PPE FOR REENVISIONING RESEARCH

RICE UNIVERSITY
Office of Undergraduate Research and Inquiry

VIRTUAL RICE UNDERGRADUATE RESEARCH SYMPOSIUM

2021 ABSTRACT BOOK

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Letter from the Co-Chairs

Hello all,

We are thrilled to present to you the abstract book for the 2021 Rice Undergraduate Research Symposium (RURS). These pages highlight countless examples of Rice undergraduate research across many different fields and encapsulate student contributions to the understanding and advancement of our world. Now in its twentieth year, RURS serves as a platform for undergraduate researchers to exchange observations and knowledge outside of the classroom and to promote enthusiasm for the endless possibilities for inquiry available to them.

Our theme for this year is "PPE for Reenvisioning Research: Passion, Perseverance, and Exploration." When we chose this theme, our goal was to honor student efforts in remaining dedicated and passionate about their projects during these unprecedented times and finding new ways to continue their research. We also wanted to stress that research was something anyone could accomplish, regardless of major or year. Dealing with the COVID-19 pandemic this past year has certainly been difficult, but students have continued to persevere and found creative ways to explore the world and help illuminate the answers we all seek.

During these uncertain times, the RURS team reflected inward as we examined and reenvisioned the traditional format of RURS. We wanted to ensure we preserved the spirit of the symposium because at its core, RURS provides undergraduates to showcase their research, gain presentation experience and feedback from experts in their field, and celebrate what they have accomplished to strengthen passion for the exploration of knowledge. We truly believe that research allows students to grow as individuals and leaders and also enhances the undergraduate experience and such work deserves a place to be recognized. We hope that you too, when reading through this booklet, will be as inspired as we are by the fascinating research our peers are conducting.

We would like to thank all of the faculty, students, and staff who make RURS possible. This celebration of scholarship would not be possible without mentors from within Rice and beyond who are dedicated to supporting student scholarship, promoting undergraduate research, and providing opportunities for inquiry.

Sincerely,
Anika Sonig and Linda Liu
RURS 2021 Co-Chairs

Office of Undergraduate Research and Inquiry

Stay involved with OURI! Read about some highlighted undergraduate research programs at Rice and learn about additional opportunities at ouri.rice.edu.

Peer Research Ambassadors
Peer Research Ambassadors are Rice students who have engaged in research, design, and creative work during their undergraduate careers and want to help other students get involved. Ambassadors host office hours and attend OURI workshops and events in order to share information specific to their academic schools. They also serve as an advisory board, providing feedback to OURI staff on how to improve outreach efforts.

Bowl of Rice Podcast
Bowl of Rice tells the story of Rice University undergraduate researchers and scholars. In each episode, you'll hear from a student about their project and next steps for academic, professional, or research plans. Host Brendan Wong is a Sociology and Ecology and Evolutionary Biology double major. He is also a bit of a foodie, so he'll also ask students about their favorite food in Houston. The podcast name Bowl of Rice pays a nod to this question, but also represents how each student engaged in research, design, and creative work at Rice come together in the recipe of Rice undergraduate inquiry.

Conference Funding
Juniors and senior students who are attending a conference to present research or design are eligible to apply for conference funding. Students, both individuals and teams, can apply for up to $500 to support either travel or registration costs.

UNIV 301
This zero credit course enables students to have supervised research experience on and off campus recorded on their transcript, and is repeatable for credit. The requirements for satisfactory performance need to be agreed upon between you and your research advisor at the beginning of the term. Note that your research advisor can be faculty on or off campus. OURI does not determine these requirements.

Rice Undergraduate Scholars Program (RUSP)
The Rice Undergraduate Scholars Program (RUSP) is a two-semester, for-credit program aimed at senior Rice students in all disciplines who are interested in pursuing a research career and planning a one-year senior research project through an honors thesis or independent study. Students attend weekly seminars on topics related to graduate school and research careers across sectors. The program is focused on developing research and presentation skills, an understanding of a research career, and how to apply to graduate school and nationally competitive fellowships. In addition, all students in the program receive funding that may be used for research materials or conference attendance.

Summer Undergraduate Research Fellowship (SURF)
OURI Summer Undergraduate Research Fellowships, support undergraduates from underrepresented and under-resourced backgrounds pursuing supervised research with a Rice faculty member over the summer. Preference will be given to first- and second-year students who have secured unpaid opportunities and who have not had prior research experience. Returning undergraduates in all disciplines are eligible to apply. The research project may be faculty-led or initiated by the student, in-person or remote. Fellows will receive $3000 and are expected to work approximately 200 hours on their research project.

Sustaining Excellence in Research Scholars Program (SER)
Sustaining Excellence in Research (SER) Scholars are freshmen & sophomore students in the STEM (Science, Technology, Engineering, and Mathematics) disciplines who are invited to participate in the SER Scholars Program, based on a constellation of factors relevant to the student's academic preparation for the science and engineering course work at Rice. In the HHMI SER Scholars Program, students receive support to achieve academic excellence. They attend regular mentoring meetings with program staff, and are paired with a lab either within Rice or the Texas Medical Center, where they receive $10.00 per hour for the first 150 hours of their work. In addition, there are monthly meetings and workshops to network with other Scholars and learn new study and stress management skills.

Mellon Mays Undergraduate Fellowship Program (MMUFP)
The fundamental objective of MMUFP is to increase the number of minority students, and others with a demonstrated commitment to eradicating racial disparities, who will pursue PhDs in core fields in the humanities and social sciences. During their junior and senior years, fellows conduct research under the guidance of a faculty mentor and attend weekly meetings with the Mellon cohort and faculty and staff coordinators. Fellows receive a stipend to support their research.

Distinction in Research and Creative Work
Distinction in Research and Creative Works is a university award for select undergraduates, granted at commencement, which appears on the transcript and diploma. Students must apply to be considered for the award, and the application must be supported by a letter from a faculty member (or Center director). The most common path of application will be to the student's major department. A student whose research or other creative project is in a field outside of his/her major should submit an application to the academic department or program most closely associated with the subject matter of their project.

Outstanding Undergraduate Research Mentor Award
The Outstanding Undergraduate Research Mentor Award honors individuals who demonstrate exemplary mentorship to Rice undergraduate students in research, design and creative works projects. The Office of Undergraduate Research and Inquiry accepts nominations from current Rice students who would like to acknowledge the impact their research mentor has had on them and their experience.

Rice Undergraduate Student Journals
Rice University has a number of student publications that promote the research and creative work of Rice's Undergraduate population

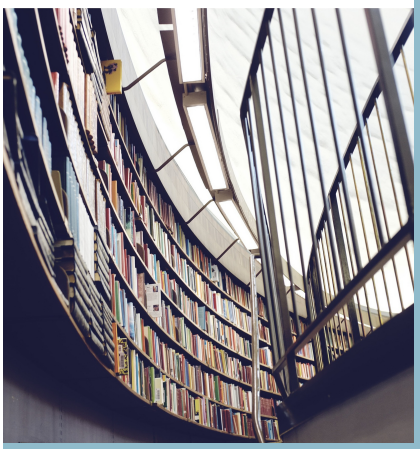
Plat: *https://www.platjournal.com/*
R2, The Rice Review: *https://www.r2ricereview.com/*
Rice Asian Studies Review: *https://chaocenter.rice.edu/students/rasr*
Rice Catalyst: *http://ricecatalyst.org/*
Rice Examiner: *https://riceexaminer.rice.edu/*
Rice Historical Review: *http://www.ricehistoricalreview.org/*
Rice Journal of Public Policy: *http://bisf.bakerinstitute.org/rjpp*

2020 Recipients of Distinction in Research and Creative Work

Abigail Hope Grayson
Akhil Krishna Jonnalagadda
Alexander Acosta
Allison Yelvington
Alyssa Marie Alvis
Ana Paula Pinto Diaz
Andrew Kin Wei Low
Anna Cole
Anna Guseva
Anna Louise Croyle
Anna Yen Fritz
Anson Tong
Arielle Xiaofen Liu
Ashley M. Fite
Benjamin Samuel Ruben
Bilal Rehman
Caroline Renee Frieders
Carter McKean Taft
Casimir Smith
Cassandra Jane Jennings
Changxu Sun
Charles Kelley Davis
Claire Angeline Stevens
Devon Sheppard Merz
Eappen Sebastian Nelluvelil
Eleanor Anne Mix
Elisa Arango
Emma Every
Frances Williamson
Gabriel Thomas Tugendstein
Gabrielle Humphrey
Gennifer Kaori Geer
Grant Wei Lu
Jacob Daniel Bhoi
Jacob Garrett Kesten
Jacob R Mattia
Jared Amir Beshai
Jared Ethan Nirenberg
Jennifer Chijen Lee
Jessica Weng
Jin Young Kim
Johann Gan
John Chen
John James Ahn
Jolen Martínez
Jonathan Peter Parts
Jordan Alexandra Sims
Jordan Michelle Graves
Jose Manuel Pacheco Luna
Joseph Emilio Munar
Julia Helen Steele Casbarian
Julie Maria Thamby
Kalen Alexandra Ziegler
Katherine Rose Garcia
Kelsey Nicole Sanders
Kevin Jaime Gonzalez
Kristen L Hickey
Lily Catherine Wulfemeyer
Madeline Claire Bowen
Mahesh Krishna
Maria Carolina Salazar
Mario Paciuc
Matthew Zachary Brehm
Maximilian Fielding Murdoch
Megan Patricia Torti
Meredith Maurine McCain
Michael T. McDowell
Naomi Rose Lavine Kass
Nikhil Chellam
Orlando Nathaniel Cervantes Cantero
Paul Novak
Raj Mirut Dalal
Reagan Borick
Rebecca Ann Artall
Richard Appel
Rose Kantorczyk
Ruchi Gupta
Rylee Linhardt
Sarah Elena Downing
Sarah Elizabeth Bradford
Sarah Ellen Berton
Sarah Katherine Glover
Shravya Kakulamarri
Shreekumar Babasaheb Kale
Shubhangi Mehra
Shung-June David Danjul
Takuma Makihara
Tanner Christian Reese
Thomas Elliot Herring
Trevor John Egerton
Victoria S. Joshi
William C. Huie
Wu Ruilin
Yixing Ling
Yvonne Carrillo
Zhiren Wang
Zhuoyuan Xu

Fellowships

Center for Civic Leadership



The Center for Civic Leadership recruits and offers intensive advising for a range of scholarship and fellowship opportunities for graduate study, leadership programs, and international travel and research.

Contact Us

cclfellowships@rice.edu

More information on:
https://ccl.rice.edu/fellowships-overview

CENTER FOR CIVIC LEADERSHIP
RICE UNIVERSITY

Who We Are

We offer workshops on the application process, one-on-one advising, and feedback on application drafts to help students reflect on their experience and goals in order to craft and submit competitive applications.You do not need to know what fellowships you plan to apply for in order to get advising. We approach fellowship advising as assisting you develop the skills to identify your motivations, synthesize your experiences, and find opportunities that open the doors you seek to open. Whether you are awarded the fellowships or scholarships for which you apply, we assure you that the process of reflection you engage with in order to apply is extremely valuable and is a practice that you will be able to apply in your future.

We have created an online hub for Fellowship Advising through the Canvas page below. We are here to support you as you identify potential funded opportunities that match your experience and goals. We primarily advise for Rice nominated national fellowships and Rice internal awards, but are happy to help you find resources and provide guidance on other opportunities for which you are interested in applying.

Join the Fellowships Canvas Page

Rice Nominated Fellowships

GRADUATE STUDY

POST GRADUATE TRAVEL

POST GRADUATE RESEARCH

WORK ABROAD

FELLOWSHIP OPPORTUNITIES PURSUED PRIOR TO SENIOR YEAR

> Through fellowships advising, we seek to build upon academic and leadership experiences to identify undergraduate and post-baccalaureate option that best meet the future goals of our students.

POST GRADUATE TRAVEL

The Thomas J. **Watson & Zeff Fellowships** are one-year grants for purposeful, independent exploration and travel outside the United States, awarded to graduating seniors to enhance their capacity for resourcefulness, imagination, openness, and leadership and to foster their humane and effective participation in the world community.

GRADUATE STUDY

The **Marshall Scholarship** fund young Americans of high ability to study for a graduate degree in the United Kingdom.

The **George J Mitchell Scholarship** is an award for U.S. citizens sponsored by the US-Ireland Alliance.

The **Rhodes Scholarship** is a highly selective fellowship program for high achieving students with exceptional leadership potential who will contribute to the Oxford experience and beyond.

The **Winston Churchill Foundation** awards scholarships that fund a one year graduate degree for a graduating (or recently graduated) seniors in STEM programs at Cambridge University.

The **Michel David-Weill Scholarship** carries a monetary value of $80,000 and covers the cost of tuition and living expenses during a two-year master's program at Sciences Po.

The **Yenching** Academy of Peking University builds bridges between China and the world through an interdisciplinary master's program in China Studies.

Fulbright Study: The Fulbright Scholarship provides financial support for a program of study at universities in select countries. All United Kingdom Fulbright opportunities are for graduate study in selected partner institutions.

POST GRADUATE RESEARCH

Fulbright Research: The Fulbright Scholarship provides financial support for independent research in a single country. Fulbright Research requires a host affiliation with a university, nonprofit, research center, based on the country specific requirements.

James C **Gaither Junior Fellows**: Through the program, the Carnegie Endowment for International Peace offers approximately 12-14 one-year fellowships to uniquely qualified graduating seniors and recent alumni. Gaither Junior Fellows spend one year working as research assistants to Carnegie's senior scholars

The **Wagoner Foreign Study Scholarship,** founded by Rice alumnus James T. Wagoner ('29), provides students and alumni with the opportunity to conduct research abroad for a minimum of eight weeks and up to one year. A research project may be combined simultaneously with the advanced study of a language (400 level or above); or an introductory level of languages not offered at Rice. Funding is available up to $15,000 per award (Note: funding is considered taxable income). The Wagoner only supports university enrollment when it is required to get a visa in the host country.

WORK ABROAD

Fulbright ETA: The Fulbright English Teaching Assistant programs place grantees in schools overseas to supplement local English language instruction and to provide a native speaker presence in the classrooms. ETAs help teach English language while serving as cultural ambassadors for the U.S.

The **Luce Scholars** Program provides an individualized professional placement, along with language training and stipends, in an Asian country. The nationally competitive program is intended for students who have had limited experience of Asia and who might not otherwise have an opportunity in the normal course of their careers to come to know Asia.

