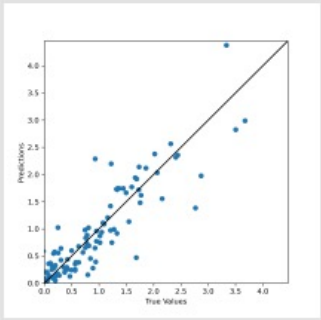
- Kaggle housing data set – This is the data set we will be using for the experiment. It contains 80 feature variables with 1 output variable (Sale price)
- Python and PyTorch – This is the language and library that will be used to build the model. PyTorch specifically is a library designed for deep learning applications through the use of tensors.

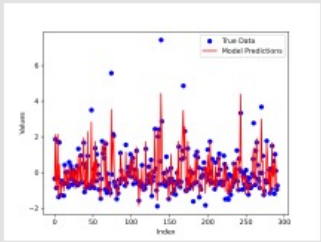
Methodology



Results

Average Test Loss: 0.14





Conclusion

In conclusion, our model was able to capture the data reasonably well. However, It did have some trouble, especially with outlier data. Not only that, but during the training of the model, model loss seemed to fluctuate greatly indicating that the model was not able to capture the data completely. If we were to reconduct this experiment, we may try using an embedding to see if that would allow us to better capture the non-numerical parts of the data.

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Acknowledgements

I would like to thank the FYRE program for giving me this opportunity and to Dr. Ghamarian for mentoring and guiding me through this topic.

CAD Enhanced Design of Ergonomic Laptop Stands to Reduce Work-Related Musculoskeletal Disorders

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Aerospace and Mechanical Engineering, 865 Asp Ave. Rm. 205 Norman, OK 73019

CAD Enhanced Design of Ergonomic Laptop Stands to Reduce Work-Related Musculoskeletal Disorders

Alfonzie C. Stepney

Dr. Yingtao Liu, Aerospace and Mechanical Engineering, 865 Asp Ave. Rm. 205 Norman, OK 73019

Introduction

Recently, there has been an increasing demand for laptop stands. In fact, the market share is expected to grow to $504.32 million by 2031 (Business Report Insights, 2024). However, with greater use comes greater risk of injury with work-related musculoskeletal disorders (WMSDs), and stands can be an effective tool in reducing these injuries.

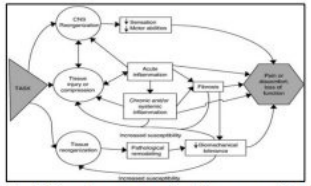


Fig. 1: A flowchart showing the ways WMSDs can occur. (Barr, Barbe, and Clark, 2004).

Background

Over the past 30 years, several studies have been done to determine how the amount, duration, and frequency of force put on one's joints can impact joint health over time. These studies revealed that consistent, hard force resulted in noticeably weaker joint strength.

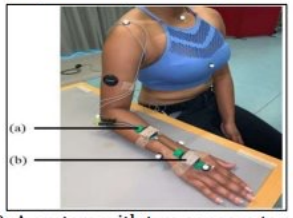
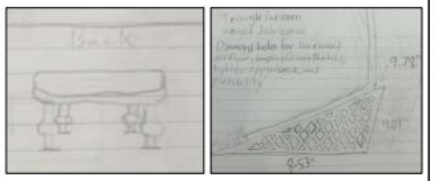


Fig. 2: A system with two sensors to measure movement in arm (Karnica and Yang, 2022).

Methods

To ensure that my design was feasible, I needed to have sketches to make an initial framework for the stands. The images below (Figs. 2-3) show what the initial concept design was intended to look like. This also was a crucial step to take so that any changes I made could be done without significantly altering the final design.



Figs. 3-4: Sketches of initial (left) and final (right) designs, with sketched laptop sitting on final sketch and hinges on the initial sketch.

After the sketching process was complete, I used Computer-Aided Design (CAD) to transform the sketches into models and prepare them for 3D printing. A popular CAD software to do this is SolidWorks, and this is what I chose for the project. The images below (Figs. 4-5) show the modeling of the initial and final designs, with distinct features unique to each one.

Figs. 4-5: (left) Model of initial and (right) model of final design, with diamond rods to be placed inside the holes on the right and hinges to move a tray back and forth on the left. The rods are intended to be used for stability purposes.

Results/Discussion

At the conclusion of this project, I completed a 3D print model of the stand from a profile view. An example of this can be seen in the image below (Fig. 6). Due to resource constraints from the Bizzell Library's 3D printing lab, a full-size model could not be built. However, this project has the potential for further expansion to determine if this design can reduceWMSDs. The future plan is to discover how this design can be applicable in various settings.

Fig.6: A side profile view of the 3D printed stand base.

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2. Business Research Insights. "Laptop Stands Market Size, Share, Growth, and Industry Analysis, by Type (Aluminum Laptop Stand, Acrylic Laptop Stand, Plastic Laptop Stand and Others), by Application (Office, Residence, School and Others), Regional Insights, and Forecast from 2024 to 2031." *Laptop Stands Market 2024 To 2031 | [119] Pages Report*, 1 Apr. 2024. www.businessresearchinsights.com/market-reports/laptop-stands-market-103230.

3. Manivasagam, Karnica, and Liyun Yang. "Evaluation of a New Simplified Inertial Sensor Method against Electrogoniometer for Measuring Wrist Motion in Occupational Studies." MDPI, February 21, 2022. https://www.mdpi.com/1424-8220/22/4/1690.

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I would like to thank Dr. Liu for mentoring me throughout this project, FYRE and the Honors College for allowing me to participate in this program and do research, and finally, the Gallogly College of Engineering for allowing me to utilize their computer lab.

Designing a Smart, Modular Greenhouse for Rural India

Katy Joyce, Timi Oduleye

Team Members
Katy Joyce
Timi Oduleye

Designing a Smart, Modular Greenhouse for Rural India

OU Mentors
Farrokh Mistree
Mayank J. Bhalerao
Wesley T. Honeycutt

PROBLEM

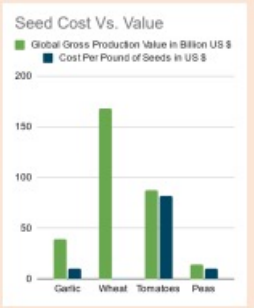
Frame of Reference

Indian citizens have difficulties making money in rural areas. Farming, a popular avenue towards making money in these areas, can be inefficient at times. This issue needs to be addressed promptly or local economies will continue to struggle.

Existing Greenhouses

- Greenhouses are structures that allow farmers to have complete control over their crops.
- Greenhouse efficiency is enhanced through the use of smart systems.
- Smart systems use sensors to monitor conditions. Once conditions are recorded, the data are read, and the system maintains ideal conditions.

Problem Description

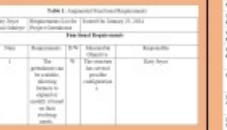


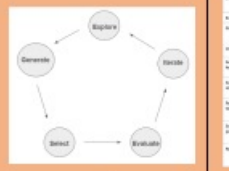
The high cost of conventional greenhouse farming limits its use to high-value crops, excluding some farmers. To address this, we propose designing and deploying low-cost modular greenhouses using local waste materials for construction, aiming to make greenhouse farming more accessible and affordable for farmers based in rural India.

DESIGN METHOD

Initial Steps

- Design development included dissecting the problem with a requirements list.
- Gathering information about the scope of the project refined our ability to extract knowledge gained from research.
- Pairing the requirements list with a randomized design system allowed us to generate four unique concepts that fit the constraints outlined before ideation.





Concept Evaluation

- Concept generation is enhanced through critical thinking.
- Breaking down each design using PMI and PDPC revealed strengths/weaknesses.
- Better iterations were developed as we continued to grow in our research skills.
- Once concepts are fully evaluated, they need to be methodically filtered out based on potential for success in the outlined scenario.

Go/No Go Analysis

Concept 3 (Lean Green Eco Machine): Go/ No Go Analysis

Effective Self-Regulation (7 points)	Prevent Humidity Buildup (6 points)	Allow Sunlight Penetration (5 points)	Provide Water (4 points)	Suitable Growing Medium (3 points)	Regulate Pests (2 points)	Operate Cost-Effectively (1 point)
No Go	Go	Go	Go	No Go	Go	No Go

Go Total: 17 points

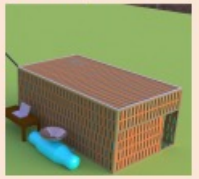
No Go Total: 11 points

- Go/No Go analyses are used in research to compare designs using certain criteria.
- Chosen criteria are framed and prioritized in the context of providing the greatest yield for rural India (focus on desired modularity).
- If a design received a "No Go", we then identified potential modifications that could be made to better the design.

POSSIBLE OUTCOMES

Concept Comparison

After conducting the Go/No Go Analysis, two concepts fulfilled all functional requirements.



Both designs have their merits, but Concept 4 was chosen due to its ability to remain self-sufficient while enhancing the local community.

Chosen Concept

For our chosen concept, we decided on concept 4. This design exemplifies the balance of "smart" and "modular" defined in the requirements list in several ways:

- Concept 4 utilizes a smart system that is able to properly measure and regulate greenhouse conditions.
- Concept 4 is almost entirely made from reusable materials, making it cost- efficient and eco-friendly.
- Sustainable water collection and heating methods are utilized.
- Companion plants keep bugs away and have the potential to be sold for profit.

Value + Way Forward

There are plenty of ways the project can be developed further, including prototyping and design validation. More research needs to be done regarding monetary feasibility.

Katy's value: I found value in getting to learn more about research and the design process. I loved touring the greenhouses and plan on contributing to other research projects in the future.

Timi's value: I plan to apply the skills learned during this project to research in a different field regarding technological advancement for the benefit of third world countries.