FELLOWSHIP OPPORTUNITIES PURSUED PRIOR TO SENIOR YEAR

The **Goldwater** awards students who intend to pursue careers as scientists, mathematicians, and engineers.

The **Truman** supports juniors who have outstanding promise as agents of change in public service.

Udall is awarded to sophomores and juniors with a strong and demonstrated commitment to leadership and service areas of environment or to Native American nation.

The **Abraham-Broad** provides the opportunity to study abroad for a returning Rice undergraduate's junior academic year in the UK in an exchange between students at Rice University and Trinity College, University of Cambridge.

The **Beinecke** Scholarship is awarded to a high achieving junior with demonstrated financial need to support graduate study in the arts, humanities, and social sciences

The **Amici di Via Gabina** grants a summer traveling stipen for a student to provide a transformational opportunity in the study of architecture, art, history, archeology, languag music, and culture.

Goliard and Brotzen offer short-term, purposeful travel experiences abroad through a proposed independent trip abroad to explore a topic of their choice.

The **Gottschalk** will award up to $2000 to one music student, currently enrolled in Rice University's Shepherd School of Music, to travel to encourage the creative development by engaging with places and opportunities outside the academic norm.

The **Wagoner Foreign Study Scholarship** provides students and alumni with the opportunity to conduct research abroad for a minimum of eight weeks and up to one year.

The **Kathryn Leebron Smyth Award** provides students with up to $5,000 in funding to pursue language study abroad for a language not offered at Rice, or not offered at the level at which applicants are pursuing study.

FELLOWSHIPS FRIDAYS

FRIDAYS AT 1 PM CT

The Center for Civic Leadership offers one-on-one advising, information sessions, and workshops to support students in developing competitive applications. Through fellowships advising, we seek to build upon your academic and leadership experiences to identify undergraduate and post-baccalaureate opportunities that best meet your future goals. Please join us for the Spring 2021 Fellowships Fridays.

Schedule:

April 2 - The Value of the Fellowship Process
April 16 - Fellowships Fair - CCL Showcase
April 23 - Personal Statement Workshop
April 30 - Choosing Country and Program Workshop
May 7 - Host Affiliation and Connections Workshop
May 14 - Research and Program Proposal
May 21 - Letter of Recommendation Panel

Use the following zoom link for all of the workshops: bit.ly/ff-s21

To learn more about individual fellowships, please visit ccl.rice.edu/fellowships-overview

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HOUSTON ACTION
RESEARCH TEAMS

Interested in using your research and analysis skills to address issues facing Houston?

Be part of a semester long interdisciplinary team working with community partners on questions that impact the residents of Houston.

Questions? Contact Dr. Jessica Khalaf, **jkhalaf@rice.edu**

CCL.RICE.EDU/HART

Engineering

Bioengineering and Biomaterials

ENGI 1 **Approaching Fast, Multi-Channel Magnetogenetic Cell Activation**

Joseph Asfouri

Mentor: Dr. Jacob Robinson

Genetically-targeted cell activation offers high spatial precision for neural stimulation and cell-based therapies. Magnetic control of cell activity or "magnetogenetics" is a non-invasive method of stimulation which couples magnetic nanoparticle heating with temperature-sensitive ion channels expressed in select neural circuits. However, two issues currently hinder the widespread adoption of magnetogenetics: 1) temporal latency and 2) multi-channel stimulation. Specifically, the delay between magnet application and ((in vivo)) behavioral response is currently tens of seconds, and only very few channels can be selectively activated. Here we show enhancements to magnetogenetics on both of these fronts. To reduce temporal latency, we characterize an ion channel which responds more strongly to a high rate of temperature change than to an absolute temperature threshold. To create more stimulation channels, we mix different types of nanoparticles and reveal the distinct heating properties of these combined populations. Such improvements will enable fast, multiplexed, and non-invasive control of deep-tissue regions by magnetogenetics for treating disease and augmenting human function.

ENGI 2 **Acoustic Biomaterials for Prolonged Blood-Brain Barrier (BBB) Opening**

Joycelyn Yiu

Mentor: Dr. Jerzy Szablowski

Microbubbles respond to ultrasound and are key to the advancement of ultrasound imaging, molecular imaging, and targeted drug and gene delivery. When insonated, perfluorocarbon (PFC) microbubbles oscillate and exert pressure on the walls of blood vessels, temporarily opening pores within the blood-brain barrier (BBB). However, PFC microbubbles have a short circulation time and require multiple injections, rendering long-term PFC microbubble-enhanced functional ultrasound imaging (fUS) infeasible. We designed a self-assembling acoustic biomaterial to overcome the above shortcomings, and tested its acoustic properties against PFC microbubbles with the Vantage 256 ultrasound device (Verasonics). Results include a designed peptide sequence for self-assembled protein scaffolds, 3D printed mounts for the L22-14vX Verasonics transducer, 3D printed molds for the agarose phantom, and a preliminary design for self-assembled DNA origami nanotubes. Engineering strategies to overcome the limitations of PFC

microbubbles will allow us to achieve longer treatment sessions, independence from multiple injections, and new capabilities in functional imaging.

ENGI 3 **Approximation of Fine Wire EMG Signals**

Katie Bablak

Mentor: Dr. B.J. Fregly

Understanding internal forces in human movement is critical for improving orthopedic treatment and rehabilitation methods. Use of Electromyogram (EMG)-driven modeling has the potential to improve patient care by offering key information about internal joint forces. Study of muscle synergies using lower-extremity EMG-driven models can give valuable insight into gait and walking patterns. Unfortunately, these models rely on data that can be invasive to collect. Certain EMG signals are collected by fine wire EMG electrodes, which are much more invasive than surface electrodes. Approximating these fine wire signals, using the surface signals, would allow researchers to study patients' EMG signals without invasive insertion of fine wire electrodes. This project investigates the feasibility of using a linear combination of surface EMG signals to approximate fine wire signals. Using a set of sixteen lower-extremity EMG signal channels, five fine wire signals will be tested to see if each can be approximated with eleven surface EMG signals. After further testing, these approximations can be used to analyze patient data with only surface EMG signals, reducing invasiveness of future study.

ENGI 4 **Characterization of PLGA Formulations for Highly Tunable Pulsatile Release Kinetics**

Pujita Munnangi

Mentor: Mr. Tyler Graf

The therapeutic potential of many drugs and vaccines is restricted by patient compliance and pharmacokinetics. Current drug delivery systems are limited in the release profiles attainable and must be customized for each new incorporated drug. The previously-developed injectable “StampED Assembly of Polymer Layers (SEAL)” method enables the generation of highly pulsatile drug delivery core-shell microparticles composed of poly(lactic-co-glycolic acid) (PLGA). Employing PLGA with different properties can generate particles featuring multiple distinct pulsatile release events in a single injection. However, reliance on a limited number of commercially available PLGA formulations restricts possible release times. In this study, we blended PLGAs to build a library of particles with an array of release kinetics. Particles composed of PLGAs in varying proportions were fabricated, filled with fluorescently-tagged dextran, sealed, and incubated in PBS at body temperature. Release was monitored through fluorescence assays. Attaining an inventory of PLGA particles with well-defined pulsatile release enables the creation of modular systems with fully customizable release kinetics.

ENGI 5 **Shape of the diaphragm is unaltered during forceful efforts whereas reduction in its muscle surface area is postural dependent in dogs**

Scott Fessler

Mentor: Dr. Aladin Boriek

We tested the hypothesis that despite maintaining the shape of the diaphragm (DIA) during forceful efforts, reduction in its surface area (SA) is postural dependent. Using biplane fluoroscopy, locations of markers in six dogs were determined during quiet breathing and inspiratory forceful efforts at lung volumes from the active state at functional residual capacity (FRC) to total lung capacity (TLC). DIA curvature and normalized SA were measured for the DIA in supine and prone postures. In the supine posture, reduction in SA of the DIA from end of expiration (EE) to TLC was 21.4% Â± 0.11, while in the prone posture the reduction in SA of the DIA from EE to TLC was 27.5 % Â± 0.15. In the supine posture, the reduction in SA of the DIA from EE to FRC was 0.9% Â± 0.05, while in the prone posture the reduction in SA of the DIA from EE to FRC was 13.1 % Â± 0.06. Our data also confirmed that the DIA curvature was not altered by posture at any lung volume during forceful efforts. Our findings strongly suggest that regardless of posture, curvature of the DIA is unaltered during forceful efforts at low lung volumes whereas posture plays a role in modulating the reduction in its muscle SA.

ENGI 6 **Leveraging Synthetic Biology Tools to Engineer Mesenchymal Stem Cells for Therapeutic Applications**

Shonik Ganjoo

Mentor: Dr. Caleb Bashor

Mesenchymal stem cells (MSCs) are of interest for cell-based therapies due to their localization and immunomodulatory properties. These features, however, are often insufficient in therapeutic applications. Genetic circuits developed in synthetic biology have afforded precise and engineerable control over cell functions in other cell-based therapies, but these tools have yet to be effectively implemented in MSCs. To overcome this, we will systematically assess genetic circuits in MSCs by first constructing a combinatorial library of genetic parts and quantifying their effect on gene expression in MSCs using flow cytometry and fluorescence microscopy. We will also validate user-controlled and autonomous gene circuits that will afford dynamic and cell state-specific modifications to MSC phenotype. We aim to use these circuits to modulate the relative levels of key surface proteins (such as PSGL-1) that we hypothesize will improve the ability of MSCs to migrate to sites of inflammation and suppress overactive immune responses. We will deploy these engineered MSCs and assess their effect on outcomes in a model of traumatic brain injury.

ENGI 7 **A platform for post-translational spatiotemporal control of cellular proteins**

Zengyi Wan

Mentor: Dr. Laura Segatori

Mammalian cells process information through coordinated spatiotemporal regulation of proteins. Engineering cellular networks thus relies on efficient tools for regulating protein levels in specific subcellular compartments. To address the need to manipulate the extent and dynamics of protein localization, we developed a platform technology for target-specific control of protein destination. This platform is based on bifunctional molecules comprising a target-specific nanobody and universal sequences determining target subcellular localization or degradation rate. We demonstrate that nanobody-mediated localization depends on the expression level of the target and the nanobody, and the extent of target subcellular localization can be regulated by combining multiple target-specific nanobodies with distinct localization or degradation sequences. We also show that this platform for target localization and degradation can be regulated transcriptionally and integrated within orthogonal genetic circuits to achieve the desired temporal control over spatial regulation of target proteins. The platform could be useful for protein function investigation and large gene circuit regulation.

Civil and Mechanical Innovation and Materials Research

ENGI 8 **Theoretical Investigation of the Relationship Between PFCA Structure and Photocatalytic Degradation Tendency**

Benjamin Walls

Mentor: Dr. Thomas Senftle

Perfluorooctanoic acid (PFOA) is particularly concerning water pollution due to its high chemical stability, tendency to bioaccumulate, and carcinogenic properties. Prior research has shown that PFOA can undergo photocatalytic degradation in the presence of certain wide-bandgap semiconductors, and several of such studies found that potentially toxic short-chain intermediates (known generally as perfluorocarboxylic acids (PFCAs)) seem to degrade progressively less readily. In this investigation, density functional theory was applied to determine the cause of this trend. No significant correlation was observed between PFCA chain length and reduction potential, but there was a positive relationship measured between chain length and adsorption energy. This potentially explains the empirically observed correlation between chain length and reactivity, as species must adsorb to the catalytic surface in order to react with photogenerated holes and radicals. Following these results, additional calculations were performed to simulate adsorption over various other photocatalysts and under varied pH conditions.

ENGI 9 **Optimization of Additive Manufactured Heat Sinks Based on the Performance of a Unit Cell Structure**

Hociel Landa

Mentor: Dr. Geoff Wehmeyer

Recent advances in metal additive manufacturing create opportunities to produce heat sinks without the topological restrictions of standard machining strategies. Heat sink efficiency improvements can lead to lighter, smaller, and faster electronic devices. Here, we used Ansys Fluent to perform finite-element thermal-fluid simulations for air flow through aluminum body-centered cubic heat sinks. Our simulations consider a single unit cell and quantify the effect of geometric parameters and air flow rates on the heat sink performance. We validate our simulations against known analytical solutions for flow over flat plates and flow over single cylindrical fins. For the unit cell geometry, we find that increasing the strut diameter creates a larger surface area for heat transfer, but inhibits the fluid flow, meaning that the optimal geometry must balance the heat flow and pressure drop requirements for a specific application. Future work will build on the single-unit cell results by applying periodic boundary conditions to the simulations and to determine the thermal efficiency of additively manufactured heat sinks.

ENGI 10 **Modelling an Oscillating Gadolinium Heat Switch with Time Dependent Heating**

Kaitlyn Zdrojewski

Mentor: Dr. Geoff Wehmeyer

Heat switches are devices that can switch between being thermal conductors and thermal insulators as a function of temperature (T). Heat switches are used in thermal management applications to maintain electronic devices, spacecraft, or batteries within a desired T range. Here, we designed and modeled a heat switch based on a ferromagnetic material with a T-dependent magnetization (here, gadolinium) that mechanically oscillates between a hot permanent magnet and a cold surface. Building on prior studies that considered steady-state T for the hot and cold surfaces, we modeled the impact of time-periodic hot surface T on the heat switch. We used finite element modeling to determine the T-dependent magnetic forces, and used lumped thermal modeling to predict the gadolinium T as a function of time. Our results show that we can control the switching transition T, oscillation frequency, and thermal conductance of the switch by adjusting mechanical parameters such as the gap spacing and magnet surface area. Our results provide insight into the rich thermal-magno-mechanical behavior of the heat switch and provide guidance for future gadolinium heat switch implementations.

Computer and Information Science and Engineering

ENGI 11 **Real-time estimation and prediction of gas concentration with drone networks**

Guancong Jia

Mentor: Ms. Maryam Khalid

This research project is an integral part of a bigger project of Astro group that focuses on the evaluation of drone networks for real-time identification and prediction of unsafe regions in emergency situations. A data-driven based strategy to estimate and predict gas concentration map was already developed for static sensors. However, it was unable to deal with drone mobility. Setting up the problem in state-space setup, I developed an extrapolation-based solution for moving drones and tested it with real experimental data. The estimation and prediction module is based on the Matrix-pencil method and kalman filter that utilizes all the past and current drone measurements to estimate the current snapshot of gas concentration map and estimate the near future. Space extrapolation based on Gaussian Kernel Extrapolation is added to the original model to yield lower errors. Along with that, I developed a GUI that allows users to test the current system with both experimental and artificial data that was generated using the physical models for gas dispersion.

ENGI 12 **Changing Parameters of Neural Network to Improve Hippocampal Sharp-Wave Ripple Detection**

Jinjiang Zhang

Mentor: Dr. Caleb Kemere

Hippocampal sharp wave ripples (SPW-R) have been identified as key biomarkers for important brain functions such as memory consolidation, curiosity, and decision making. Detection of SPW-R events typically relies on human curation, which is subjective and time-consuming. Automated real-time detection of SPW-R events is critical to understanding these brain functions. There exists an artificial intelligence implementation for detecting SPW-R events, named 'RippleNet', but it does not function in real-time and has a significant number of false alarms and misses. We seek to improve the architecture of RippleNet so that it functions in real-time and detects SPW-R events more accurately. This will be accomplished by experimenting with the shapes of input and validation data as well as various layer parameters of the neural network architecture. This project will allow neuroscientists to pursue previously unexplored experimental paradigms that rely on real-time detection of SPW-Rs.

ENGI 13 **CoughNet: COVID Diagnosis Through Cough Sounds**

Will Mundy

Mentor: Mr. Bishal Lamichhane

The COVID-19 virus has proven to be a public health crisis, infecting around 15 million and killing over 280 thousand in the US alone. The most effective tool in controlling the virus has been continuous testing, which facilitates the early detection of positive cases. However, constant testing is made difficult by the high cost of tests, the long duration between taking a test and receiving a result, and the

inconvenience of being unable to test from the safety of one's home. Previous studies have explored deep learning-based approaches for the diagnosis of COVID-19 through cough audio samples. However, due to the very small number of publicly available COVID-positive cough recordings, we are unsure of the generalizability of such architectures. In this work, we propose a novel use of WaveGAN to generate synthetic COVID-positive and COVID-negative cough recordings as a form of data augmentation. We show that including the synthetic cough variants from WaveGAN in the training set of a binary classification network improved the generalizability of these networks to unseen coughs.

ENGI 14 **Deep Graph Generation for Molecular Design**

Xincheng Wang

Mentor: Mr. Santiago Segarra

Nowadays, synthesizing new molecules with desired properties is an important step towards discovering new drugs. The space of possible molecules is vast and it is expensive to design each molecule and do experimental validation for eligibility. In this project, we apply deep neural networks to this problem. Molecules can be represented in the form of graphs with constituent atoms as nodes and chemical bonds between them as edges. In such a setting, we formulate the highly complex process of new drug design as a graph generation problem, with the additional constraint on chemical properties. Graph Neural Networks (GNNs) can be applied to the generation problem with a Conditional Variational Autoencoder (VAE) framework that would incorporate desirable chemical properties in the molecules. Additionally, we extend the pipeline to generate synthetic molecules with certain properties. By developing this pipeline, we hope to be able to efficiently generate molecule graphs with some desirable chemical properties and preferably, to be a valid drug.

ENGI 15 **CSI Prediction -- From a ML perspective**

Yaning Hu

Mentor: Mr. Tarence Rice

To help improve the relationship between users, we propose the use of massive MIMO (mMIMO) ground stations and unmanned aircraft as tools to improve the channel response. However, the stability of our wireless communication is vulnerable to several environmental factors, so we quantify these influences from a Machine Learning perspective. Specifically, we looked into the Channel State Information (CSI), which accounts for the scattering and fading effects, in hope of finding a statistically significant relationship with the location data.

Existing research has accounted for prediction from CSI matrix to locational data using "Channel Charting". However, more research is needed for starting from spatial information to predict the CSI matrix. Due to the unexpected coronavirus circumstances, we utilise an existing indoor dataset collected in the summer of

2019 with KU Leuven mMIMO testbed. We begin by dissecting the CSI matrix data into "amplitude" and "phase", and then train a Convolutional Neural Network to predict how each pair changes with the location labels. Furthermore, to understand how CSI changes over time, we also constructed a time-series forecasting model.

Electrical Communications and Cyber Systems

ENGI 16 **Amplifying the Jugular Venous Pressure (JVP) with a Computer Vision Pipeline**

Roy Phillips, Denizhan Yigitbas, Daniel Fay, Xander Spriggs, Alex Sang-Hyun Lee, Josh Kowal

Mentor: Dr. Gary Woods

Chronic heart failure is a costly, pervasive, and potentially fatal condition that requires periodic monitoring by a patient's cardiologist. Measurement of the jugular venous pressure (JVP) can detect hypervolemia, an over-accumulation of water in the body, allowing a cardiologist to prescribe diuretics before hospitalization is necessary. However, an accurate measurement currently requires an in-person visit to an experienced cardiologist. To assist cardiologists and provide patients a remote monitoring option, Team Jugularnauts has developed a prototype system which uses advanced computer vision techniques for magnification of internal jugular vein pulsations. Our system includes: (1) a web interface for uploading videos and adjusting magnification parameters; (2) an algorithm for video processing that performs Eulerian video magnification on the video in a short timespan. Currently, this system can assist our cardiologist sponsor by amplifying the JVP, and we will begin clinical testing in the first weeks of April. Long-term, we hope that our system will reduce inpatient visits by providing cardiologists and patients a convenient and accurate method for remotely monitoring JVP.

Environmental and Earth Sciences

ENGI 17 **COVID-19 Policy Impacts on NO2, Ozone, and PM2.5 Levels in U.S. Cities**

Hsing-Yng (Winnie) Louh

Mentor: Dr. Daniel Cohan

The emergence of COVID-19 in the U.S. and changes in activity due to policies and personal choices offer a unique opportunity to study the effect of anthropogenic emissions on air pollution levels. Previous research has identified some changes in pollutant levels during the initial shutdowns, but there is limited research after stay-at-home orders ended. Particularly, traffic volume and power plant emissions reflect the continuing shifts in human activity in response to policy updates. Consequently, examining air quality changes together with changes in human

activity can offer insight into the potential impacts of policies that influence emissions.

In our study, we quantify the trends in NO2, O3, and PM2.5 in six major metropolitan regions of the U.S. We find, in certain locations, notable differences in pollution amounts in 2020 compared to historical data. Furthermore, we correlate changes in air pollution with changes in traffic levels and power plant emissions, considering periods before, during, and after COVID-19 stay-at-home periods. We examine the consistency of temporal and spatial patterns in changes in human activity and pollutant levels within and across the regions.

Mathematical and Physical Sciences

ENGI 18 **Spatiotemporal & Socioeconomic Lung Cancer Relationships in Texas Between 1995 and 2015 via R INLA Modeling**

Dileka Gunawardana

Mentor: Dr. Cici Bauer

In the United States, lung cancer has the second highest incidence rate and the highest mortality rate of any cancer. This research investigated county-level spatial and temporal trends of four lung cancer histologic types in the state of Texas between 1995 and 2015. The results were then used to create an online interactive dashboard for the purpose of assisting public health officials in, for example, allocation of state funds. A combination of the Bernardinelli and Leroux models was used to find the relative risk (smoothed, modeled version of SIR) for each county in each year of the study. Implementation was by R'S INLA software, which is a faster alternative to MCMC sampling for Bayesian models, conducted via a Laplace approximation of the marginal posterior distribution. Although most lung cancer types have been trending downward in recent years due to decreased smoking use, adenocarcinoma has seen a rise in the last 20 years, driven mostly by females. While there were no significant associations between relative risk and county-level poverty rate, there were some between relative risk and rurality. The more metropolitan that a county was, the higher its risk for lung cancer.

Other works in Engineering

ENGI 19 **Powering Soft Wearable Devices Using Body Heat**

Aman Eujayl

Mentor: Dr. Daniel Preston

The emergence of pneumatically powered soft robots has enabled wearable assistive devices that aid users with limited mobility. However, these devices rely on bulky, noisy compressors or pumps that inhibit comfort and usability. Pneumatic power has been generated from heat by vaporizing a low-boiling-point fluid (LBPF) but has relied on electric heaters that have tethers or hard

components. In this work, we developed a device that generates pneumatic power by vaporizing a LBPF using waste heat from the human body. We used a stacked lamination method to create a textile-based device with a warm chamber that absorbs body heat to pressurize the LBPF, a cool chamber that collects and condenses the LBPF after actuation, and an insulating layer between the chambers to prevent parasitic heat loss. Using a valve, the pressurized warm chamber inflates an actuator on demand, and the cool chamber depressurizes it. We used a thermal resistance network to model the pressures in each chamber, experimentally verified the pressures, and used the device to operate an actuator. This work paves a path to self-powered wearable assistive devices for the upper body without hard components or tethers.

ENGI 20 **COVID-19 Policy Impacts on Satellite-Observed Tropospheric NO2**

Amy Jiang

Mentor: Dr. Daniel Cohan

This study is done as part of Dr. Daniel Cohan's Satellite Air Quality Team looking at early COVID-19 lockdown impacts on satellite-observed US tropospheric NO2 concentrations. This study compares trends of NO2 concentrations in a select few US cities to those of cities in Italy and China, two other countries notably affected by the pandemic during its onset in 2020. Data analysis utilizes NASA's Ozone Monitoring Instrument (OMI) data and compares 2020 measurements to those of a 2016-2019 baseline. Both raw and GAM-smoothed 15-day rolling averages are computed and plotted alongside monthly percent changes and heat map images. NO2 concentration decreases were found to approximately line up with lockdown dates of each city respectively, and maximum decreases ranged between 20% to 65% for most cities. The studied Chinese city was found to have NO2 concentrations an order of magnitude greater than most cities studied in the United States and Rome. Future work could further incorporate holiday travel patterns into this analysis as well as examine more cities and countries in recent dates.

Humanities

Creative and Performing Arts

HUMA 1 **Queering Curanderismo: Holism, Accessibility, and Care in the Practice of Traditional Medicine in the United States**

Mariana Najera

Mentor: Dr. Nia Georges

Curanderismo is a traditional healing system found throughout Latin America. Despite its growing presence in the United States, there is little knowledge about how curanderismo is understood, practiced, and used outside of Latinx communities. To begin to address these questions, this project examines how non-Latinx queer and femme individuals engage with curanderismo. Relying on interviews conducted with Latinx curanderxs and non-Latinx queer/femme healers, I argue that curanderismo is popular with queer and femme non-Latinxs because of its focus on holism and accessibility. Approaching these qualities as core pillars of modern curanderismo, I suggest an understanding of this tradition that, based on queer theory, proposes its growing American presence is due in large part to the modern relevance, prioritization, and perceived need of these traits amongst marginalized American populations. With a focus on curanderismo's adaptability, curanderismo is thus shown to be a form of care that is relatable and responsive in ways that allow it to survive (and thrive) in the United States.

History and Cultural Heritage

HUMA 2 **Eugenicist J. W. Slaughter's Legacy at the Rice Institute, in Houston, and Beyond**

George Huang

Mentor: Dr. Caleb McDaniel

When the Rice Institute was established in 1912, President Edgar Odell Lovett declared that the school would teach and advance to "the theoretic foundations for the applied sciences of engineering, economics, eugenics, and education." Dr. John Willis Slaughter was one such eugenicist and worked at Rice from 1920 to 1947. An interdisciplinary social scientist of the early twentieth century, his work and scholarship in eugenics, sociology, and philanthropy all exemplified the emerging progressive ideals which surrounded deliberate, regulated societal development. By analyzing the scholarship, career, influence, and legacy of professor John Willis Slaughter, I aimed to contribute untold stories to the history

of Rice University concerning an individual who disseminated eugenics scholarship and espoused racism at Rice, in the Houston community, and beyond.

HUMA 3 **Rice University at the Intersection of Epidemic and Global Crisis: Experiences of the 1918 Influenza and COVID-19 Pandemics**

Sally Yan

Mentor: Dr. Melissa Bailar

Two pandemics have occurred in the history of Rice University—the 1918 influenza pandemic and the ongoing COVID-19 pandemic. Although quantitative data abound for both pandemics, little has been catalogued about daily experiences during pandemic times within the microcosm of our university, especially for the 1918 pandemic. Drawing on issues of the ((Houston Post)) and the ((Rice Thresher)) and an alumni's reflection from the period, I attempt to reconstruct Rice students' and faculty's experiences of the 1918 pandemic. Comparisons to the Rice community's perspectives on the COVID-19 pandemic—as depicted in the ((Rice Thresher)) and interviews I conducted with students and faculty—better elucidate the impacts of both pandemics on life at our university. Particularly, these comparisons demonstrate that although life was fundamentally altered at Rice University during both periods, the impacts of the epidemics occurred in conjunction with other crises. While experiences of the 1918 flu pandemic at Rice were driven by the context of the ongoing World War I, current racial justice crises are fueled by the disproportionate impacts and skewed narratives of the COVID-19 pandemic.

Other Works in the Humanities

HUMA 4 **Technological Promise of Virtual Medical Conferences During COVID-19 from Focus Group Data**

Anh Nguyen

Mentor: Dr. Audrey Mendez

Virtual conferences for healthcare professionals are rising in popularity since the COVID-19 pandemic. With this, a number of challenges and benefits with the virtual platform have been cited by conference attendees. Most papers on these conferences draw on survey/poll data, but few draw on focus group data, which can provide a more detailed and emotionally nuanced look into attendees' experiences. My presentation addresses this by assessing the effectiveness of the Veteran Affairs Quality Scholars Summer Institute (SI) using focus groups. I conducted focus groups among SI attendees, after which I coded focus group transcripts. While results showed that the virtual environment hindered some social interactions and networking opportunities, they also showed that virtual platforms, with adequate technological support and tools, promoted increased learning and virtual engagement with access to conference materials, E-posters, the WHOVA app, and expanded keynote speaker options. Ultimately, we were

able to effectively and thoroughly assess the virtual capabilities of SI using focus groups. We hope our findings will inform technological development for other virtual medical conferences.