Image Sources (In Order of Appearance):
Row 1, Panel 1: https://c.stocksy.com/a/BOfA00/z9/2542383.jpg
Row 1, Panel 2: https://blog.sensaphone.com/hs-fs/hubfs/Blog/Greenhouse-Sensors-1.jpg?width=1185&height=656&name=Greenhouse-Sensors-1.jpg

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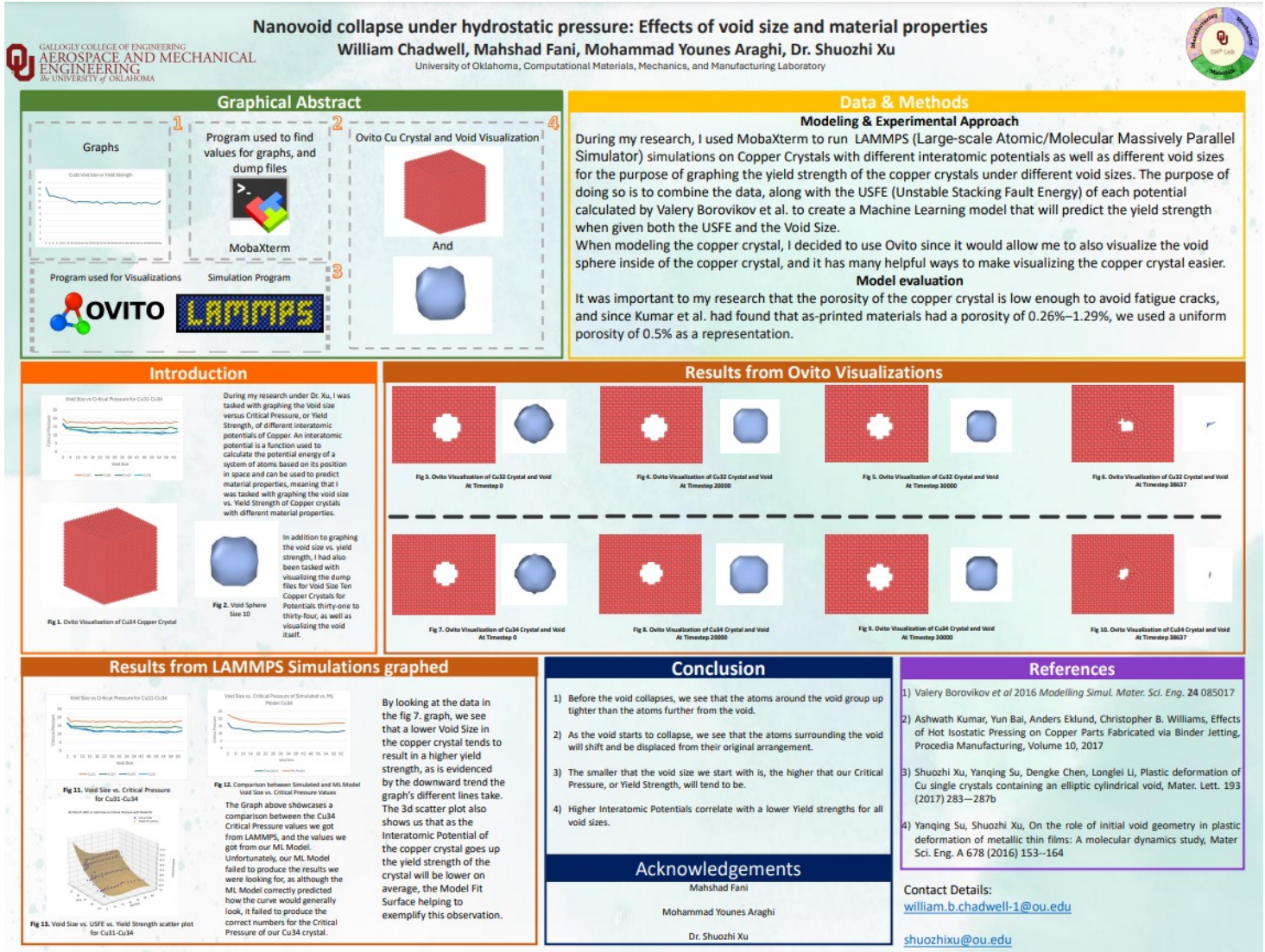
GALLOGLY COLLEGE OF ENGINEERING SCHOOL OF AEROSPACE AND MECHANICAL ENGINEERING

Nanovoid collapse under hydrostatic pressure: Effects of void size and material properties

William Chadwell, Mahshad Fani, Mohammad Younes Araghi, Dr. Shuozhi Xu

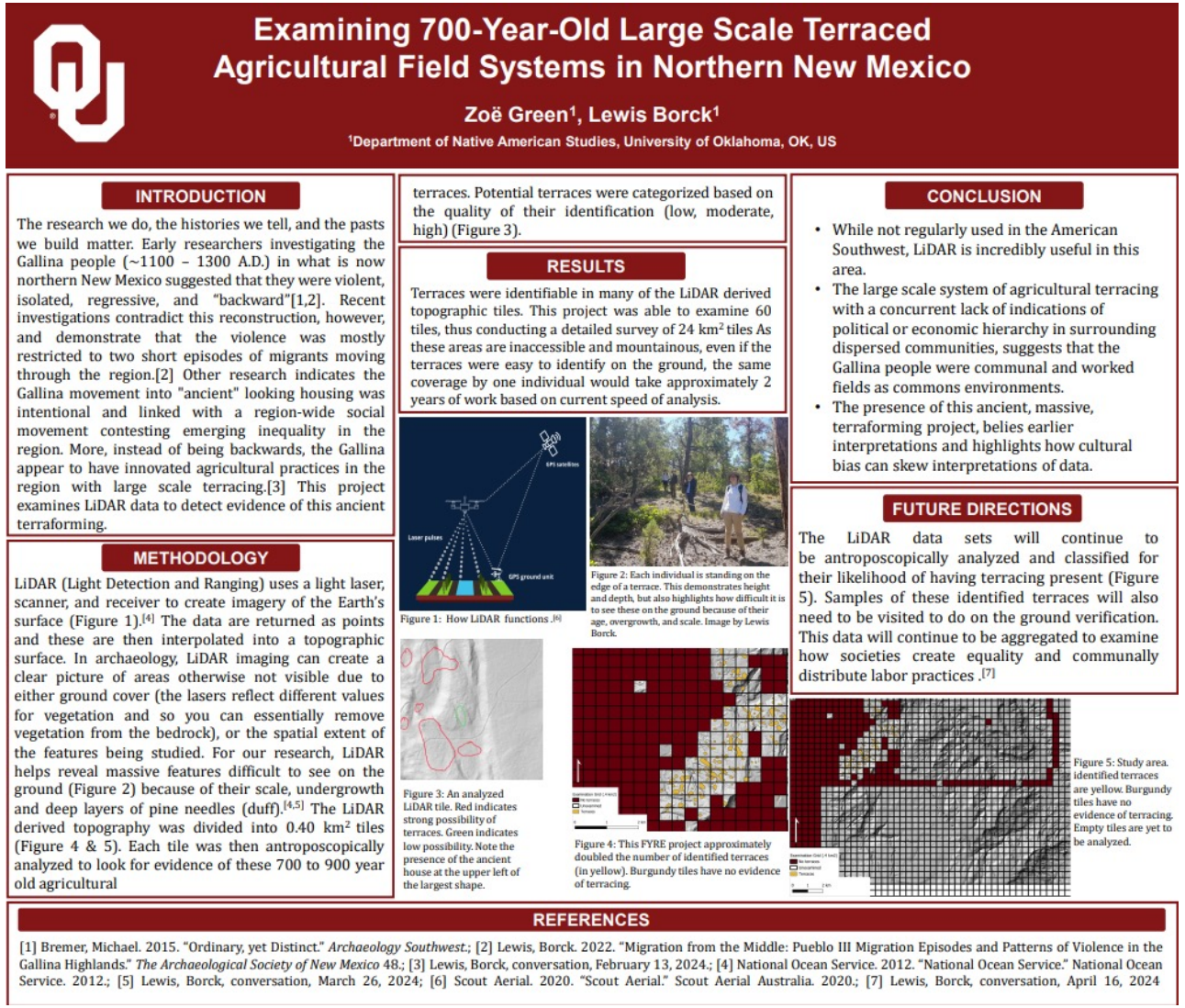
University of Oklahoma, Computational Materials, Mechanics, and Manufacturing Laboratory



Examining 700-Year-Old Large Scale Terraced Agricultural Field Systems in Northern New Mexico

Zoë Green 1, Lewis Borck 1

1 Department of Native American Studies, University of Oklahoma, OK, US



Examining 700-Year-Old Large Scale Terraced Agricultural Field Systems in Northern New Mexico

Zoë Green[1], Lewis Borck[1]

[1]Department of Native American Studies, University of Oklahoma, OK, US

INTRODUCTION

The research we do, the histories we tell, and the pasts we build matter. Early researchers investigating the Gallina people (~1100 – 1300 A.D.) in what is now northern New Mexico suggested that they were violent, isolated, regressive, and "backward"[1,2]. Recent investigations contradict this reconstruction, however, and demonstrate that the violence was mostly restricted to two short episodes of migrants moving through the region.[2] Other research indicates the Gallina movement into "ancient" looking housing was intentional and linked with a region-wide social movement contesting emerging inequality in the region. More, instead of being backwards, the Gallina appear to have innovated agricultural practices in the region with large scale terracing.[3] This project examines LiDAR data to detect evidence of this ancient terraforming.

METHODOLOGY

LiDAR (Light Detection and Ranging) uses a light laser, scanner, and receiver to create imagery of the Earth's surface (Figure 1).[4] The data are returned as points and these are then interpolated into a topographic surface. In archaeology, LiDAR imaging can create a clear picture of areas otherwise not visible due to either ground cover (the lasers reflect different values for vegetation and so you can essentially remove vegetation from the bedrock), or the spatial extent of the features being studied. For our research, LiDAR helps reveal massive features difficult to see on the ground (Figure 2) because of their scale, undergrowth and deep layers of pine needles (duff).[4,5] The LiDAR derived topography was divided into 0.40 km^2 tiles (Figure 4 & 5). Each tile was then antroposcopically analyzed to look for evidence of these 700 to 900 year old agricultural terraces. Potential terraces were categorized based on the quality of their identification (low, moderate, high) (Figure 3).