HUMA 5 **The Baggage of Wellbeing: Freedom Through Meaning Making at the End of Life**

Lillian Wieland

Mentor: Dr. Daniel Mahoney

With the current biomedical model disallowing space for considerations of meaningfulness, patients and communities are not able to connect to important understandings and context at the end of life. This project aims to investigate the implications of various well being theories for end of life care and to propose an alternative framework of meaning-making. Through literature reviews on topics in philosophy, medical humanities, and disability research as well as personal narrative examination, meaning-making emerges as a feasible and educational framework, as it emphasizes evaluative perspectives over prescriptive commands which cut into patient autonomy. Utilizing a meaning-making framework may allow patients and their communities more understanding and acceptance at the end of life. Further, by introducing the narrative element of meaning-making to clinical education, clinicians may show less bias and support more patient agency. The inclusion of dying people in conversations about end of life encourages more meaning and joy in that most universal experience of life, death.

HUMA 6 **David Hume's Theory of Aesthetics: Taste, Judgment, and Moral Intention in British Enlightenment Thought**

Jingyi Zhou

Mentor: Dr. Joseph Manca

This thesis concerns the aesthetic ideas of the Scottish Enlightenment philosopher David Hume (1711-1776). Throughout the eighteenth century, and building on the ideas disseminated in earlier centuries, the field of aesthetics developed rapidly and became prominent in Europe, including a remarkably high level of interest in intellectual circles in Britain. Hume's thoughts on beauty and taste show both originality and influence from earlier thinkers, and they played a crucial role in aesthetics in the eighteenth-century and beyond. The analysis in this thesis focuses on the essential arguments of Hume's important essay "Of the Standard of Taste" (1757), the last essay of Hume's Four Dissertations published in 1757. In that essay, Hume suggested that although taste is subjective and there are great varieties in individual taste, there is a standard of taste that separates good ones from bad ones and can be universalized. He further argued that one needs to refine his taste to make better judgment of beauty. This thesis seeks to analyze and critique Hume's aesthetics and examine the sources of his ideas and how his thoughts influenced others.

HUMA 7 **Equitable Education: Reimagining the Healthcare Experience of Marginalized Communities Through an Instructional Framework Rooted in Narrative Medicine**

Calista I. Ukeh

Mentor: Dr. Nate Serazin

While mainstream approaches to biomedical research and clinical practice produce many successful outcomes in the management of disease, it falls short in fulling accounting for the sociocultural and structural influences that negatively impact the health of many groups of people. Despite large gaps in current healthcare access, education and treatment among vulnerable populations, we postulate that there is a lack of academic research to address the multiple needs of marginalized populations. Our project addresses this deficit by developing a narrative medicine pilot program for implementation in US residency programs. Narrative medicine (NM) offers the potential to provide a more holistic approach to help clinicians examine not only the limited nature of current models of doctor-patient interactions, but to expand physicians' understanding and approach to care that considers structural barriers faced by many patients. We develop our NM model by analyzing existing research and programs that focus on medical training and health inequalities. Our goal is to publish a pedagogical NM framework designed to educate medical residents throughout their instruction curriculum

HUMA 8 **Patient Journey Mapping As A Tool To Understand And Prevent Diagnostic Error**

Julia Shi

Mentor: Dr. Traber Giardina

Diagnostic error is the third most common cause of death in the United States. Despite this staggering statistic, it is extremely difficult to study error because patients continuously transition between clinicians and different care settings, making their experience of the diagnostic process extremely convoluted. A literature review was conducted of patient journey maps in clinical settings. These maps help visualize a patient’s interactions with the healthcare system in order to highlight patterns that would otherwise go unnoticed. This understanding will promote a holistic view of the diagnostic process from the patient’s perspective and reveal barriers to accessing care such as stigma around mental health, lack of trust on both the clinician and patient’s end, and communication challenges. It will also enable identification of common themes in cases of correct diagnoses–such as transparency about uncertainty and curiosity about symptoms–which can be used to help future patients and doctors avoid diagnostic error

Natural Sciences

Bioengineering and Biomaterials

NSCI 1 **Understanding the Antimicrobial Peptide Sensing Specificity of the Virulence-regulating Sensor PhoQ**

Andrew Mu

Mentor: Dr. Jeffrey Tabor

Antimicrobial peptides (AMPs) are peptides produced by the innate immune system that protect against bacterial infection and have the potential to be used as antibacterial therapeutics. However, bacteria have evolved specialized pathways called two-component systems (TCSs) to detect AMPs and activate the expression of AMP-resistance and other virulence genes. One of the most important sensors of AMPs in Gram-negative bacteria is PhoPQ, a virulence-associated TCS composed of a sensor kinase (SK), PhoQ, and a response regulator (RR), PhoP. Our understanding of what AMPs PhoQ senses and how it senses them is limited, due in part to a lack of high-throughput technologies for measuring peptide-TCS interactions. Here, we develop a high-throughput approach by combining TCS engineering, a peptide surface display system, fluorescence activated cell sorting (FACS), and next-generation DNA sequencing (NGS). We used this approach to characterize interactions between ((S.)) Typhimurium PhoPQ and 117 of the 140 known human AMPs and discovered 13 new PhoQ-activating human AMPs. We further demonstrate AMP sensing differs between PhoPQ orthologs from different pathogens.

NSCI 2 **Computational Redesign of a Sulfite Reductase for Unnatural Redox Cofactor Systems**

Dru Myerscough

Mentor: Dr. Ian Campbell

Although evolution has produced an array of efficient redox cofactors in diverse biological systems, novel redox chemistries enable new functionalities and finer control over engineered metabolic processes. These innovations improve the efficiency and versatility of biomanufacturing and bioprocessing platforms, which are increasingly important to the production of modern pharmaceuticals as well as bulk materials and biofuels. Additionally, redox mediators can facilitate electron transfer between living systems and artificial devices, creating exciting new possibilities for engineering at the cell-material interface. Recent efforts applying computational protein design to noncanonical redox cofactor systems have illustrated the potential for computational methods for redox protein engineering. We intend to engineer a suite of orthogonal sulfite reductase flavoproteins that accept synthetic analogues of native cofactors. We will then apply similar methods

to more exotic redox mediators, broadening the applications of established mediators, providing novel insights into their mechanisms of action, and revealing new strategies for engineering novel redox chemistries.

Chemical Biological and Environmental Systems

NSCI 3 **The Optimization of Flash Graphene**

Jared Lee

Mentor: Dr. Duy Luong

Bulk-scale graphene is currently produced via a top-down approach through the exfoliation of graphite. Mechanical exfoliation utilizes high-shear mixing of graphite which is heavily machine intensive and expensive, and chemical exfoliation is extremely inefficient due to the large amount of solvents required and even after production, the final graphene product is partially defective due to perforations caused by harsh redox conditions required for synthesis. Recently, we have devised a way to synthesize graphene utilizing a bottom-up approach. Employing a flash joule heating process, we heated carbon sources such as coal, plastic waster, and discarded food with a high-voltage electric discharge to temperatures exceeding 3000 K in less than 100 ms. This process results in flash graphene which is found to be of exceptionally high quality made through the randomly oriented layering of graphene sheets known as being turbostatic. However, while flash graphene can currently be produced at a gram scale, there still remains an urgent need to scale up the production to at least 1 kilogram per day.

NSCI 4 **Collagen Mimetic Peptides for Integrin Binding**

Maia Helterbrand

Mentor: Dr. Jeffrey Hartgerink

Collagen is one of the most abundant proteins, comprising about one-third of total protein in humans. These individual collagen triple helices assemble to form macroscopic fibers in skin, ligaments, and the extracellular matrix (ECM). Thus, synthetic collagen mimetic peptides (CMPs) are a desirable material for synthetic ECM and directing cell behavior such as integrin binding. The amino acid motif, GFOGER, is found in collagens and binds to α1β1 and α2β1 integrins, playing a role in the transduction of biochemical signals. Several CMPs with this motif were designed with Lys/Glu substitutions in the canonical (Xaa-Yaa-Gly)n triplet repeat to promote supramolecular assembly and covalent bond formation. The peptide length was varied and the peptides were covalently tethered using amide bonds so the folding properties and biological activity can be compared. Three peptides with different lengths were synthesized and peptide identity was confirmed using mass spectrometry. The secondary structure and thermal

stability was characterized using circular dichroism. It was found that increasing the length of the peptide resulted in a more stable supramolecular triple helix.

NSCI 5 **Analyzing the Fitness and Virulence of ((Pseudomonas aeruginosa oprD)) Mutant Strains**

Emily Pepperl

Mentor: Dr. Natasha Kirienko

((Pseudomonas aeruginosa)), a common human pathogen, poses a significant threat to patients residing in hospital settings. These opportunistic, Gram-negative bacteria engender potentially deadly infections in the circulatory, respiratory, and otherwise vulnerable body systems, especially in patients that utilize intrusive medical devices or are postoperative. Following treatment with carbapenem antibiotics, mutant or downregulated OprD proteins can effectuate antibiotic resistance. Past work involving said alteration of the ((oprD)) gene in ((P. aeruginosa)) has demonstrated increased microbial fitness and virulence, rather than the expected associated costs. However, the mechanism behind the enhancement of ((oprD)) mutants is not well-studied. Here, the fitness and virulence of ((oprD)) transposon insertion mutants and ((oprD))-deficient clinical isolates were analyzed using ((Caenorhabditis elegans)) as a model host; colony-forming unit assays assessed fitness, while both liquid- and slow-killing assays evaluated virulence. Following the optimization of assay conditions, results indicated that the ((oprD)) deficiency generally promotes fitness and does not impact virulence.

NSCI 6 **Using Microfluid Technology to Measure ((Streptomyces)) Interactions**

Sarah Kong

Mentor: Mr. Xinhao Song

Microbes form complex microbial communities and have diverse social interactions, which are important drivers of evolutionary success. Social interactions can be organized by a Hamiltonian scheme, which defines behavior based on its impact on the 'self' and 'other'. Some social interactions are evolved through indirect fitness effects, which can be selected for using microfluidic technology, named Microfluidic Assembly of Synthetic Ecologies (MASE). MASE generates droplets as micro-environments, in which new social interactions between bacterial strains can be experimentally evolved. Experimental evolution allows for the evolution of social interactions to be understood, how non-cooperative vs. cooperative interactions form, and the genetic basis of these evolutions.

To obtain more strains of ((Streptomyces)), glycerol stocks were made from a library of 73 wild soil isolates. The isolates will be encapsulated in micro-droplets

and undergo sorting in microfluidic devices to screen strains that have the potential for evolving social interactions.

Ultimately, evolving social interactions between strains of ((Streptomyces)) offers a model for understanding how other social interaction

NSCI 7 **Genetic Incorporation of Red Fluorescent Amino Acid for Protein Tracking in Mammalian Cells**

Anna Chung

Mentor: Mr. Yuda Chen

Fluorescent noncanonical amino acids (ncAAs) are useful tags for understanding protein function, structure, and interactions. One method for using fluorescent tags with proteins involves site-specifically incorporating large protein tags (>20 kDa), which can significantly alter protein structure or function. Another approach involves site-specifically incorporating small fluorescent ncAAs into proteins using orthogonal tRNA/aminoacyl tRNA synthetase machinery. One of these small ncAAs, 3-(6-acetylnapthalen-2-ylamino)-2-aminopropanoic acid (Anap), can be incorporated into proteins to track their localization in a minimally perturbed way. However, its blue emission fluorescence limits its tissue penetration ability and introduces high photon toxicity. To design a fluorescent amino acid with more red-shifted fluorescence, we aim to genetically incorporate an Anap-analog-containing amino acid to track protein localizations. Modifying the R group of N-[isoleucinyl]-N'-[adenosyl]-diaminosufone (ILA) with Anap analogs, we studied docking interactions between ILA mutants and the E. coli Leu-RS-tRNA complex to determine which analog binds to the protein most effectively.

NSCI 8 **The Synthesis of Nitrile-substituted Molecular Machines for Use as Antimicrobials**

Aaron Wyderka

Mentor: Dr. James Tour

In recent times, antibiotics have had waning effectiveness in the fight against bacteria due to evolved antimicrobial resistance. Previous work has been done by the Dr. James Tour group at Rice University regarding the use of these machines and their capabilities of opening cell membranes through nanomechanical action initiated by ultraviolet light excitation. The work in this project will involve the synthesis and study of molecular machines in order to optimize their effectiveness in the fight against bacterial disease. Novel molecular machines must be created in order to study their mechanism of action to discover what determines greater efficacy in terms of bacterial cell death, as well as selectivity in bacterial models. In terms of efficacy, this project sought to incorporate nitrile substituted machines to

be studied due to the relative absorption shift toward less damaging light because of added conjugation.

Civil and Mechanical Innovation and Materials Research

NSCI 9 **Synthesis of Porous Organic Polymers for the Purpose of Direct Air Capture of Carbon Dioxide**

Gulnihal Tomur

Mentor: Dr. Soumyabrata Roy

In the last century, atmospheric carbon dioxide, the main contributor to global warming, has increased at an unprecedentedly high rate. Multiple synthetic materials have been proposed for direct CO2 capture from the air, with porous organic polymers (POPs) being one of the most promising ones due to their stability, large surface area, and variety in pore sizes, structure, and functional groups. In this project, POPs were polymerized by combining multiple monomer pairs through Schiff-base reactions between amine and aldehyde or ketone functionalities of individual monomers. During the post-functionalization of POPs, more amine functionalities were embedded into the system through the conversion of prevalent functional groups into nitrogen-containing motifs. The structure of POPs was analyzed through FTIR spectroscopy with special attention to the imine bonds obtained in Schiff-base reactions. Additionally, sorption analysis was used to calculate the Brunauer-Emmett-Teller surface area of each polymer.

Environmental and Earth Sciences

NSCI 10 **An Intuitive Method for Approximating Grain Sizes on Mars**

Sarah Preston

Mentor: Dr. Kirsten Siebach

The grain sizes of sedimentary rocks encode valuable information about the conditions in which the rocks formed. Correctly measuring grain size allows us to use physics-based methods to unravel the history of Martian climate and geology. However, when rovers image rocks at the surface of Mars, they are frequently dusty and wind-eroded and it is difficult to clearly identify grain boundaries for quantitative measurements. By modifying a grain size card, a tool commonly used on Earth, we can verify the accuracy of existing grain size measurements and provide a benchmark for novel methods. To ensure applicability to the Curiosity rover's Mars Hand Lens Imager (MAHLI) data and enable quick comparisons, we create a grain size card representing five grain size classes and five common image scales. Early results show that the grain size card method is effective for a wider range of conditions and sedimentary textures than existing methods that rely on distinct grain boundaries or variations in chemistry. This method will allow for

intuitive verification of results and allow analysis of textures that are hard to measure quantitatively, and may be expanded to apply to other rover cameras.

NSCI 11 **Assessing Rice University irrigation trends to find reduction strategies**

Rachel Johnson

Mentor: Dr. Evan Siemann

Rice University uses around 230 million gallons of water each year with ~ 40 million gallons for irrigation. Water use will only increase as the campus population expands and the number of students rises, unless actions are taken to reduce water consumption. By interviewing professionals, creating models, and calculating water budgets for irrigation zones, this project examined methods to reduce Rice University's irrigation. Through this study, it was found that Rice University tends to overwater, the irrigation is reactive, and it could be meeting most irrigation needs through rainfall. Efforts must be made to reduce overwatering on campus. An important first step is updating the aging irrigation system followed by the utilization of a smart irrigation system to have adaptive irrigation. In the future, in depth research should be conducted on implementing rainwater harvesting technology on campus so that Rice University can become self-sufficient. With these changes Rice University will save water and money while lessening their dependence on the City of Houston water system.

NSCI 12 **Epichloe Endophytes Confer Resistance to Drought, Competition, and Herbivory in Their Cool Season Grass Hosts: A Meta-analysis**

Ella Segal

Mentor: Dr. Tom Miller

EpichloÃ« fungi are endophytes that commonly infect cool season grasses and have been shown to increase their hosts' resilience to drought, competition, herbivory, and more. Available research is not unanimous, however, and some studies have shown a cost or lack of effect associated with endophytes under varying conditions or with different partner species. While numerous meta-studies have pooled research to examine the relationship between endophytes and one of these stressors, no meta-study, to our knowledge, has quantified the benefit that endophytes confer to their hosts against all of these stressors relative to each other. In our study, we aggregated data from over thirty papers and found the extent to which EpichloÃ« endophytes modified host grasses' tolerance of these stressors. Where possible, we extracted data concerning plants' biomass to give a common metric to compare between studies. Because climate change will alter the relative levels of stress that grasslands will face from different factors, it is important to gauge the effect that each may have on grasses' fitness to create best management practices.

NSCI 13 **The Impacts of Extreme Heat on Texas Football**

Gargi Samarth

Mentor: Dr. Sylvia Dee

This research project will focus on the impact that extreme heat has on Texas football. We conducted a literature review of previous studies on extreme heat and sports. Our analysis consists of compiling 20th-century temperature data, examining different RCP climate model projections, and interviewing football coaches about their experiences with and decision-making during heatwaves. Through this project, we hope to understand how increasing temperatures will affect athlete and general human health, the Texan economy, outdoor sports, and our culture.

NSCI 14 **Designing a Graphical User Interface (GUI) for a Lake Proxy System Model (PRYSM)**

Srivinay Tummarakota, Henry Qin

Mentor: Dr. Sylvia Dee

Paleoclimatic reconstruction is the process by which archives such as lake sediments, ice cores, or corals are utilized to reconstruct past climate conditions. In 2015, a suite of Python-based models was created to allow climate modelers to collaborate more fluidly with paleoclimate geochemists, enabling data-model comparison between archives of past climate and model simulations. To expand use as both a teaching and research tool, Melinda Ding and Dr. Sylvia Dee created a user-friendly Graphical User Interface (GUI) for models that utilized coral, cellulose, and ice core paleoclimate proxy data.

We expanded on work from Ding and Dr. Dee by building a Python GUI that runs a lake sediment proxy system model (PSM) in Fortran and visualizes output data. Supplementing the lake PSM, our GUI runs leaf wax, carbonate, GDGT, compaction, and bioturbation models to provide additional analysis of paleoclimatic data. We used several Python libraries to build the GUI: tkinter provided us with a GUI framework, pandas allowed us to organize output data, and matplotlib facilitated data visualization. We also created a tutorial video to provide in-depth instructions on how to use the GUI.

Environmental Biology

NSCI 15 **Adult amphibian phenological distributions shape competition in larval communities**

Calvin Carroll

Mentor: Dr. Volker Rudolf

Shifts in the phenological overlap of community members have the potential to reshape spatiotemporal interaction networks, but whether these shifts follow suit between age classes remains unclear. Here, we employ a novel analysis of long-term records for five amphibian species to test whether adult phenological trends predict variation in larval phenologies. Specifically, we assessed patterns in pairwise phenophase overlap, which mediates potential competitive interactions between species. We found that species and site identity strongly determine the degree of interaction potential between larval pairings, which is generally maintained from the adult calling phenophase to larval activity. Importantly, our analysis of adult calling data uncovered the efficacy of audio-based sampling to capture phenological trends in inter-species overlap as well as the timing and duration of related intra-species phenophases. These results suggest that increased phenological shifts in response to climate change will restructure temporal communities through complex changes in the shape, timing, and duration of phenologies across age classes and species.

NSCI 16 **The Effect of Environmental Sources of l-DOPA on the Divergence of Cognitive Abilities between ((Drosophila)) Species**

Erin Harrison

Mentor: Ms. Madeline Burns

Although learning and decision-making abilities vary greatly across animal species, the evolutionary factors influencing the divergence of these cognitive abilities are still yet unknown. In many species, including ((Drosophila)), dopaminergic pathways facilitate the formation and retention of learned associations. Because of this, we hypothesize that specialization to a host containing an environmental source of l-DOPA, the precursor to dopamine, is likely to impact the amount of dopamine produced within the organism, which may alter cognitive ability. To investigate this, we compared the gustatory associative learning ability of two sister species of ((Drosophila)): a generalist, ((D. simulans)), and a specialist to the l-DOPA-rich noni fruit, ((D. sechellia)). We reared both genotypes in either standard media or l-DOPA supplemented media, then tested flies for their initial medium preference. We then tested their associative learning ability through associative food conditioning with a negative gustatory stimulus. Our pending results could elucidate possible avenues through which divergences in cognitive abilities can appear.

NSCI 17 **Genetic and Environmental Effects on Seed Provisioning of an Invasive Tree, ((Triadica Sebifera))**

Dustin Ho

Mentor: Dr. Evan Siemann

Plants have limited resources for reproduction, so they face tradeoffs between offspring size and number as well as embryo provisioning and seed dispersal. Such tradeoffs may be mediated by genetic and/or environmental factors,

resulting in varying seed properties over different populations and years. Chinese Tallow Tree ((Triadica sebifera)) is a problematic invasive species in the American South. Its seeds are dispersed by birds, who digest the waxy coating for energy and excrete the rest elsewhere. Here, we determined wax mass (reward for disperser) and seed mass (resources for embryo) for individual trees from 21 populations from Texas to North Carolina over ~20 years. We used historical temperature, precipitation, and drought data to explore environmental effects on seed provisioning. Wax mass was more variable than seed mass. We found little evidence for genetic effects on seed provisioning, but a strong role for environmental factors, especially low winter temperatures and drought late in the growing season that reduce seed mass. Together, these results suggest that environmental effects on seed provisioning vary by season through impacts on flowering and seed maturation.

NSCI 18 **Spatiotemporal Heterogeneity in Coral Reef Fish Community Recovery After Disturbances**

Brendan Wong

Mentor: Dr. Evan Siemann

Plants have limited resources for reproduction, so they face tradeoffs between offspring size and number as well as embryo provisioning and seed dispersal. Such tradeoffs may be mediated by genetic and/or environmental factors, resulting in varying seed properties over different populations and years. Chinese Tallow Tree ((Triadica sebifera)) is a problematic invasive species in the American South. Its seeds are dispersed by birds, who digest the waxy coating for energy and excrete the rest elsewhere. Here, we determined wax mass (reward for disperser) and seed mass (resources for embryo) for individual trees from 21 populations from Texas to North Carolina over ~20 years. We used historical temperature, precipitation, and drought data to explore environmental effects on seed provisioning. Wax mass was more variable than seed mass. We found little evidence for genetic effects on seed provisioning, but a strong role for environmental factors, especially low winter temperatures and drought late in the growing season that reduce seed mass. Together, these results suggest that environmental effects on seed provisioning vary by season through impacts on flowering and seed maturation.

NSCI 19 **Reproductive Strategy Divergence Between Host-Associated Species of Gall-Forming Insect**

Amy Roush

Mentor: Dr. Scott Egan

Differentiation in morphological traits due to divergent selection is well documented, but whether life history traits such as reproductive strategy differ is unclear. Fecundity and egg size affect individual fitness and should be targets of selection. This study tests the role of divergent selection on reproductive strategy

between two sister species of gall-forming wasps, ((Belonocnema treatae)) and ((B. fossoria)), which induce tumor-like growths of plant material where their offspring feed and grow on tree species ((Quercus virginiana)) and ((Q. geminata)), respectively. These wasp species diverge in phenology, morphology, and behavior, and exhibit significant genome-wide genetic divergence (GST = 0.37). The number of eggs and egg size were measured for a total of 182 individual females across 8 populations [3 from ((B. treatae)) and 5 from ((B. fossoria))]. We then compared whether these traits differed between the species relative to body size (estimated via tibia length). We found that egg number and size relative to body size averaged greater for ((B. fossoria)) than ((B. treatae)), which suggests divergence in reproductive strategy.

Human and Medical Lifesciences

NSCI 20 **Impulse Control Disorders in Parkinson's Disease: From Bench to Bedside**

Andrea Augustine

Mentor: Dr. Vaishnav Krishnan

Parkinson's disease (PD) is a neurodegenerative disorder that is characterized by symptoms that impact both motor and non-motor domains. Outside of motor impairments, PD patients are at risk for impulse control disorders (ICDs), which include excessively disabling impulsive and compulsive behaviors. ICD symptoms in PD (PD + ICD) can be broadly conceptualized as a synergistic interaction between dopamine agonist therapy and the many molecular and circuit-level changes intrinsic to PD. Aside from discontinuing dopamine agonist treatment, there remains a lack of consensus on how to best address ICD symptoms in PD. In this review, we explore recent advances in the molecular and neuroanatomical mechanisms underlying ICD symptoms in PD by summarizing a rapidly accumulating body of clinical and preclinical studies, with a special focus on the utility of rodent models in gaining new insights into the neurochemical basis of PD + ICD. We also discuss the relevance of these findings to the broader problem of impulsive and compulsive behaviors that impact a range of neuropsychiatric syndromes.

NSCI 21 **Leveraging Trans-Species Actigraphy to Advance Digital Psychiatry**

Mark Abboud

Mentor: Dr. Vaishnav Krishnan

Advances in wearable devices are poised to radically transform psychiatry by supplementing serial mental status exams (subjective, qualitative) with continuous, objective and in situ behavioral data. A similar movement in basic research now supplants short tests of emotionality in rodents (e.g., open field testing) with prolonged recordings of spontaneous home-cage behavior. This study provides the very first quantitative comparison of rest and activity patterns

("actograms") in mice and humans to define potential avenues for cross-species translation. We compare video-tracking data from wild-type laboratory mice to annotated human wrist-actigraphy data collected in the Study of Latinos (n=1887). In comparison with humans, murine actograms display marked nocturnality and discontinuity. Simultaneously, both species display similarities in ultradian periodicity and activity quantization ("active states"). We describe how (i) gender and (ii) trait anxiety impact actigraphic parameters across both species. Together, our ethologically sound approach provides a novel framework to dissect the genetic, psychopharmacological and environmental determinants of rest and activity rhythms.

NSCI 22 **Overexpression of Human Epidermal Growth Factor 2 across Head & Neck Cancers Creates a Potential Target for Antigen-Specific Immunotherapy**

Joshua Anil

Mentor: Dr. Andrew Sikora

The purpose of this study is to describe human epidermal growth factor 2 (HER2) overexpression in head and neck squamous cell carcinoma (HNSCC) and re"evaluate its potential as a target for HER2"directed immunotherapies. A retrospective cohort of patients with HNSCC receiving curative treatment was identified, and HER2 expression evaluated in archival tissue by immunohistochemistry and correlated with clinicopathological characteristics. HER2 expression data were also determined for HNSCC patients in The Cancer Genome Atlas. Nineteen percent of HNSCC and 39% of oropharyngeal HNSCC (OPSCC) were HER2 positive. HER2 expression positively correlated with nodal metastasis (p = 0.035). Patients with HER2"positive tumors had decreased overall survival (p = 0.012), including within the human papilloma virus" positive OPSCC subgroup (p = 0.007).A substantial fraction of HNSCC overexpresses HER2 protein, suggesting it may be a suitable target for antigen" directed immunotherapy. HER2 expression and its correlation with survival vary across HNSCC subsites, making it unsuitable as a prognostic marker.

NSCI 23 **Inhibiting the Generation of Adenosine as a Treatment for Lung Fibrosis**

Lucy Revercomb

Mentor: Dr. Harry Karmouty-Quintana

Idiopathic pulmonary fibrosis (IPF) is a chronic and irreversible lung disease with a poor survival rate and limited treatment options. Ecto-5'-nucleotidase (CD73), encoded by the NT5E gene, is the major enzyme that catalyzes the formation of extracellular adenosine from ATP released due to cellular injury. In the setting of lung inflammation, adenosine is produced as a protective response, but worsening of fibrosis can attribute to long-term, sustained elevation of adenosine levels that promote tissue remodeling. To further examine the role of CD73 in IPF, the

efficacy of CD73 inhibitor (CD73i) was evaluated in a bleomycin (BLM)-model of lung fibrosis compared to pirfenidone. Mice were exposed to IP-BLM or PBS (control) twice weekly for 4 weeks. Mice were then treated with oral pirfenidone in 0.5% carboxymethylcellulose (CMC), CD73i suspended in labrasol, CMC, or labrasol every day for 14 consecutive days. Immunohistochemistry, RT-PCR, histological analysis, and western blots were performed to evaluate markers of fibrosis and lung function analysis using the Flexivent. We expect treatment with CD73i to result in a significant reduction in fibrosis comparable to pirfenidone.

NSCI 24 **ACVR1, MGMT and CXC4: Potential Therapeutic Targets against Diffuse Intrinsic Pontine Gliomas**

Emily Wang

Mentor: Dr. Leomar Ballester

Diffuse intrinsic pontine glioma (DIPG) is the deadliest pediatric solid tumor. Lack of effective chemotherapy and its location result in near 100% fatality. However, DIPG genomic characterization has paved the way for targeted therapeutic strategies. This study evaluated three potential therapeutic targets: ACVR1, MGMT, and CXCR4.