RESULTS

Terraces were identifiable in many of the LiDAR derived topographic tiles. This project was able to examine 60 tiles, thus conducting a detailed survey of 24 km^2 tiles As these areas are inaccessible and mountainous, even if the terraces were easy to identify on the ground, the same coverage by one individual would take approximately 2 years of work based on current speed of analysis.

Figure 1: How LiDAR functions .[6]

Figure 2: Each individual is standing on the edge of a terrace. This demonstrates height and depth, but also highlights how difficult it is to see these on the ground because of their age, overgrowth, and scale. Image by Lewis Borck.

Figure 3: An analyzed LiDAR tile. Red indicates strong possibility of terraces. Green indicates low possibility. Note the presence of the ancient house at the upper left of the largest shape.

Figure 4: This FYRE project approximately doubled the number of identified terraces (in yellow). Burgundy tiles have no evidence of terracing.

CONCLUSION

- While not regularly used in the American Southwest, LiDAR is incredibly useful in this area.
- The large scale system of agricultural terracing with a concurrent lack of indications of political or economic hierarchy in surrounding dispersed communities, suggests that the Gallina people were communal and worked fields as commons environments.
- The presence of this ancient, massive, terraforming project, belies earlier interpretations and highlights how cultural bias can skew interpretations of data.

FUTURE DIRECTIONS

The LiDAR data sets will continue to be antroposcopically analyzed and classified for their likelihood of having terracing present (Figure 5). Samples of these identified terraces will also need to be visited to do on the ground verification. This data will continue to be aggregated to examine how societies create equality and communally distribute labor practices .[7]

Figure 5: Study area. identified terraces are yellow. Burgundy tiles have no evidence of terracing. Empty tiles are yet to be analyzed.

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Particle Deposition in 3D Printed Human Lung Model Under Realistic Physiological Conditions

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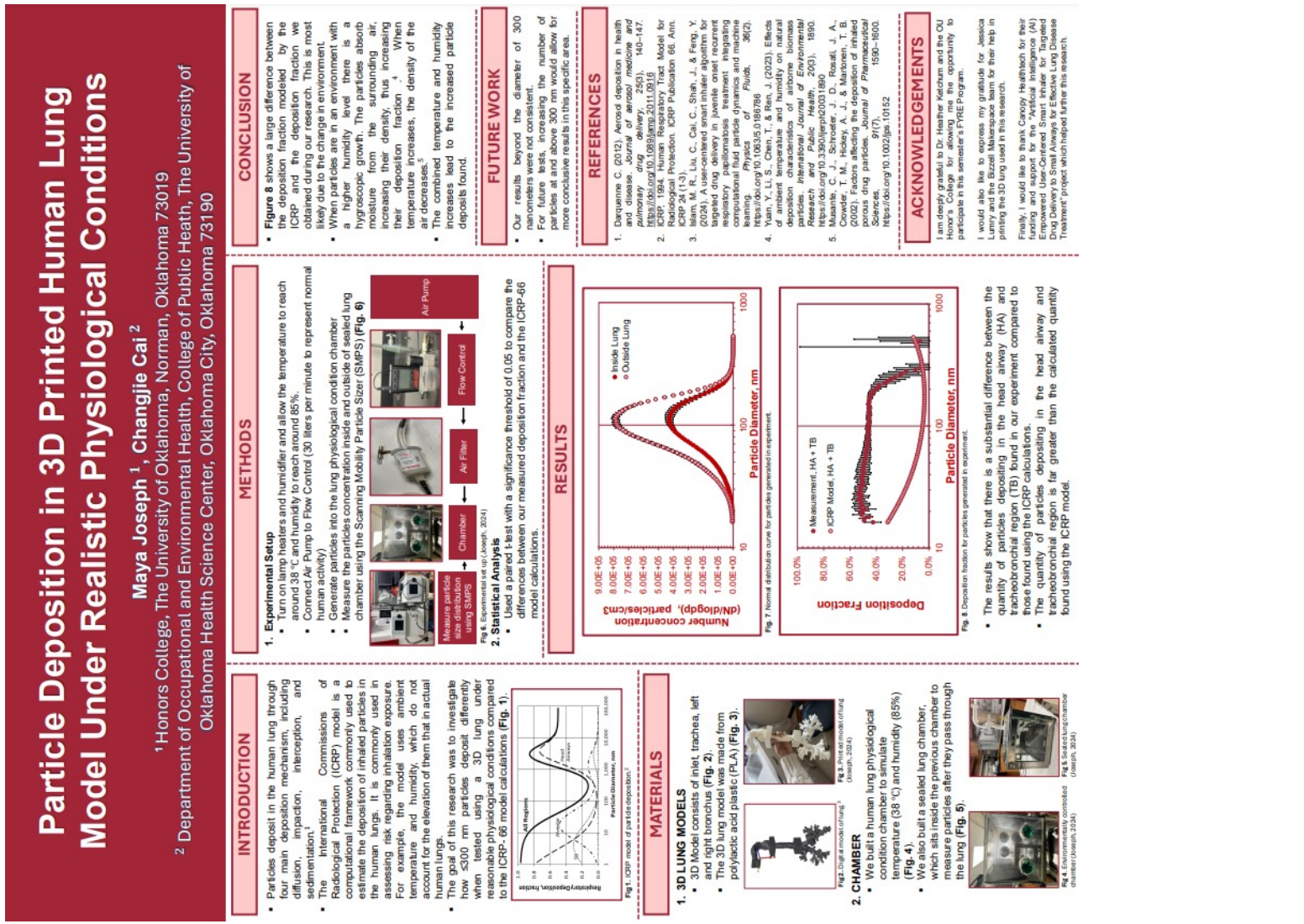
1 Honors College, The University of Oklahoma, Norman, Oklahoma 73019
2 Department of Occupational and Environmental Health, College of Public Heath, The University of Oklahoma Health Science Center, Oklahoma City, Oklahoma 73190



Measuring RNA Stability with 5-EU and its Implications

Kane Hoffman 1, Jayden Lee 1, Haripriya Gupta 2, Je-Hyun Yoon 2

1 University of Oklahoma, 2 University of Oklahoma Health Sciences Center

Measuring RNA Stability with 5-EU and its Implications

Kane Hoffman[1], Jayden Lee[1], Haripriya Gupta[2], Je-Hyun Yoon[2]

1 – University of Oklahoma, 2 – University of Oklahoma Health Sciences Center

Abstract

RNA is intimately related to a large majority of biological processes from expression of genetic material to even structural molecules. As such, RNA decay is a topic that demands further study given its ubiquity. Given its impacts in protein creation and thus bodily function, we sought to quantify the decay of RNA over increasing periods of time. Notably, we utilized 5-ethynyl-uridine (5-EU) labeling over previously used methods such as transcription shut-off methods such as chemical inhibitors or mutants of RNA polymerase. This designed protocol allows for real-time dynamics and precise decay rate measurements due to its ability in identifying and isolating newly synthesized RNA.

Introduction

Messenger RNA (mRNA) plays a crucial role in gene expression through protein synthesis by acting as an intermediary between the information stored in DNA and the amino acid sequence and thus function of proteins (1). The decay of mRNA allows newly synthesized mRNA to replace mRNA that may possess defects and ensures rapid turnover for fast changes in the transcriptome composition (2). By understanding how mRNA degrades, we can understand more about how this process affects other cellular processes. 5-Ethynyl Uridine (5-EU) is a nucleoside that we are using to monitor RNA degradation. 5-EU permeates the cell and incorporates into nascent RNA in place of uridine, marking RNA and making it detectable via click chemistry (3).

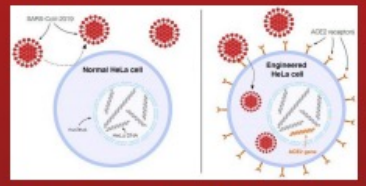


Fig. 1 (4) - a graphic showing the use of HeLa cells in COVID-19 research. We use the cells in a similar manner, by extracting a specific RNA.

Methodology

1. Growing + treatment of cells (Fig. 1)
   - Grow HeLa cells in 100-150mm culture dish using DMEM supplemented with 10% fetal bovine serum and 100 U/mL Penicillin/Streptomycin
   - Add 200 mM stock solution into the media and incubate cells at 37 C for 24 hours
   - After incubation change medium lacking 5-EU and harvest cells at 0, 2, 4, and 6 hours

2. Harvest cells
   - Wash cells with DPBS twice and add 1mL Trizol to lyse the cells
   - Transfer the lysate to a 1.5mL tube using a scraper and pipette
   - Add 200uL chloroform and shake vigorously for 10 seconds
   - Centrifuge the sample for 15 min at 12,000 × g, 4°C.
   - Transfer 400uL of the aqueous phase containing the RNA to a new tube.
   - Add 0.5 mL of isopropanol to the aqueous phase, shake vigorously for 10 seconds and incubate for 10 min.
   - Centrifuge for 15 min at 12,000×g, 4°C and discard the supernatant.
   - Resuspend the pellet in 1mL cold 75% ethanol.
   - Invert the sample, then centrifuge for 5 min at 7,500 x g, 4°C and discard the supernatant.
   - Air dry the RNA pellet for 10 minutes and add 100 uL deionized water.
   - Measure the RNA concentration and dilute with deionized water to make the total RNA concentration 1-5 ug/uL for the click reaction and save at least 10 ug for input RNA.