We tested ACVR1 mutant (DIPG4) and wildtype (DIPG24 and 33) cell lines' sensitivity to ACVR1, MGMT, and CXCR4 inhibitors. We used a cell viability assay to determine in vitro cytotoxic effect of these inhibitors. Immunohistochemistry, western blot, and RT-PCR were used to determine protein and mRNA expression, respectively.

CSLP-31 and LDN-193189, showed selective toxicity against ACVR1 mutant cells, but other ACVR1 inhibitors led to ACVR1-independent cell death. MGMT promoter analysis demonstrated methylation absence in all cell lines, and LMG (a MGMT inhibitor) elicited the most effective treatment with concurrent temozolomide. CXCR4 was expressed in all cell lines, and AMD3100 significantly reduced DIPG cell viability.

This suggests a promising role of individual-based therapeutics for DIPG therapy, but more in vivo and clinical studies are needed.

NSCI 25 **Story telling as a measure of cognition and language after stroke**

David Ai

Mentor: Dr. Simon Fischer-Baum

Aphasia is an acquired communication disorder that impacts one's ability to express oneself. Aphasia can range from total loss of ability to understand and/or produce language to subtle difficulties with expressing one's thoughts, wants, and needs. The current study focuses on the communication deficits in people with aphasia (PWA) categorized as either “mild” or "non-aphasic” based on standard

clinical criteria. Despite the fact that they are supposedly back to "normal", they frequently report continued difficulty communicating effectively and efficiently, which prevents them from return to work and results in social isolation. We are examining discourse abilities "the ability to tell stories" in this population, through narrative analysis in order to quantitatively and qualitatively demonstrate their underlying cognitive-linguistic deficits. At this stage we have collected and analyzed data from two participants and we are in the process of developing a scoring rubric to objectively demonstrate the type of subtle deficits that are typically missed on existing assessment measures designed to evaluate PWA.

NSCI 26 **Investigating TERT Antibodies as a Surrogate for TERTp Mutations**

Puneetha Goli

Mentor: Dr. Leomar Ballester

Infiltrating gliomas contribute to 80% of malignant primary brain tumors. Research has shown that oligodendroglioma IDH-mutant 1p/19q frequently presents TERT promoter mutation, helpful in the accurate diagnosis of this infiltrating glioma subtype, while IDH-mutant astrocytomas rarely harbor TERT promoter mutations. Additionally, the recent cIMPACT-NOW update 3 has suggested that grade II-III astrocytoma IDH-wildtype harboring TERT promoter mutations should be classified as glioblastoma IDH-wild type grade IV, as they behave more aggressively. While the role of TERT promoter mutations has been extensively investigated in identifying infiltrating gliomas, its analysis requires digital droplet PCR or sequencing techniques that are usually costly and require long turn-around time compared to more commonly utilized techniques such as immunohistochemistry (IHC). The research objective is to investigate TERT antibodies as a surrogate for TERT promoter mutations for infiltrating gliomas. The experiment statistically compares the TERT next-generation sequencing results of patient tumor samples with the TERT IHC using the rabbit monoclonal Y182 primary TERT antibody.

NSCI 27 **The Effects of a College-Mentored Physical Activity Program for Elementary Students**

William Sayre

Mentor: Dr. Laura Kabiri

Health risks of a sedentary lifestyle for children, defined as less than 5,000 steps per day, include unfavorable indicators of body composition and cardio-metabolic risk. Results of school-based interventions to increase activity have been mixed, however, similarly-aged peer-to-peer mentorship programs have shown promise. College mentors, who have largely been ignored in research to date, present an alternative and low-cost resource. This study investigated the impact of a novel, individualized college-mentored physical activity program on activity levels among elementary school students. Fifth grade students (n = 12) were paired one-to-one with college mentors for 30 minute bi-weekly running sessions for six

weeks. Multiple assessments from activity trackers were compared on intervention versus non-intervention days using paired-samples t-tests. Significant increases in steps ($t(11) = 8.056$; $p \leq .001$) and moderate-to-vigorous activity ($t(11) = 5.202$; $p \leq .001$) were seen on intervention days, as well as an average increase in step count (6381 versus 3158). This novel high-impact and low-cost approach should be further developed for future physical activity programs and research.

Mathematical and Physical Sciences

NSCI 28 **Stochastic Gravitational Wave Background Resulting from Higgs Field Inhomogeneities**

Brandon Khek

Mentor: Dr. Andrew Long

Gravitational radiation is commonly associated with compact objects, but such waves are also present on the Hubble scale. Due to thermal fluctuations after electroweak symmetry breaking, regions of space attained different Higgs field vacuum expectation values (VEV). As the regions come into causal contact, a tension in the field arises, for inhomogeneities result in contributions to the field's energy density. In order to obey energy conservation and discard the excess energy, gravitational waves are expected to be emitted from the Higgs field. In this project we calculate the gravitational wave energy density power spectrum resulting from the relaxation of the Higgs field in various eras of the universe. We consider a modified cosmic history with an early manipulable era capable of modeling radiation, matter, and kination domination. The power spectrum has two other free parameters including the VEV and the time at which the early modifiable period ends, no later than one second after the big bang. We then overlay gravitational wave detector sensitivity curves with our spectrum and find that the gravitational radiation we expect from the Higgs field remains undetectable for now.

Molecular and Cellular Biology

NSCI 29 **Characterizing the Molecular and Physiological Defects Associated with ((Arabidopsis thaliana)) LON2 Mutations**

Stefanie King

Mentor: Dr. Bonnie Bartel

Peroxisomes are organelles housing metabolic reactions that produce reactive oxygen species that must be sequestered or inactivated to prevent cellular and organellar damage. LON2 is a peroxisomal chaperone and protease protein that helps modulate peroxisomal degradation through an unknown mechanism. LON2 contains three main domains: the N-terminal, AAA ATPase, and protease

domains. The AAA and protease domains have defined roles identified from analogous genes in other organisms; however, the N-terminal domain function in ((Arabidopsis thaliana)) remains unknown. To elucidate the specific functions of ((A. thaliana)) LON2 domains, I began characterizing a ((lon2)) mutant series containing domain-specific missense mutations and a truncation in the N-terminus. I present progress toward characterizing molecular and physiological defects of the series through immunoblotting, growth assays, and confocal microscopy of a peroxisome-targeted fluorescent reporter. Preliminary data revealed variance in key peroxisomal protein accumulation across the lines, while differences in growth patterns are being quantified. Further investigation into the causes of these differences is ongoing.

NSCI 30 **The Role of Nop2 Methyltransferase in the Progression of Cancers**

Karen Wang

Mentor: Dr. Catherine Denicourt

The 5-methylcytosine (5mC) modification indirectly regulates crucial cellular processes such as gene expression, ribosome biogenesis, and protein synthesis. Studies show 5mC methyltransferases upregulated in various tumor tissues. Nop2, a putative rRNA methyltransferase, is a tumor marker overexpressed in various cancers. Though Nop2 is hypothesized to play a role in the dysregulation of ribosome biogenesis in cancer, the precise function of Nop2 is not clear. Studies in ((S. cerevisiae)) show that Nop2 modifies the 25S rRNA and is crucial for pre-rRNA processing and cell survival, but its substrates in human cells are unknown. Elucidating targets of Nop2 modification and how they alter ribosome biogenesis in cancer cells will build a foundation for designing therapeutic agents able to target a wide range of cancers. Using bisulfite sequencing, we show that Nop2 modifies the 25S rRNA equivalent in humans, the 28S rRNA. Furthermore, we perform cross-linking immunoprecipitation (CLIP-seq) experiments and sequencing to identify new substrates, including small nucleolar RNA and vault RNA. We are currently conducting experiments to verify the presence of 5mC on those substrates.

NSCI 31 **Statistical Analysis of Twinkle Helicase in Evolution and Prevalence of Twinkle-Related Diseases**

Neil Chopra

Mentor: Dr. Yang Gao

The Twinkle protein is a mitochondrial DNA (mtDNA) helicase with major roles in mtDNA storage, replication, and maintenance. Mutations in Twinkle lead to serious diseases including progressive external ophthalmoplegia (PEO) and infantile-onset spinocerebellar ataxia (iOSCA). While similar in function to the GP4 protein in the T7 bacteriophage, Twinkle has low conservation to GP4. Using multi-sequence alignment, statistical coupling analysis, and other evolutionary analysis techniques, a protein sector of human twinkle helicase is generated and

analyzed. This sector is a set of physically connected residues that tend to carry out similar functions within the protein and provide insight into evolutionary relationships between residues within twinkle helicase. Following analysis of this sector, we aim to learn more about the origin of twinkle-related mitochondrial diseases like PEO and iOSCA and understand the significance of the changes between the T7 DNA helicase (GP4) protein and the human Twinkle protein.

NSCI 32 **Investigating light activated DNA-repair mechanisms in Symbiodiniaceae against UV stress**

Julia Kim

Mentor: Dr. Adrienne Correa

Symbiodiniaceae, eukaryotic algae that live in an endosymbiotic partnership with corals, must possess some mechanism to repair DNA damages from UVR stress. DNA damage causes cell cycle delay and putative activation of viral infections in Symbiodiniaceae, disrupting their partnership with corals and potentially leading to coral decline. This project is a phylogenetic investigation of whether photolyase proteins, light-activated repair enzymes, are involved in protecting Symbiodiniaceae from UVR damage, and the diversity of photolyases (specific to types of DNA damage) Symbiodiniaceae possess. To perform this investigation, a database of established protein sequences from photolyases and closely related proteins was created. This database was used for a BLAST-based homology search against publicized Symbiodiniaceae protein sequences. Identified homologs were cross referenced against the NR protein database to confirm their identity as photolyases. Phylogenetic trees were constructed using a maximum likelihood method to visualize protein diversity. This work elucidates how Symbiodiniaceae persist against UVR damage, specifically in their free-living life stage during bleaching cycles.

NSCI 33 **Ion Channel Expression Differences in Molecular Subtypes of Infiltrating Glioma**

Arvind Ramesh

Mentor: Dr. Antonio Dono

Glioblastoma (GBM) is the most common malignant primary brain tumor in adults, and it is classified by the IDH1/2 gene status. This study aimed to identify the ion channel expression differences between IDH wild-type (IDH-WT) and mutant glioma patients. TCGA RNAseq expression data was evaluated. Expression and intensity of the most different 6 ion channels in TCGA were evaluated in 37 glioma patients (4 astrocytomas, 27 glioblastomas (GBM), and 3 oligodendrogliomas) through immunohistochemistry (IHC). RNAseq expression showed 67 downregulated and 38 upregulated genes in IDH-mutant tumors after multiple comparison adjustments. IHC validated that TRPM8 (78.6% and 66.7% vs. 100%, p=0.028) and KCNK5 (21.4% and 0% vs. 63.2%, p=0.021) expression were decreased in IDH-mutant astrocytoma and oligodendroglioma compared to

GBM IDH-WT. Additionally, the genetic evaluation showed that CDKN2A/B loss was more frequent in patients with TRPM8 increased intensity (93.8% vs. 6.2%, p=0.050). Also, ATRX mutation was more frequent in KCNK5 negative patients (88.9% vs. 11.1%, p=0.048). In conclusion, TRPM8 and KCNK5 expression are decreased in IDH-mutant astrocytoma and oligodendroglioma patients.

NSCI 34 **Investigating the Role of Carbon Availability on Pexophagy in ((Arabidopsis thaliana))**

Abigail King

Mentor: Dr. Bonnie Bartel

Autophagy is the cellular process by which organelles are catabolized. Peroxisomes are organelles responsible for Î²-oxidation of fatty acids and can be destroyed by pexophagy, a targeted autophagy for which regulators remain largely unknown in plants. We have used peroxisomal protein levels as a proxy for pexophagy in ((Arabidopsis thaliana)) seedlings and evaluated the role of carbon supply in pexophagy by preventing photosynthesis using darkness, which leads to carbon starvation. We observed that carbon starvation in seedlings activates general autophagy but not pexophagy. In contrast, when seedlings are in darkness, but supplemented with an alternative fixed carbon source (sucrose), pexophagy does occur. Because peroxisomes can mobilize stored carbon by metabolizing fatty acids, we seek to elucidate how lipid utilization relates to pexophagy by disrupting Î²-oxidation. We will also evaluate adult plants to determine whether adult pexophagy mirrors seedling responses and whether the response is localized or responds to overall nutrient availability in the plant. These experiments will further our understanding of pexophagy and its regulation in plants.

NSCI 35 **Determining the Effect of TRMT1L Nuclear Localization Signal and Nucleolar Localization Signal Mutants on Translational Fidelity and Initiation**

Amirtha Shekar

Mentor: Dr Catherine Denicourt

One of the biggest challenges to creating targeted cancer treatments is understanding the unregulated cellular processes that allow for cancer cells' growth. One of the vital resources contributing to cancer cells' growth is proteins, and over-expression of proteins is prevalent across many aggressive forms of cancer. An important methyltransferase that may be responsible for the over-expression of proteins due to differential rRNA methylation is TRTM1L. This novel protein remains uncharacterized while similar methyltransferases, such as Nop2, have been extensively studied, allowing us to examine the effect of these methyltransferases' presence on global protein translation levels. Since TRMT1L is over expressed in certain cancers, understanding its function and localization are important in determining its effect on ribosome production in cancer cells. In

examining the effect of altered localization on function, mapping the nuclear localization signal (NLS) and nucleolar localization signal (NoLS) on TRMT1L is crucial. Mutating these signal regions allows us to determine the varied expression of TRMT1L and how this subsequently affects translation initiation and fidelity.

NSCI 36 **The Role of Bacteriophage SPO1 Gene Products 45 and 46 in the Shutoff of Host Protein, RNA, and DNA Syntheses in ((Bacillus subtilis)) Cells During Infection**

Haoting Huo

Mentor: Dr. Charles Stewart

This project aims to determine specific functions of two gene products, gp45 and gp46, of the SPO1 bacteriophage and how they affect the shutoff of host protein, RNA, and DNA syntheses in ((Bacillus subtilis)) cells. Host-takeover requires complex regulatory mechanisms to eliminate the host-specific biosyntheses while allowing phage-specific syntheses to proceed in the same cell. Researching the precise functions of gp45/46 contributes to a greater understanding of bacteriophage host-takeover processes. Based on preliminary findings, we hypothesize that gp45/46 inhibit host protein and DNA synthesis without affecting host RNA synthesis, but repeated experiments are needed. To test this hypothesis, pulse-labelling is used with tritiated thymidine, uridine, or leucine to measure rates of host biosynthesis in two separate infection scenarios: one in which a culture is infected with wild-type SPO1 and another in which a culture is infected with double mutant gp45-/46- SPO1. Repeated results of this project will conclusively determine the effects of gp45/46 on the shutoff of host biosyntheses. Future experiments should test the host-takeover effects of individual SPO1 gp45 and gp46.