3. Biotinylation (Fig. 2)
   - Thaw the 10 mM Biotin Azide and Click-iT reaction buffer
   - Use 5 ug of RNA (if possible, use the highest RNA amount fitted in 50 uL volume) and 2.5 uL of Biotin azide
   - Prepare the Click-iT reaction mixture cocktail in 50 uL volume per reaction as mentioned below.
     - Deionized water - 14.75uL
     - EU Buffer 2x - 25uL
     - CuSO4(25mM) - 4uL
     - Biotin Azide - 2.5uL
     - 5-EU RNA 1˜5ug - 1uL
     - Buffer additive 1 - 1.25uL
   - Gently pipette up and down to mix the cocktail after adding each component
   - Add buffer additive 1, then immediately mix the cocktail by gently pipetting it up and down and incubate it for 3 minutes. This step initiates the click reaction between the 5-EU-RNA and biotin azide.
   - Add buffer additive 2 after 3 minutes of incubation of cocktail with buffer additive 1. It should turn dark brown.
   - Incubate this reaction cocktail for 30 minutes by gently vortexing.

4. Precipitation of Biotinylated RNA
   - Add 1 uL of Glycoblue, 50 uL of 7.5M ammonium acetate, and 700 uL of chilled 100% ethanol to the biotinylated RNA sample. Mix it by inverting the tubes or gently pipetting up and down.
   - Incubate the tube overnight at -70 to -80°C.
   - Centrifuge the tube at 13,000 g for 20 min at 4°C.
   - Remove the supernatant from the tube without disturbing the pellet and add 700uL of 75% ethanol. Vortex the tube briefly and centrifuge it at 13,000 g for 5 min at 4°C.
   - Repeat step 4 once and discard all the supernatant without disturbing the pellet. Let the pellet dry for 10 min at a clean bench and resuspend it in 30uL of deionized water.

5. Binding of Biotinylated RNA to Magnetic Beads
   - Prepare 20 uL Dynabeads in 1.5mL tubes.
   - Centrifuge the beads mix at 2,000 g, 1min, 4°C and remove the supernatant.
   - Wash the beads mix 3x time.
   - Add 500uL wash buffer2 (Component J) and resuspend it.
   - Place the tube on a magnet for 2 min and discard the supernatant.
   - Remove the tube from the magnet and resuspend the washed beads in 500uL wash buffer2 (Component J).
   - Repeat steps ii and iii twice, for a total of 3 washes
   - After the final wash, add 500 uL of wash buffer2 to the beads are resuspend it.
   - Prepare RNA binding reaction mix per condition in 0.5 mL epitube as below:
     - RNA binding buffer, 2X - 75uL
     - RNase inhibitor - 1uL
     - RNA - 30uL
     - Deionized water - 44uL
   - Heat the binding reaction mixture at 70°C for 5 minutes.
   - Add 20 uL of resuspended bead suspension to heated RNA binding reaction.
   - Incubate the RNA binding reactions at room temperature (RPM 300, at 21~25°C) for 2 hr while gently vortexing them on a vortex mixer. This will prevent settling of the beads.
   - After incubation, immobilize the beads using the DynaMag-2 magnet or the DynaMag-Spin magnet and wash the immobilized beads with 200uL (10 fold volume of resuspend beads in wash buffer1. Spin down and discard the supernatant.
   - Wash the immobilized beads with 200uL wash buffer 2 (Component J). Spin down and discard supernatant. Resuspend the beads in 500 uL of wash buffer 2.

6. Elution of Captured Beads from RNA
   - Elute RNA by re-suspending the beads in 30uL of elution buffer (10mM Tris pH 7.4, 1mM EDTA pH 8.0) then incubate at 92°C for 4 minutes.
   - Place the tube on a magnet for 1 min and save the supernatant which includes your 5-EU labeled RNA.

7. cDNA synthesis (Fig. 3)
   - Add these components to a PCR tube:
     - 5-EU RNA - 12uL
     - dNTP - 0.5 uL
     - Hexamer - 0.5uL
     - Nuclease-Free Deionized water - 2uL
   - Incubate 5 min at 65°C and then 5 min at 4°C.
   - Add cDNA synthesis reaction components together:
     - Solution from step 9a - 15uL
     - 5x buffer - 4uL
     - Reverse Transcriptase - 0.5uL
     - RNase inhibitor - 0.5uL
   - PCR - cycle PCR tubes at:
     - 50°C 2 min
     - 95°C 10 min
     - 95°C 15 sec, 60°C 1 min – 40 cycles

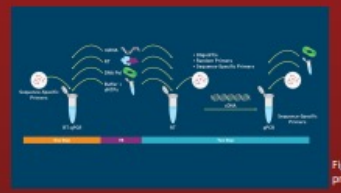


Fig. 3 (6) - the process of qPCR

Results/Conclusion

For this experiment, we neglected to utilize controls, an essential component of any experiment. Without positive or negative controls, interpretation of the data cannot be made, rendering all other work null. Further, critical errors in the protocol resulted in insufficient concentrations of genetic material as a product. We suspect the error may have arisen during an incubation stage that required mixing at 92 C.

This protocol demonstrates the principle of specificity and reactivity. As specificity increases, a molecule or compound is less likely to react to other molecules around it. By utilizing our protocol, labeled and isolated RNA undergoes specificity increases, increasing its stability over longer periods of time. Although the experiment itself did not progress as planned, we remain hopeful that, after correcting our experimental errors (by, for example, including a control such as a housekeeping gene), that this protocol will provide more precise measurements and analysis, especially in real time. This may provide more insight and importantly, context, which is extremely valuable in better understanding how these essential molecules interact. Notably, we failed to include a control and may not have sufficiently allowed the reaction to progress during incubation.

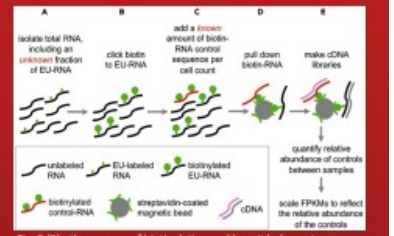


Fig. 2 (5) - the process of biotinylation and how it helps us to differentiate between labeled and unlabeled RNA

References and Acknowledgements

- OU FYRE Program
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- Haripriya Gupta
- Dr. Heather Ketchum

References

Role of MAP4k4 in Metabolic Dysfunction-Associated Fatty Liver Disease

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INTRODUCTION

MAP4K4 (Mitogen-Activated Protein Kinase Kinase Kinase Kinase 4) is a protein-coding gene that plays a role in various cellular processes, including inflammation and cell proliferation (1). In the context of fatty liver diseases, MAP4K4 has been implicated in the development and progression of metabolic dysfunction-associated fatty liver disease (MAFLD) and metabolic dysfunction-associated steatohepatitis (MASH), which are characterized by the accumulation of fat in the liver and can lead to inflammation, fibrosis, and liver damage (2).

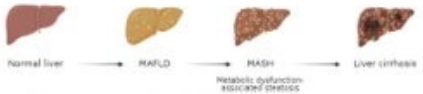

Figure 1. Progression of MAFLD

OBJECTIVE

To determine the effects of a pharmacological MAP4K4 inhibitor, Glucosyl pyrolysis-pyrimidinone (GPPD), on the progression of MAFLD

Hypothesis: GPPD will decrease the production of fat deposits within hepatocytes (liver cells).

METHODS

Oleic acid (OA) was used to induce steatosis (production of fat) within the mice hepatocytes (liver cells).

Oil Red O

Cells were washed with PBS, incubated in propylene glycol for 5 minutes, then incubated overnight in Oil Red O solution (Abcam, Waltham, MA). The stained slides were treated with 85% propylene Glycol for 1 minute, rinsed with distilled water, incubated in hematoxylin solution for 2 minutes to counterstain the nuclei, then rinsed again for imaging.

RESULTS

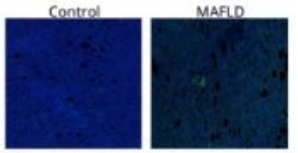

Figure 2. Human Tissue Sample of Normal vs. MAFLD-Affected Liver

The greenish hue in the MAFLD sample represents MAP4K4 expression, thus we can conclude that MAP4K4 is a prominent gene that aids in MAFLD progression.

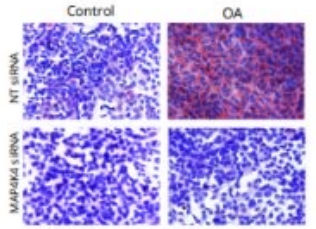

Figure 3. Inhibition of MAP4K4 Gene

The Oil Red O-staining allows us to assess fat content within cells by staining the fat pink. In inhibiting the MAP4K4 gene (MAP4K4 siRNA), the production of fat ceases completely compared to our non-targeting treatment (NT siRNA).

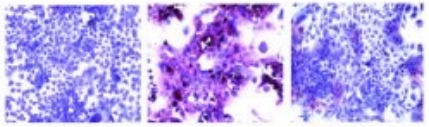

Figure 4. Oil Red O-stained Hepatocytes

Our Oil Red O-staining results show that GPPD is a successful MAP4K4 inhibitor and reduces the production of fat significantly.

RESULTS CONT.

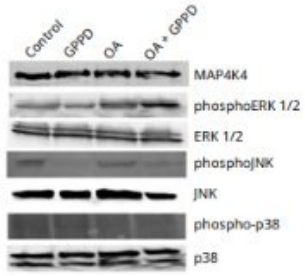

Figure 5. Western Blot of Hepatocytes

Immunoblotting did not show significant decrease in MAP4K4 expression, but a reduction of MAP4K4 activity. Increased MAP4K4 activity led to higher levels of MAFLD and MASH gene expression.