NSCI 37 **Purification and Iron Chelation of Pyoverdine from Ferroproteins**

Jaime Ramirez

Mentor: Mr. Alex Kang

Pyoverdine is a major siderophore and virulence factor produced by Pseudomonas aeruginosa. As an iron-scavenging molecule, pyoverdine provides the bacterium with this essential micronutrient, often by chelating it from eukaryotic host ferroproteins such as transferrin and lactoferrin. Interestingly, different strains of P. aeruginosa produce structural variants of pyoverdine, namely pyoverdine types I, II, and III. However, their differential abilities to chelate ferric iron is understudied. Here, I purified pyoverdine variants from clinical isolates and showcase their ability to chelate iron from transferrin and glutaredoxin-2. The results of my study depict the efficacy of each pyoverdine variant. These results show that P. aeruginosa strains produce pyoverdine variants which have characteristic differences in their ability to chelate iron.

NSCI 38 **Categorizing the Mechanisms of Carbapenem Resistance in ((Pseudomonas aeruginosa)) Clinical Isolates**

Alex Deyanov

Mentor: Dr. Natasha Kirienko

Antibiotic resistance remains one of the most pressing issues in the fields of healthcare. ((Pseudomonas aeruginosa)) infections are a leading cause of death in cystic fibrosis patients, the immunocompromised, and burn victims. Of particular concern are those strains that have acquired enough resistance mechanisms to be classified as "extensively drug-resistant" (XDR). XDR strains are resistant to last-line antibiotics such as carbapenems; previous studies have put forward three classes of carbapenem resistance mechanisms: overproduction of carbapenemases or antibiotic efflux pumps and underproduction of OprD porins. We characterized eight clinical isolates of ((Pseudomonas)) based on the presence of a carbapenemase through the carbapenemase inhibition test as described by Zwaluw et al. (2015) as well as the CarbaNP test as described by Nordmann et al. (2012) and then developed a novel protocol combining aspects of both assays. We tested the effect of the efflux pump inhibitor Phe-Arg Î²-napthylamide (PaÎ²N) on the growth of one particular strain shown to overproduce efflux pumps. Finally, we examined WGS data to identify which isolates had non-functional porins.

NSCI 39 **Using Cancer as a Model to Elucidate Mitochondrial Sensitivity and Maintenance**

Allison Taffet

Mentor: Dr. Natalia Kirienko

Mitochondrial homeostasis is critical for cell survival. Dysfunctional mitochondria are well documented in cancer, but it is unclear which cancer mutations affect mitochondrial health. We hypothesized that unhealthy mitochondria in cancer provide both a chemotherapeutic target and a model to understand the pathways necessary for normal mitochondrial function. To investigate this, a set of common cancer mutations was established with the NCI-60 panel. Using the model organism ((C. elegans)) and RNA interference, ~600 orthologs were tested for hyperactive mitophagy, sensitivity to mitochondrial damage, and specificity. An expansion led to a network of 137 genes that underlie mitochondrial sensitivity. This gene network can serve as a predictor of cancers sensitive to mitochondria-targeting drugs, and also provides insight into nuclear genes required for mitochondrial health. Bioinformatic pathway analysis reveals overrepresentation of organelle fission and cell division compared to the genome. Effects of select gene knockdowns on mitochondrial health were assessed and showed abnormal levels of ATP, NADH, and ROS, abnormal oxygen consumption, and fragmented mitochondrial networks.

NSCI 40 **Determining the Migratory Pattern of Neural Crest Cells During Development of the Avian Corneal Endothelium**

Sean Smith

Mentor: Dr. Peter Lwigale

It is well known that neural crest cells (NCCs) migrate from the periocular region into the presumptive corneal region beginning at day 4.5 (E4.5) of avian development and subsequently differentiate into the corneal endothelium. However, the relative cell contributions of each periocular region outside the presumptive cornea, as well as the routes the NCCs take, is not known. Moreover, several genes are differentially expressed around the perimeter of the cornea during development, and we do not know if they play a role in migration. So far, we have shown that vital dye-stained periocular NCCs appear to migrate to the temporal and nasal regions in greater numbers compared to the dorsal and ventral regions of the cornea when injected just prior to migration at E4. We have also shown that quail NCCs injected into the chick periocular region at E4 do not take the shortest path possible into the cornea, but instead often travel around the perimeter of the cornea to a specific entrance point. Our preliminary findings suggest that NCCs follow distinct spatiotemporal migratory patterns during ocular development.

NSCI 41 **Immunohistochemistry Reveals Enteric Neural Crest Cell Migration and Differentiation in the Formation of the Zebrafish Enteric Nervous System**

Akshaya Venkatesh

Mentor: Dr. Rosa Uribe

Enteric Neural Crest Cells (ENCC) are neural stem cells that migrate and proliferate in the developing gut and differentiate into neurons or glia to form the Enteric Nervous System (ENS), which controls the gastrointestinal tract. A mechanism for how and when ENCCs transition to neurons and glia has not been completely discovered in vivo. To understand ENS development in vivo, immunohistochemical assays were conducted to detect when neurons and glia first form across two developmental time points using the zebrafish transgenic line ((-8.3phox2bb:Kaede)), which labels ENCC. Zebrafish have transparent embryonic development which allows for microscopic observations. Results confirmed ENCC migration across the length of the gut during the time period. Furthermore, ENCC differentiation to enteric neurons was detected through colocalization patterns with antibody Elavl3, a neuronal marker, and the protein Kaede, which expresses ENCCs in this specific zebrafish line. These results identify initial timepoints of when differentiation occurs during ENCC migration. To further identify mechanistic control of this transition, intercellular ENCC communication will be studied in the future.

NSCI 42 **Investigation of Gene Expression in Vagal Neural Crest Cell Development Using a Zebrafish-based Optogenetic Toolkit**

Grayson Kotzur

Mentor: Dr. Rosa Uribe

Vagal neural crest cells (vNCCs), a transient group of migratory stem cells found in vertebrate embryos, arise from the neural tube and differentiate into various cell types, including pigment cells, thymic mesenchyme, cardiac outflow tract, and enteric nervous system. Although widely researched, the genetic drivers of vNCC diversity remain to be determined. Zebrafish are a good predictive model of human disease and development and are preferred over other models for their transparent embryonic phenotype, rapid development, robust fecundity, and relative ease in introducing genetic changes. Here, we investigate the consequences of altering vNCC spatiotemporal gene expression patterns in zebrafish by developing a blue light-activated TAEL 2.0 optogenetic toolkit, which utilizes a TAELn transcription factor that activates the ((C120)) promoter to allow for time and tissue-specific control of gene expression. We have adapted various TAEL 2.0 synthetic DNA constructs to be introduced into the embryo that will allow for this time and tissue-specific control.

NSCI 43 **The Effect of Combined PD-1 and IL-6/STAT3 Pathway Blockade on Kras Mutant Lung Cancer**

Stephen Peng

Mentor: Dr. Seyed Moghaddam

Recently, immune checkpoint blockade (e.g., PD-1 blockade) has shown promising results for Kras mutant lung cancer. Our laboratory has previously shown that IL-6 blockade reprograms the myeloid tumor microenvironment (TME), leading to a more robust cytotoxic immune response. As PD-1 blockade utilizes T cells' cytotoxic activity to kill cancer cells, we hypothesized that there might be an additive/synergistic effect of targeting the IL-6 pathway and PD-1 simultaneously. We also chose to inhibit STAT3, the main transcription factor downstream to IL-6. We treated six cohorts of Kras-mutant lung cancer bearing mice with control IgG, anti-PD-1 Ab, anti-IL-6 Ab, selective STAT3 inhibitor, or a combination of anti-PD-1 with anti-IL-6 or STAT3 inhibitor. We found a reduction in tumor burden in all treatment groups. Interestingly, some treatment groups had clustered responses, with some mice responding exceptionally well and others receiving no benefit. Further experiments and analysis will determine changes in tumor and immune cells and TME contexture. These findings will be important in determining why certain mice are responders or nonresponders to specific treatment.

NSCI 44 **Evolution of ((Pseudomonas aeruginosa)) to Colistin Using a Microfluidics Biomarker Discovery Platform**

Saoirse Disney-McKeethen

Mentor: Dr. Seokju Seo

Antibiotic resistance is a global health crisis. Understanding mechanisms of resistance will allow design of novel therapies to combat resistance. Evolution by passage of cells in bulk culture leads to loss of weaker, low frequency mutants. Microfluidic emulsion offers a potential method for evolving a large quantity of diverse resistant strains by lowering the competition between fast and slow growing mutants via spatial segregation. The lambda value, or number of bacteria to be encapsulated per microdroplet, is an important parameter. The goal of this experiment was to determine the parameters necessary for proper spatial segregation followed by adaptation of P. aeruginosa to colistin in a microfluidic environment over a 21 day period. Serial dilution experiments determined that OD= 0.01 corresponded to a 3.57 x 10^9 cfu/ml density of PAO1. Based on this, to achieve a lambda of 2.335, PAO1 was grown in 50 micron droplets with SCFM (artificial sputum) media to mimic cystic fibrosis lung environment and increasing colistin concentration. At the end of adaptation, evolved populations will be deep sequenced to identify mutations conferring resistance.

NSCI 45 **The Discovery and Development of Novel SARS-CoV-2 Neutralizing Antibodies**

Hannah Boyd

Mentor: Dr. Zhiqiang An

Within the past year, the severe acute respiratory coronavirus-2 (SARS-CoV-2) pandemic responsible for COVID-19 has reached all corners of the world, infecting over 100 million people. As SARS-CoV-2 continues to proliferate globally, many variants have arisen with resistance to available antibody therapeutics, including B. 1. 351 emerging from South Africa and B. 1. 1. 7. emerging from the UK. The development of a diverse antibody cocktail could act as a viable treatment option by preventing viral escape. Currently, the SARS-CoV-2 receptor binding domain (RBD), responsible for interacting with ACE-2 on host cells, is a common immunogenic target for current monoclonal antibodies . Despite the neutralizing success of these RBD-targeting antibodies, it has been proven that antibody cocktails targeting epitopes outside of the RBD are more broadly neutralizing. A region adjacent to the RBD on the spike protein named the N-terminal domain (NTD) has been shown to have immunogenic potential. I intend to isolate and develop novel SARS-CoV-2 NTD-specific antibodies as therapeutic candidates for the diversification of current antibody cocktails.

NSCI 46 **Construction of a miR-302 overexpression vector in IUE glioma**

William Mao

Mentor: Ms Rachel Keuls

"Glioma are highly proliferative brain tumors that result in 100% patient lethality. These tumors are heterogeneous and are difficult to treat with conventional therapies. Cancer stem cells (CSCs) contribute to tumor heterogeneity, growth and metastasis.

We have found a population of cancer stem cells that reactivate pluripotency factors such as miR-302, a micro RNA expressed during embryonic development to promote stemness. We hypothesize that an increase in miR-302 expression within glioma tumors would cause an increase in tumor aggressiveness, pathophysiological development, and other markers of cancer. To test this hypothesis, it is necessary to create an overexpression vector. This process involves cloning genomic miR-302 into a pbCAG vector for expression in mice. Linearization of the vector and amplification with primers resulted in fragments that could be ligated with Gibson cloning. This vector will later be electroporated into mouse models. glioma and miR-302 overexpression glioma were sectioned and stained for markers such as CD44. The results of this experiment will help our understanding of stemness glioma development, as well as potentially provide therapeutic targets"

NSCI 47 **Novel Synthetic Genetic Regulatory Tools in ((Streptomyces))**

Katherine Cohen

Mentor: Dr. James Chappell

Streptomyces is a genus of bacteria with extensive secondary metabolite production. However, Streptomyces is poorly characterized and only has a limited toolset for synthetic regulation of genetic expression. In order to exploit valuable metabolites and uncover new ones, three methods of gene regulation were optimized in Streptomyces venezuelae. First, various promoters were tested in Streptomyces using mCherry fluorescence as a reporter. A library of constitutive promoters and one OTR inducible promoter system were measured. Subsequently, these newly characterized promoters were used to optimize a Clustered Regularly Interspaced Short Palindromic Repeats interference (CRISPRi) system in Streptomyces. CRISPRi provides specific transcriptional repression of a target gene. The third genetic regulation tool characterized in Streptomyces were anti-sense RNAs (asRNAs). asRNAs are post-transcriptional regulators which block translation by binding to the Ribosome Binding Site (RBS) of mRNA. A simple linear asRNA followed by a terminator hairpin, a modified natural five-hairpin asRNA, and an HFQ protein associated with a guide asRNA were tested for translational repression of mCherry.

NSCI 48 **Mitigation Strategies for Valproate-Induced Neural Tube Defects in a Sensitive Mouse Strain**

Nellie Chen

Mentor: Dr. Richard Finnell

Valproic acid (VPA) is a common antiepileptic drug used for management of seizures. While effective, use of VPA during pregnancy increases risk for adverse pregnancy outcomes including neural tube defects (NTDs), a major congenital anomaly. Understanding metabolic factors that contribute to VPA risk can lead to development of novel mitigation strategies for safer use of VPA in women of childbearing potential. To address this challenge, we performed whole embryo metabolomics in murine models with variable sensitivity to VPA-induced NTDs. By comparing metabolic signatures in sensitive and non-sensitive strains, we identified affected metabolic pathways in the VPA-sensitive embryos. Affected pathways included vitamin B6-dependent metabolism, cysteine/methionine metabolism, carnitine metabolism, and arginine/nitric oxide signaling. Based on these data, we tested mitigation strategies targeting these specific metabolic pathways for their ability to reduce the occurrence of NTDs in sensitive mouse strains exposed to VPA, including nitric oxide prodrugs, L-citrulline, and the B6 vitamer, pyridoxal-5'phosphate. Successful mitigation strategies could lead to safer VPA use during pregnancy.