CONCLUSION

- The MAP4K4 gene aids in the progression of MAFLD
- Inhibiting MAP4K4 stops the production of fat
- GPPD is a successful drug that inhibits MAP4K4
- MAP4K4 expression decreased significantly with GPPD treatment

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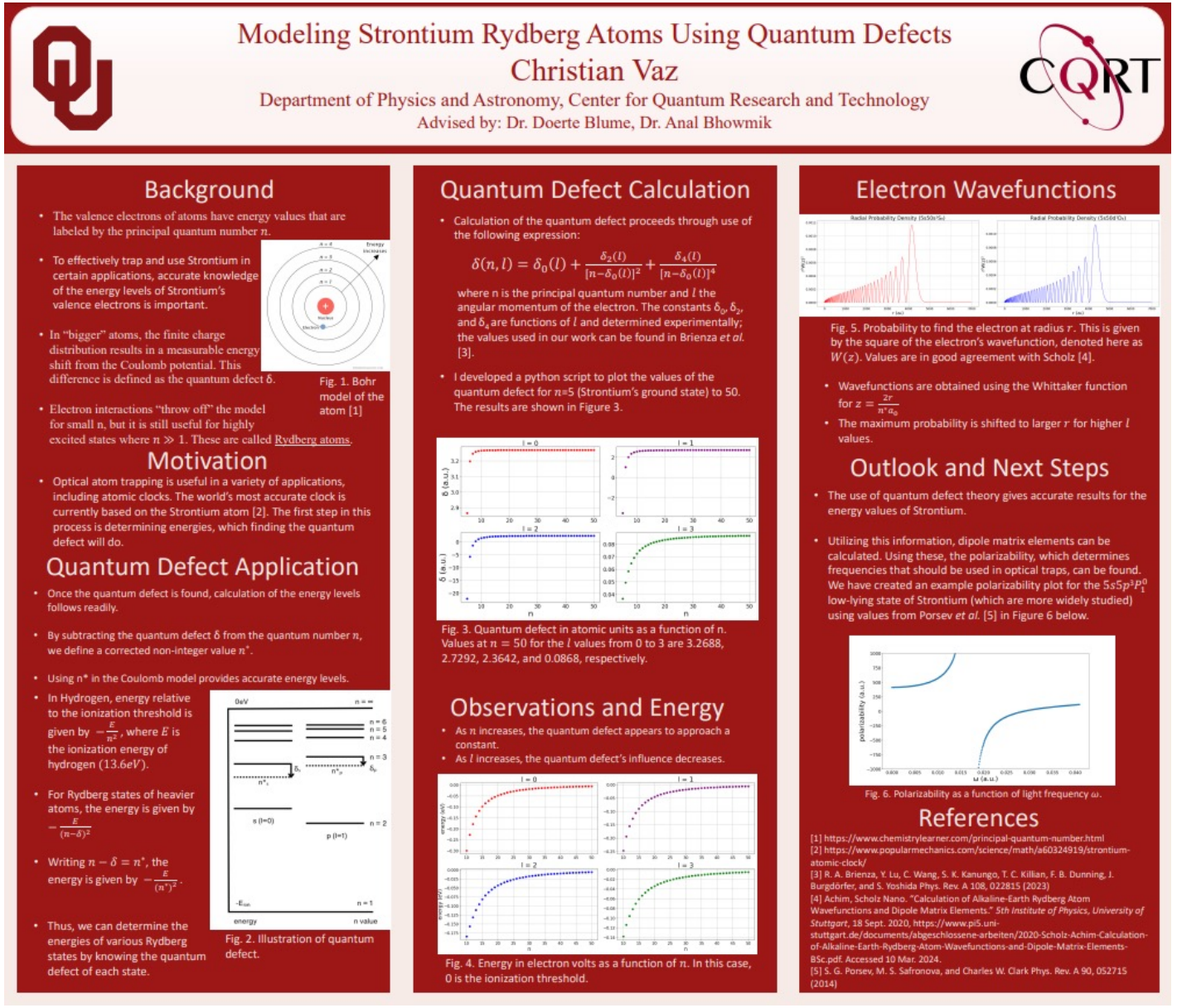
Modeling Strontium Rydberg Atoms Using Quantum Defects

Christian Vaz

Department of Physics and Astronomy, Center for Quantum Research and Technology

Advised by: Dr. Doerte Blume, Dr. Anal Bhowmik



Modeling Strontium Rydberg Atoms Using Quantum Defects
Christian Vaz
Department of Physics and Astronomy, Center for Quantum Research and Technology
Advised by: Dr. Doerte Blume, Dr. Anal Bhowmik

Background

- The valence electrons of atoms have energy values that are labeled by the principal quantum number n.
- To effectively trap and use Strontium in certain applications, accurate knowledge of the energy levels of Strontium's valence electrons is important.
- In "bigger" atoms, the finite charge distribution results in a measurable energy shift from the Coulomb potential. This difference is defined as the quantum defect δ.
- Electron interactions "throw off" the model for small n, but it is still useful for highly excited states where $n \gg 1$. These are called Rydberg atoms.

Fig. 1. Bohr model of the atom [1]

Motivation

- Optical atom trapping is useful in a variety of applications, including atomic clocks. The world's most accurate clock is currently based on the Strontium atom [2]. The first step in this process is determining energies, which finding the quantum defect will do.

Quantum Defect Application

- Once the quantum defect is found, calculation of the energy levels follows readily.
- By subtracting the quantum defect δ from the quantum number n, we define a corrected non-integer value n^*.
- Using n* in the Coulomb model provides accurate energy levels.
- In Hydrogen, energy relative to the ionization threshold is given by $-\frac{E}{n^2}$, where E is the ionization energy of hydrogen ($13.6eV$).
- For Rydberg states of heavier atoms, the energy is given by $-\frac{E}{(n-\delta)^2}$
- Writing $n-\delta=n^*$, the energy is given by $-\frac{E}{(n^*)^2}$.
- Thus, we can determine the energies of various Rydberg states by knowing the quantum defect of each state.

Fig. 2. Illustration of quantum defect.

Quantum Defect Calculation

- Calculation of the quantum defect proceeds through use of the following expression:

$$\delta(n,l)=\delta_0(l)+\frac{\delta_2(l)}{[n-\delta_0(l)]^2}+\frac{\delta_4(l)}{[n-\delta_0(l)]^4}$$

where n is the principal quantum number and l the angular momentum of the electron. The constants δ_0, δ_2, and δ_4 are functions of l and determined experimentally; the values used in our work can be found in Brienza *et al.* [3].

- I developed a python script to plot the values of the quantum defect for n=5 (Strontium's ground state) to 50. The results are shown in Figure 3.

Fig. 3. Quantum defect in atomic units as a function of n. Values at $n=50$ for the l values from 0 to 3 are 3.2688, 2.7292, 2.3642, and 0.0868, respectively.

Observations and Energy

- As n increases, the quantum defect appears to approach a constant.
- As l increases, the quantum defect's influence decreases.

Fig. 4. Energy in electron volts as a function of n. In this case, 0 is the ionization threshold.

Electron Wavefunctions

Fig. 5. Probability to find the electron at radius r. This is given by the square of the electron's wavefunction, denoted here as $W(z)$. Values are in good agreement with Scholz [4].

- Wavefunctions are obtained using the Whittaker function for $z=\frac{2r}{n^* a_0}$
- The maximum probability is shifted to larger r for higher l values.

Outlook and Next Steps

- The use of quantum defect theory gives accurate results for the energy values of Strontium.
- Utilizing this information, dipole matrix elements can be calculated. Using these, the polarizability, which determines frequencies that should be used in optical traps, can be found. We have created an example polarizability plot for the $5s5p\,^3P_1^0$ low-lying state of Strontium (which are more widely studied) using values from Porsev *et al.* [5] in Figure 6 below.

Fig. 6. Polarizability as a function of light frequency ω.

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Quantum Chaos and Thermalization in a Spin Chain

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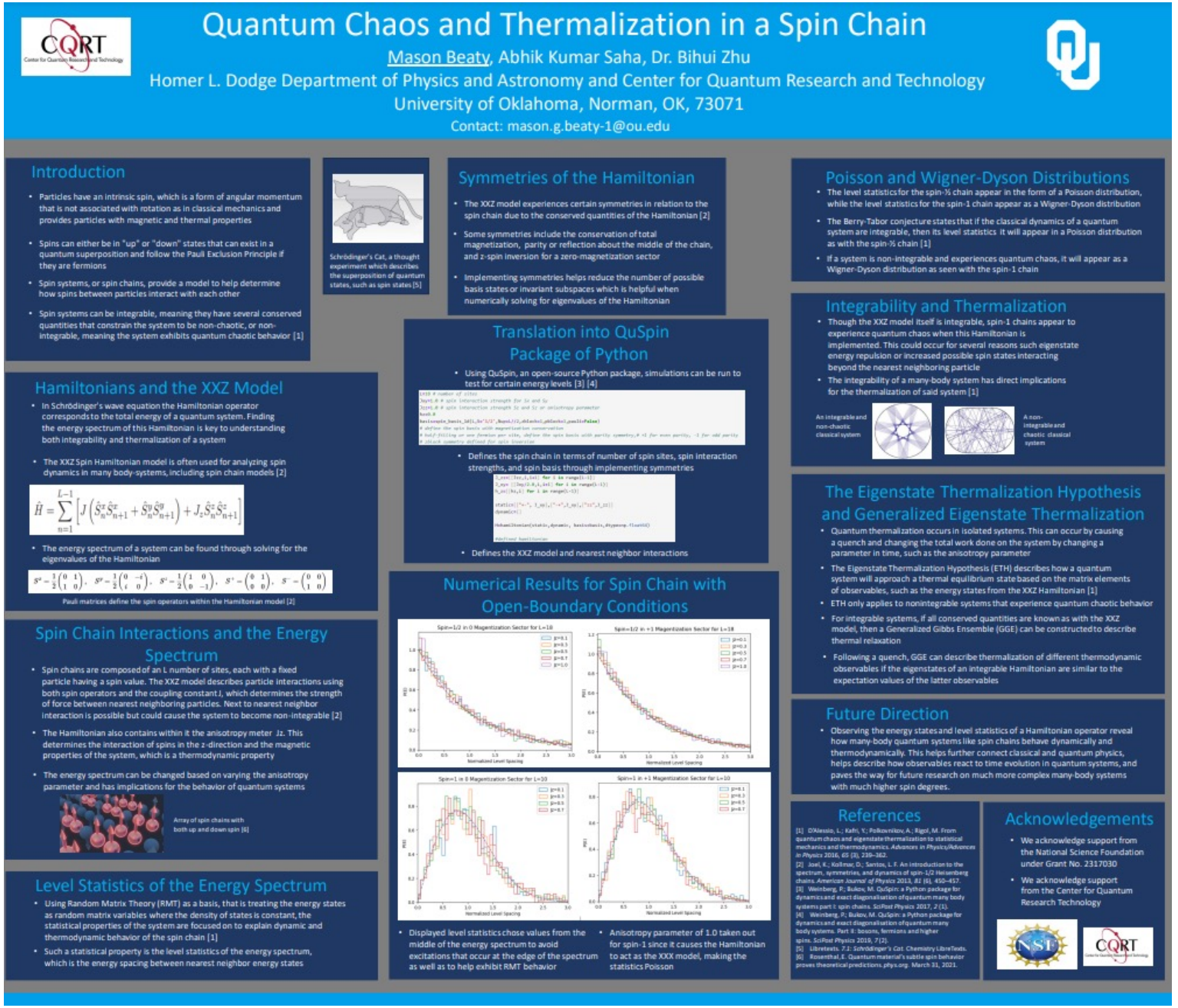

2020 Youth Attitudes on American Democracy Survey

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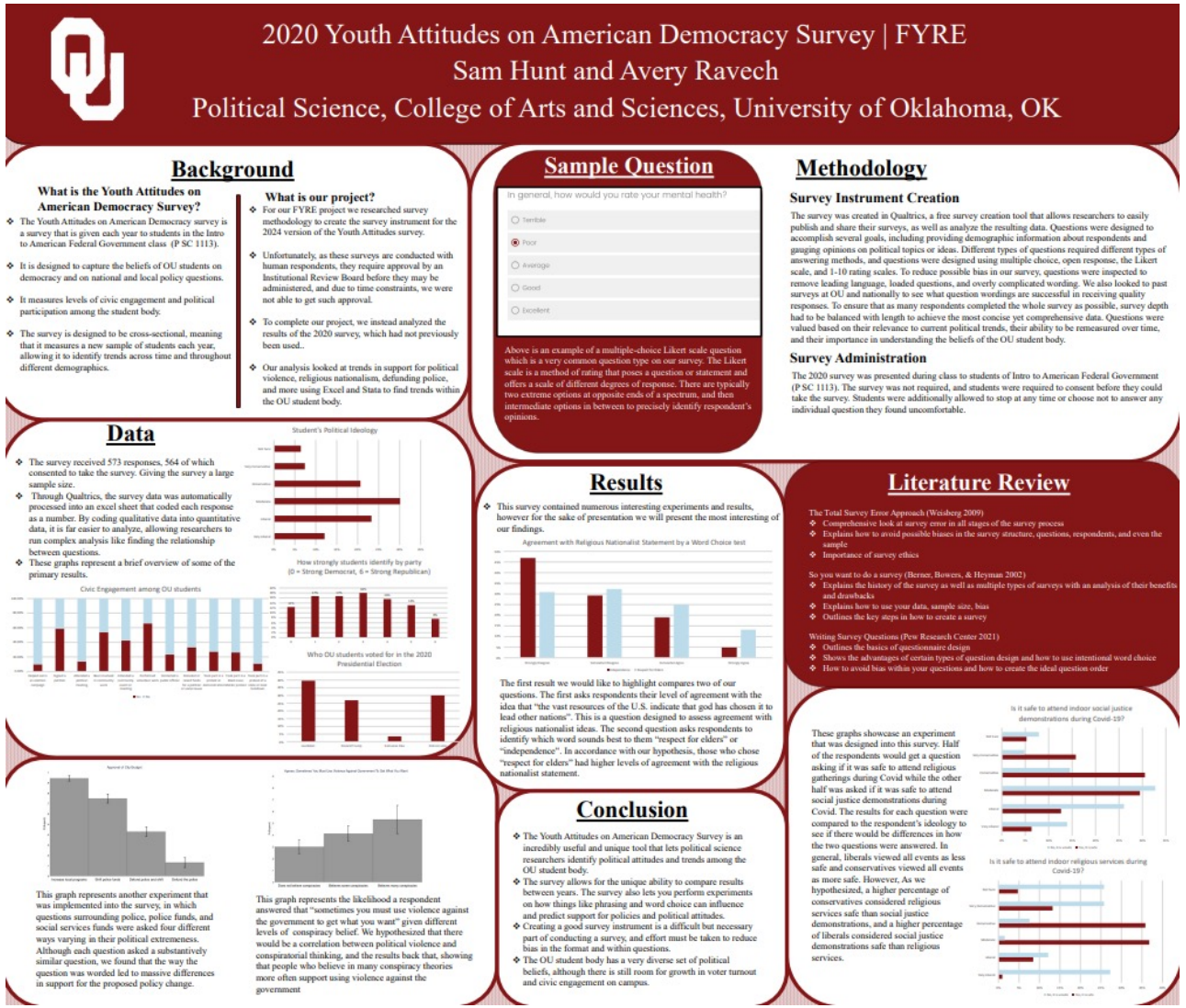
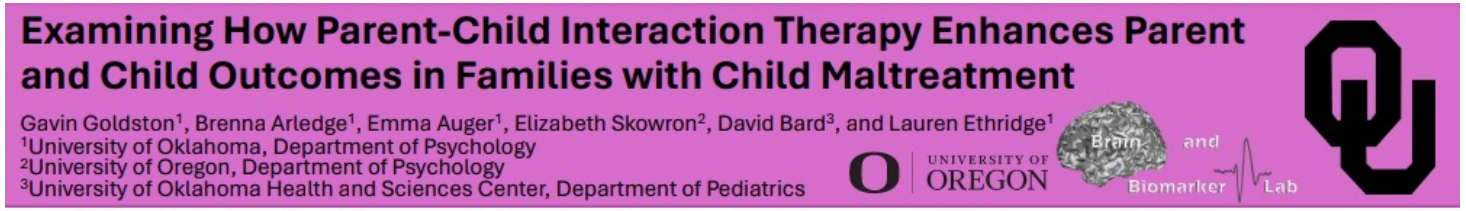


Examining How Parent-Child Interaction Therapy Enhances Parent and Child Outcomes in Families with Child Maltreatment

Gavin Goldston 1, Brenna Arledge 1, Emma Auger 1, Elizabeth Skowron 2, David Bard 3, and Lauren Ethridge 1

1 University of Oklahoma, Department of Psychology, 2 University of Oregon, Department of Psychology, 3 University of Oklahoma Health and Sciences Center, Department of Pediatrics



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Gavin Goldston[1], Brenna Arledge[1], Emma Auger[1], Elizabeth Skowron[2], David Bard[3], and Lauren Ethridge[1]
[1]University of Oklahoma, Department of Psychology
[2]University of Oregon, Department of Psychology
[3]University of Oklahoma Health and Sciences Center, Department of Pediatrics

Introduction

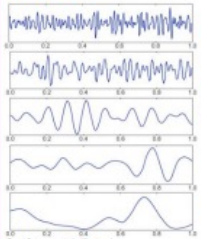
Child-Maltreatment

- Affects nearly one million children each year
- Can lead to trauma, dysregulation, and even changes in internal neural function[1]
- Difficult to treat and causes developmental delays in children which are even more difficult to treat

Parent-Child Interaction Therapy

- An intervention system that has been proven to successfully reduce harsh and aversive parenting[2]
- Decreases rates of CM recidivism from 50% to 19% while fostering higher quality relationships between parent and child
- Uses goal-driven sessions and in the moment coaching from the therapist to guide parents through interactions with their child
- Limited information about how PCIT exactly helps and through what functions it improves family dynamics

Neural Activity[3]



Gamma
Problem solving

Beta
Attentional arousal

Alpha
Active inhibition, executive function

Theta
Markers of plasticity, relaxation

Delta
Slow-wave sleep

Participants

- 204 parent-child dyads
  - 180 Mothers, 24 Fathers
  - Child is living with participating parent at least half the time
  - No parent or caregiver in the home was a documented child sexual abuse perpetrator (PCIT proven not effective in this case)
  - PCIT Engagers: Subgroup of those randomized to PCIT, engaged in at least one session of PCIT

Table 1 Demographics of Children Participants

Race/ Ethnicity	SAU (Control) (n=84)	PCIT (n=120)	PCIT Engagers (n=79)	Child Gender	SAU (n=84)	PCIT (n=120)	PCIT Engagers (n=79)
European American/ White	93% (78)	93% (112)	94% (74)	Male	60% (50)	52% (62)	54% (43)
Hispanic American	13% (11)	17% (20)	18% (14)				
African American/ Black	8% (7)	9% (11)	5% (4)	Female	41% (34)	48% (58)	46% (36)
Asian/Pacific Islander	4% (3)	3% (3)	4% (3)				
Native American/ Alaskan Aleut	21% (18)	18% (22)	19% (15)				
Other	1% (1)	1% (1)	1% (1)				

Results

Comparing Power Values

One Way ANOVA tests were run comparing power across ACE score groups for each frequency (Alpha, Beta, Gamma, Delta, and Theta) for posterior, and frontal brain regions. Significant differences were found between groups for absolute power theta ($F(8, 163) = 2.807$, $p = 0.006$), alpha ($F(8, 163) = 4.02$, $p < 0.001$), beta, ($F(8, 163) = 0.111$, $p < 0.001$), and relative power theta ($F(8, 163) = 2.042$, $p = 0.0450$) in the frontal region. Significant differences in relative power theta ($F(8, 163) = 2.042$, $p = 0.030$) and beta ($F(8, 163) = 2.140$, $p = 0.035$) were found in the posterior region.

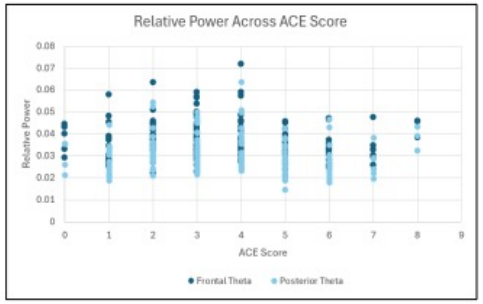


Figure 2 Relative power for theta waveforms across ACE scores, shown by one-way ANOVA to be significant in frontal ($F(8, 163) = 2.042$, $p = 0.45$) and posterior ($F(8, 163) = 2.197$, $p = 0.03$) regions.

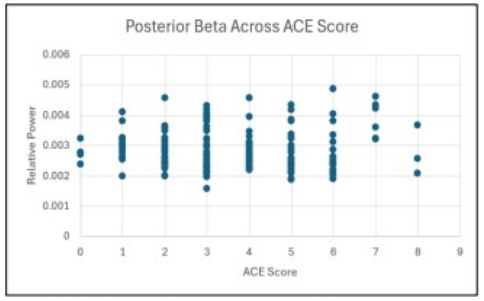


Figure 3 Relative power for beta waveforms across ACE scores, shown by one-way ANOVA to be significant in posterior regions ($F(8, 163) = 2.14$, $p = 0.035$)

Methods

- Pre-intervention and Post-intervention assessments given to all participants
  - Mid-treatment assessments given to PCIT group
- Services-As-Usual Control
  - Families receive typically delivered services from child welfare agencies
  - In-Home Family Visitation, SNAP, etc.
- Resting EEG
  - 64-channel Electroencephalogram
  - 4 minutes alternating eyes open (fixated on blank screen) and eyes closed (data is EC only)
- Adverse Childhood Experiences Scale (ACES)
  - Parents report child's exposure to adverse childhood experiences
- Study Ongoing

Discussion

Analysis

- Significant results support hypothesis that experiencing one or more adverse childhood experience affects brain function
  - Decreased theta levels at rest show a decreased measure of brain plasticity, providing evidence that children suffering from adversity are less able to adapt to immediate changes in their environment.[4]
  - Decreased beta levels show a decreased level of attentional arousal and concentration, perhaps leading to executive dysfunction[4]
- Previous studies have shown a threshold at ACE score of 4, with those scoring above showing much higher levels of health risk-factors than those below[5]
  - Reflected in our data, threshold between ACE scores of 4 and 5 (Figure 2)

Future Steps

- Study is ongoing, more EEG data will be run/processed with active tasks, pre- and post-intervention
- Analysis of whether PCIT can improve the effects of adverse childhood experiences

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Studying the Effects of Free Play on the Wellbeing of 1st-5th Graders

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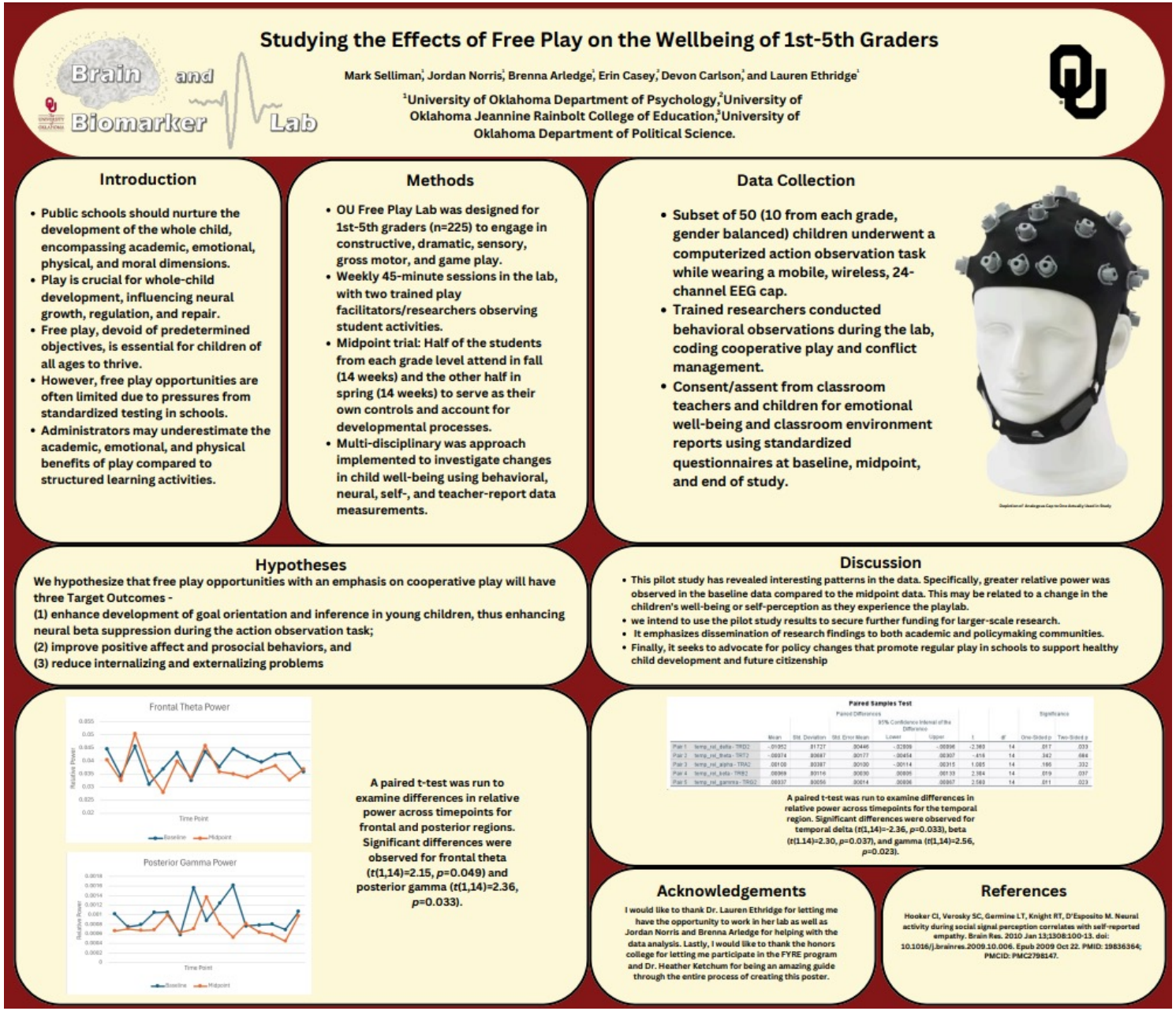

Saccharomyces cerevisiae Culturing, Spheroplasting, and Lysing for Top-Down Proteomic Analysis

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Saccharomyces cerevisiae Culturing, Spheroplasting, and Lysing for Top-Down Proteomic Analysis

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

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Background and Motivation

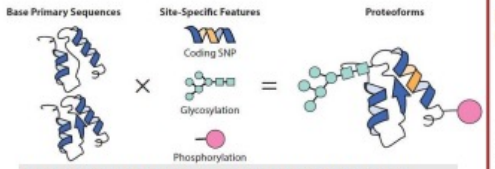

Fig. 1 – Site specific features are retainable in TDP for analysis versus alternative methods.

- *Saccharomyces cerevisiae*, more commonly known as baker's yeast, is often used for research on eukaryotic cells and the production of beer, bread, medicine and biofuel (Parapouli, 2020).
- A proteoform (Figure 1) is a polypeptide gene product that has genetic and chemical modifications that are specific among protein groups. Top-Down Proteomics (TDP) uses mass spectrometry to detect and characterize intact proteoforms (Smith, 2013).
- Our objective was to accurately identify the maximum number of proteoforms from *S. cerevisiae* utilizing TDP.

Yeast Culturing and Harvesting

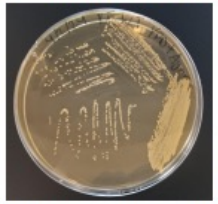

Fig. 2 – Inoculated YPD/Agar Plate from *S. cerevisiae* parental stock (BY4742).

Culturing – Grew parental strain, BY4742 (MATα only, heterothallic), using Yeast Peptone Dextrose (YPD) media and agar (Figure 2). Grew saturated cultures to 1.5-2.0 Abs @ OD600 and harvested cells by centrifugation (Figure 3).

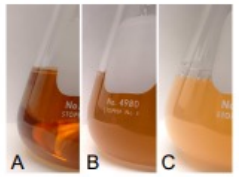

Fig. 3 – 100 mL YPD ;
A) No inoculation
B) Target Growth - 1.58 OD600
C) Overly inoculated - >3.0 OD600 .

Spheroplasting & Lysing – Used Goldbio (GB-178) kit according to manufacturer protocol (substituted 5mM dithiothreitol (DTT) for Beta-mercaptoethanol) and quantified protein concentrations in an Bicinchoninic Acid (BCA) Assay (Figures 4 and 5).

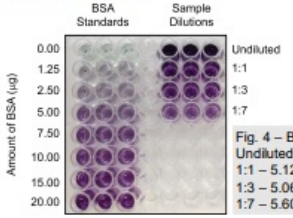

Fig. 4 – BCA Assay;
Undiluted – 4.55 µg/µL
1:1 – 5.12 µg/µL
1:3 – 5.06 µg/µL
1:7 – 5.60 µg/µL.

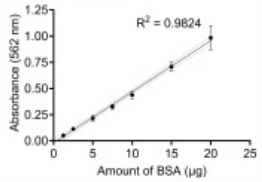

Fig. 5 – BCA protein standard curve obtained using bovine serum albumin.

Separation and MS Analysis

PEPPI – 200 µg yeast lysate was used to perform Polyacrylamide-Gel-Based Prefractionation for Analysis of Intact Proteoforms (PEPPI), using a 12% SDS-PAGE gel and targeting 0-30 kDa proteins for extraction (Figures 6 and 7). A methanol/chloroform/water precipitation step was then performed prior to LC separation for sample clean up.

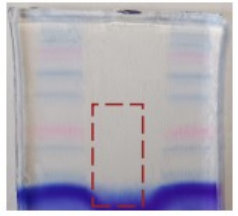

Fig. 6 – PEPPI Gel; lane 1 – Ladder, lane 2 – sample, lane 3 – ladder; dash line represents 0-30 kDa sample that was excised for LC separation and MS analysis.

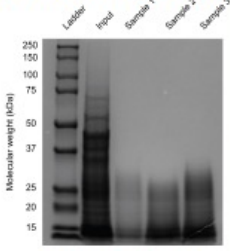

Fig. 7 – Confirmation Gel; 5% of recovered material was ran on SDS-PAGE and Coomassie stained for total protein content.

Mass Spectrometry (MS) – Samples were separated by liquid chromatography and then analyzed in an Orbitrap Eclipse mass spectrometry with gas phase fractionation via FAIMS (field asymmetric ion mobility spectroscopy).

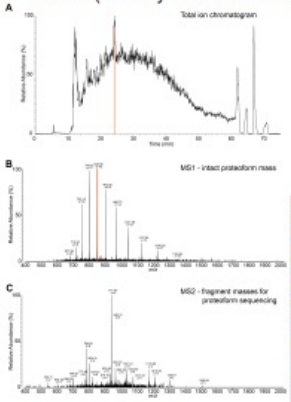

Fig. 8 – MS analysis of yeast lysates. (A) Chromatogram of intact species. Tan box represents region examined in (B). Mass spectrum of intact species. Brown box indicated isolated precursor that is fragmented resulting in (C), fragmentation spectrum from collision-based dissociation.

Fig. 9 – Overlap of proteoforms identified in each sample.

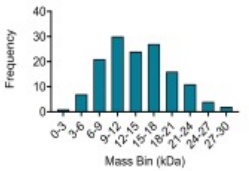

Fig. 10 – Distribution of proteoform masses identified across all samples.

Future Directions

143 proteoforms were identified from mass spectrometry-based TDP analysis. Future goals include sample preparation optimization, for maximizing protein extraction and cleanup efficiency, and organelle fractionation for subcellular localization of proteoforms.

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Isolation and Identification of a Leuconostoc sp. from local produce for university culture collection

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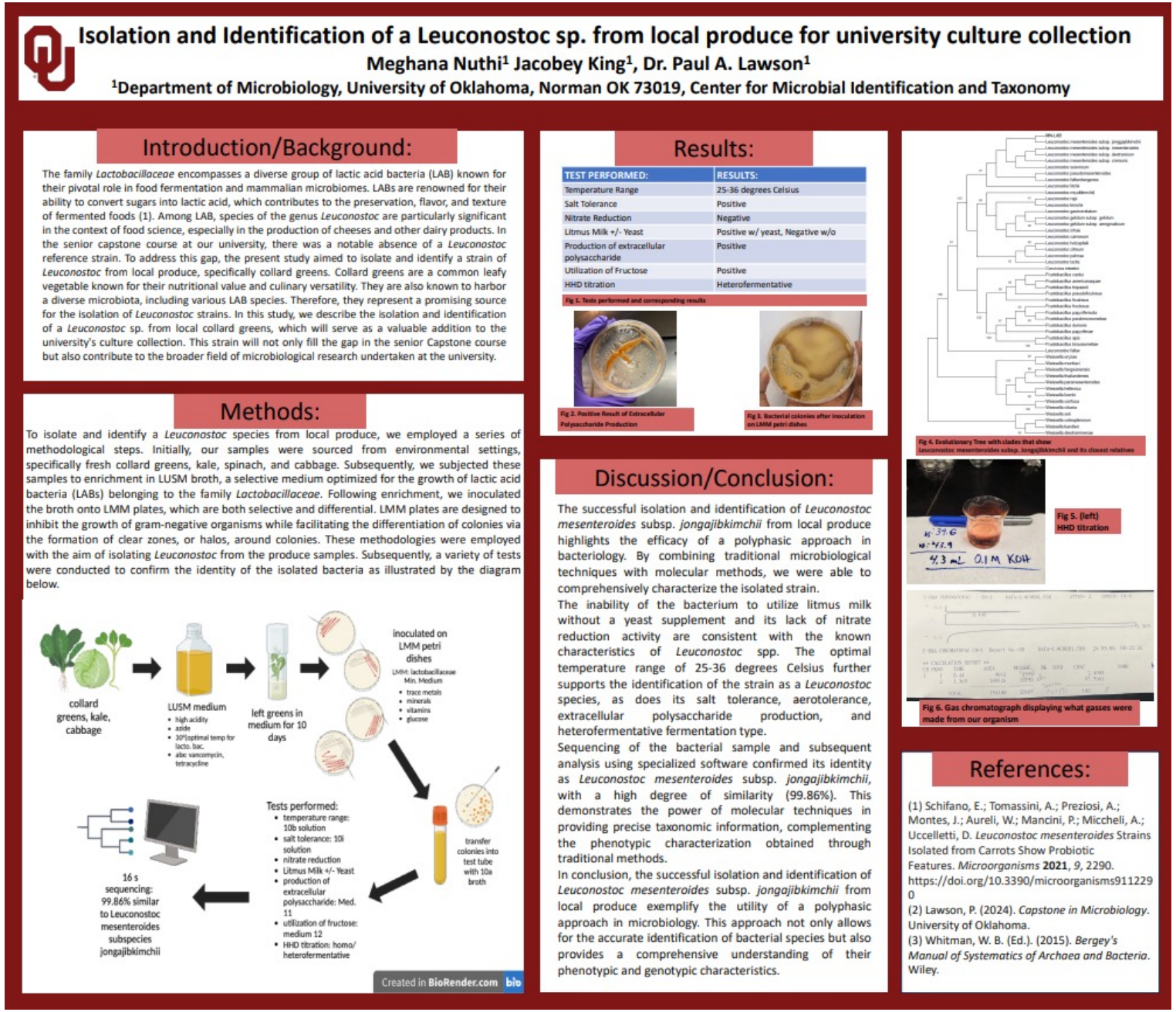

Isolation and Identification of a Leuconostoc sp. from local produce for university culture collection

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Introduction/Background:

The family *Lactobacillaceae* encompasses a diverse group of lactic acid bacteria (LAB) known for their pivotal role in food fermentation and mammalian microbiomes. LABs are renowned for their ability to convert sugars into lactic acid, which contributes to the preservation, flavor, and texture of fermented foods (1). Among LAB, species of the genus *Leuconostoc* are particularly significant in the context of food science, especially in the production of cheeses and other dairy products. In the senior capstone course at our university, there was a notable absence of a *Leuconostoc* reference strain. To address this gap, the present study aimed to isolate and identify a strain of *Leuconostoc* from local produce, specifically collard greens. Collard greens are a common leafy vegetable known for their nutritional value and culinary versatility. They are also known to harbor a diverse microbiota, including various LAB species. Therefore, they represent a promising source for the isolation of *Leuconostoc* strains. In this study, we describe the isolation and identification of a *Leuconostoc* sp. from local collard greens, which will serve as a valuable addition to the university's culture collection. This strain will not only fill the gap in the senior Capstone course but also contribute to the broader field of microbiological research undertaken at the university.

Methods:

To isolate and identify a *Leuconostoc* species from local produce, we employed a series of methodological steps. Initially, our samples were sourced from environmental settings, specifically fresh collard greens, kale, spinach, and cabbage. Subsequently, we subjected these samples to enrichment in LUSM broth, a selective medium optimized for the growth of lactic acid bacteria (LABs) belonging to the family *Lactobacillaceae*. Following enrichment, we inoculated the broth onto LMM plates, which are both selective and differential. LMM plates are designed to inhibit the growth of gram-negative organisms while facilitating the differentiation of colonies via the formation of clear zones, or halos, around colonies. These methodologies were employed with the aim of isolating *Leuconostoc* from the produce samples. Subsequently, a variety of tests were conducted to confirm the identity of the isolated bacteria as illustrated by the diagram below.

Results:

TEST PERFORMED:	RESULTS:
Temperature Range	25-36 degrees Celsius
Salt Tolerance	Positive
Nitrate Reduction	Negative
Litmus Milk +/- Yeast	Positive w/ yeast, Negative w/o
Production of extracellular polysaccharide	Positive
Utilization of Fructose	Positive
HHD titration	Heterofermentative

Fig 1. Tests performed and corresponding results

Fig 2. Positive Result of Extracellular Polysaccharide Production

Fig 3. Bacterial colonies after inoculation on LMM petri dishes

Discussion/Conclusion:

The successful isolation and identification of *Leuconostoc mesenteroides* subsp. *jongajibkimchii* from local produce highlights the efficacy of a polyphasic approach in bacteriology. By combining traditional microbiological techniques with molecular methods, we were able to comprehensively characterize the isolated strain.

The inability of the bacterium to utilize litmus milk without a yeast supplement and its lack of nitrate reduction activity are consistent with the known characteristics of *Leuconostoc* spp. The optimal temperature range of 25-36 degrees Celsius further supports the identification of the strain as a *Leuconostoc* species, as does its salt tolerance, aerotolerance, extracellular polysaccharide production, and heterofermentative fermentation type.

Sequencing of the bacterial sample and subsequent analysis using specialized software confirmed its identity as *Leuconostoc mesenteroides* subsp. *jongajibkimchii*, with a high degree of similarity (99.86%). This demonstrates the power of molecular techniques in providing precise taxonomic information, complementing the phenotypic characterization obtained through traditional methods.

In conclusion, the successful isolation and identification of *Leuconostoc mesenteroides* subsp. *jongajibkimchii* from local produce exemplify the utility of a polyphasic approach in microbiology. This approach not only allows for the accurate identification of bacterial species but also provides a comprehensive understanding of their phenotypic and genotypic characteristics.

Fig 4. Evolutionary Tree with clades that show Leuconostoc mesenteroides subsp. Jongajibkimchii and its closest relatives

Fig 5. (left) HHD titration

Fig 6. Gas chromatograph displaying what gasses were made from our organism

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