NSCI 49 **Cryo-EM Reconstruction and Functional Studies of a Covalently Linked Viral Fiber**

Jim Zhang

Mentor: Dr. Yizhi Jane Tao

Orsay remains the only known virus capable of naturally infecting ((Caenorhabditis elegans)), a valuable laboratory model. The non-enveloped virus presents a promising opportunity to develop a host-pathogen system capable of modeling eukaryotic viral infection. Orsay itself contains a (+)-ssRNA genome encoding for capsid protein, viral fiber δ, and RNA-dependent RNA polymerase. δ can be expressed as either a free or covalently fused CP-δ protein for incorporation into the viral capsid. Previous studies have successfully structured recombinant forms of both Orsay CP and δ; however, a composite structure of the native, infectious virion containing CP-δ remains unsolved.

Here, we report the structural analysis of CP-δ through single-particle cryo-EM. Preliminary screening and data collection confirmed CP-δ is asymmetrically distributed about five-fold vertices within the virion, which was subsequently mapped using prior-solved recombinant structures. Antibody-mediated δ-blocking assays with transgenic ((C. elegans)) indicated CP-δ was crucial for virus infection, with the putative host receptor FSHR-1 exhibiting expected δ-binding behavior in an ((in vitro)) pull-down assay

NSCI 50 **Analysis of D-cycloserine Mutants as Potential Proteins that Express a Radiation Protective Phenotype**

Minhhy Truong

Mentor: Ms. Lindsey Hagget

Maintaining high fidelity during DNA synthesis and repair is vital to cellular health across all domains of life. Genomic stability in organisms is correlated with outcomes in diseases such as cancer. The Rosenberg Lab has previously discovered that over 200 proteins in Escherichia coli. that, when overproduced, increase DNA damage levels and mutations. In that same assay, 23 proteins were identified that decrease DNA damage levels upon overproduction. These findings suggest the potential for the overproduction of these 23 proteins to not only mitigate endogenous DNA damage but also damage from exogenous sources such as radiation. In this project, we aim to evaluate the effects of single-gene overexpression on spontaneous mutagenesis. We report that for the vast majority of these damage-reducing proteins, overproduction did not result in significant changes in mutation rate when compared to WT. The findings of these experiments may aid in the future development of new pharmaceutical strategies to combat radiation-induced DNA damage when conventional protection is not sufficient, such as in the case of astronauts.

NSCI 51 **"Investigating Functional Genetic Variation in HSP90 Through the Creation of a Mutant Library with ((Saccharomyces cerevisiae))"**

Matthew Yonas

Mentor: Dr. Georgios Karras

Heat shock protein 90 (HSP90) can influence the consequences of genetic variation from plants to humans. Specifically, hypomorphic mutations in HSP90 genes can greatly affect the phenotypic expression of many traits in these organisms. However, it remains unclear whether functional genetic variation in HSP90 is found within natural populations, or if they are purged by purifying selection. Here, we address this question via the creation of an HSP82 (yeast analog of HSP90) mutant library using ((Saccharomyces cerevisiae)). Eventually, we will determine if such functional variations accumulate in the wild by sequencing natural yeast isolates. After using restriction enzymes to cleave plasmids implanted with hygB resistance via homologous recombination-based genome engineering, we will insert DNA fragments with specific point mutations generated with stitch PCR to create a final plasmid product. Upon transformation, we will be able to observe changes in the phenotypes of the resulting colonies. The results of this project will be used to later investigate the phenotypic effects of variations in HSP90, and how HSP90 generally responds to functional variation.

NSCI 52 **Characterizing Novel Mitophagy-Activating Compounds in Neurodegenerative Models**

Maria Hancu

Mentor: Dr. Natasha Kirienko

Mitochondria are essential to cellular function, generating most of the cell's energy supply. Disruption of mitophagy, the removal of dysfunctional mitochondria, has been implicated in neurodegenerative disease and is tied to

protein aggregation. As such, mitophagy activation through the PINK1/Parkin pathway, an established regulator of mitochondrial turnover, is a promising target in neurodegeneration research. Previously, the Kirienko Lab screened ~45,000 molecules and identified 8 PINK1-Stabilizing (PS) compounds. To investigate the effects of the compounds in neurodegenerative models, we conducted heat paralysis assays with the PS compounds in an Alzheimer's C.elegans model expressing amyloid-beta; two compounds significantly rescuing paralysis relative to controls. With heat paralysis reflective of protein aggregation, a hallmark of neurodegenerative pathology, compound-mediated rescue may indicate improved proteostasis. As an additional measure of protein aggregation, we plan to quantify aggregates in GF66, a YFP-polyglutamine strain, following treatment with the compounds. We aim to further validate mitophagy as a therapeutic target for neurodegeneration.

NSCI 53 **Glioma Genomics**

Cameron Noorbakhsh

Mentor: Dr. Kasthuri Kannan

Diffuse gliomas are the most common type of primary brain tumors in adults and almost always relapse. Molecular characterization of primary gliomas has played an important role in P4 medicine (predictive, preventative, personalized, participatory). We can extend the current classification of gliomas by characterizing recurrent glioma as well. By including multiomic analyses, examining factors such as methylation and gene expression, and clinical data from longitudinal recurrent glioma data into a graph database form, we can enable a platform that can create testable hypotheses for pre-clinical studies and find application in determining case-by-case diagnoses for gliomas. The results of this project, the graph database, will influence directions of future research and clinical decision making in the field of neuro-oncology.

NSCI 54 **Characterization of Microglial Morphology and Phagocytosis in Two Mouse Reporter Strains**

Manuj Shah

Mentor: Dr. Mirjana Maletic-Savatic

Microglia are brain-resident immune cells that are critical for brain development and function. Among their many roles, microglia clear dead cells and debris and prune neuronal spines through phagocytosis. But, research into microglia has been hampered by the lack of selective cell markers, because these cells are hard to distinguish from brain-infiltrating macrophages, their systemic immune cousins. TMEM119 was recently identified as a specific surface marker of microglia, allowing for more selective studies in disease models where peripheral macrophages enter the brain. To take full advantage of this marker, we aim to characterize TMEM119 expression in reporter mice. We will compare two mouse models: TMEM119-eGFP, in which eGFP presumably labels microglia under the

TMEM119 promoter, and CSF1R-eGFP, in which eGFP labels both microglia and macrophages. Using confocal microscopy, we will examine the extent of TMEM119 labeling of microglia, compare it to CSF1R staining, and test how well it labels phagocytic pouches, found at the distal margins of microglial processes. These analyses will build a foundation for future work in disease models wherein microglial function is implicated.

NSCI 55 **Synthesis of a Self-Deleting Circuit for Transient Expression of AAV9 Transgene**

Vaidya Parthasarathy

Mentor: Mr. Oliver Moore

AAV9 (Adeno-Associated Vector) have been used in pre-clinical and clinical studies for the successful expression of transgenes ((in vivo)). However, there exist obstacles to using AAV9s to deliver transgenes including limitations to temporal control and potential pre-existing immunity against the transgene, diminishing therapeutic effects. Here we explored the use of a self-deleting circuit that allows temporary expression of a transgene without the administration of exogenous substances. Our self-deleting circuit utilizes AAV-Cas9 technology containing two vectors: one vector expressing Cas9 with a single guide RNA against the target transgene and second vector containing the target transgene with a guide against Cas9. Here we show ((in vitro)) validation of our self-deleting circuit with a targeting transgene of ((GFP)). Following these experiments, we will now seek to validate our findings ((in vivo)) and explore clinically relevant transgenes for the treatment of heart failure and other cardiac disorders.

NSCI 56 **((hoxb5b)) Perturbation Disrupts the Localization of Neural Crest Cells and the Formation of Their Cellular Derivatives during Zebrafish Embryogenesis**

Aaron Nguyen

Mentor: Dr. Rosa Uribe

Neural crest cells (NCCs) are multipotent stem cells that migrate from the dorsal neural tube and invade and differentiate into tissues throughout the developing body. Although previous research has identified homeobox (Hox) gene networks as key factors in regulating early cell patterning in NCC populations, specifically Hoxb5 has not been comprehensively examined in NCC gene networks that control patterning. Here, the function of hoxb5b, an orthologue to mammalian Hoxb5, was investigated during NCC migration in zebrafish embryos. Since hoxb5b is highly expressed in early NCC, we hypothesized that hoxb5b overexpression would disrupt NCC migration and localization at earlier stages of development. Following induced hoxb5b overexpression during early NCC formation prior to differentiation, gene expression assays demonstrated that specific NCC pools were expanded compared to controls. Additionally, hoxb5b overexpression resulted in a decrease of enteric neurons, a NCC derivative, in a

temporally-defined manner. Together, these data indicate a potential time frame prior to NCC differentiation in which hoxb5b impacts cell patterning for NCCs and their derivatives.

NSCI 57 **Understanding Resistance Mechanisms of Castration Resistant Prostate Cancer after CAMKK2 Gene Inhibition**

Pavithr Goli

Mentor: Mr. Thomas Pulliam

Prostate cancer is one of the most common cancers worldwide, ranking as the second most diagnosed cancer with the fifth-highest global mortality rate for men in 2018. Despite the introduction of new treatments for cancer, the prostate cancer continuum demonstrates how a cocktail of treatments like radiation therapy and androgen deprivation therapy fails to have permanent effects in decreasing tumor size, as over time, the cancer is able to develop resistance mechanisms to the therapies. A specific pathway that has been identified as an important factor in tumor progression in prostate cancer is the androgen receptor. Previously published research by the lab has affirmed that the CAMKK2 gene promotes PC growth and the gene is required for the development of CRPC. These studies have proven that the AR uses the CAMKK2-AMPK-ULK1 signaling pathway to promote PC growth through a process called autophagy. The research project that my bench mentor and I are working on is studying various resistance mechanisms that CRPC genes utilize to overcome inhibition from castration. Although this project is in its nascent phase, we intend on having significant conclusions by the time of submission.

NSCI 58 **Development and Differentiation of Human Retinal Organoids as Models for Disease**

Pablo Alarcon

Mentor: Ms. Xinye Qian

Recessive Stargardt (STGD), a central blinding disease similar to Age-related Macular Degeneration (AMD), is caused by mutations in the ABCA4 gene. Both STGD patients and the Abca4-/- mouse model exhibit deposition of bisretinoid-lipofuscin in the retinal pigment epithelium (RPE) and photoreceptor degeneration. The Abca4-/- mouse model does not show a significant retinal degeneration phenotype, and thus a model that is better at mimicking the human retina is needed. Most previous studies used induced pluripotent stem cells (iPSC) derived from STGD patients to investigate the role of the complement system in disease pathogenesis, which does not fully capture ABCA4 pathogenicity. In this study, we used three iPSC lines derived from STGD patients carrying ABCA4 mutations to differentiate cone-dominant retinal organoids to model ABCA4 pathogenicity. Using the published H9 embryonic stem cell line as the control, we performed histological analyses by immunofluorescent staining and transcriptome analysis by scRNA-seq at varying time points to assess the

progression of retinal degeneration. At the D70 mark, no significant difference had been observed based on immunofluorescent staining.

NSCI 59 **The Role of ((LiaF)) in the LiaFSR System Behind Daptomycin Resistance**

John Shin

Mentor: Ms. Yue Zhou

Daptomycin is a cyclic lipopeptide used against Gram-positive bacterial pathogens to disrupt membrane homeostasis and proper cell division. It is frequently prescribed by clinicians to treat infections caused by multidrug-resistant bacteria. However, resistance to daptomycin has emerged and threatens its effectiveness as an antimicrobial drug. To counteract this, studies have been conducted to discover pathways involved in daptomycin resistance. One pathway which was found to be involved is the general membrane stress response pathway LiaFSR. Here, we focus on ((LiaF)), one of the three protein components of this system. ((LiaF)) is thought to interact with ((LiaS)), a membrane sensor kinase that phosphorylates ((LiaR)) to upregulate the antimicrobial stress response. Previously, our His-LiaF construct produced insoluble ((LiaF)). To address this issue, we created a new construct with a SUMO tag and examined how this additional tag affects solubility. We are using X-ray crystallography and biochemical analysis to further understand its role in resistance. A novel ((LiaF)) crystal structure will allow us to begin to understand a structural basis for LiaF mediated resistance.

NSCI 60 **Oocyte Specific Deletion of SUMO E2 Ligase ((Ubc9)) Results in Impaired Folliculogenesis**

Avery Myers

Mentor: Dr. Stephanie Pangas

Female fertility is dependent on the proper development and maturation of the ovarian reserve, the non-growing pool of primordial follicles in the ovary. Through the process of folliculogenesis, oocytes are highly transcriptionally active in order to develop meiotic competence prior to ovulation and the resumption of meiosis. We use a mouse oocyte-specific deletion model of ((Ubc9)) (((Ubc9flox/floxGdf9-iCre)); ((UG)) cKO) the sole E2 ligase in the SUMOylation pathway, that deletes ((Ubc9)) in oocytes within primordial follicles. These mice were sterile and suffered from premature depletion of the ovarian reserve, meiotic defects, and had an altered transcriptome, indicating errors in the regulation of transcription during oocyte development. SUMOylation is a dynamic post-translational modification that regulates numerous cell processes, including transcription, subcellular localization of proteins, and protein-protein interaction. We hypothesize that ((Ubc9)) is essential for proper regulation of oocyte transcription and gaining meiotic competence.

NSCI 61 **Investigating the Possible Hypervirulence of the Candida albicans Head-to-Head Reporter Plasmid Used to Express Fluorescence**

Jazmine Castillo

Mentor: Dr. Mike Gustin

The yeast-to-hyphae transition of the fungus Candida albicans is well documented; however, the hyphae-to-yeast transition and its role in the dissemination of the fungus in a host is less understood. Using the Christmas strain, a dual reporter strain exhibiting red and green fluorescence in yeast and hyphal cells, respectively, we aim to investigate the mTOR pathway as a positive regulator of the hyphae-to-yeast transition in C. albicans. However, the Christmas strain is hypervirulent when compared to wild type, forming more hyphae than wild type under the same conditions and hindering further investigation into the mTOR pathway. To investigate the relationship between reporter placement in the genome and hypervirulence, I will generate additional strains, modifying the location of the reporter gene. Using spectrophotometry, plate growth assays, and zebrafish virulence assays, I plan to assess yeast and hyphae growth rates in the modified strains, in the hopes of developing a non-hypervirulent reporter strain to investigate the hyphae-to-yeast transition in the progression of C. albicans infections and candidiasis.

Other Biological Sciences

NSCI 62 **Diversity and dynamics of symbiont-infecting viruses in the stony coral, Porites lobata**

Kristen Rabbitt

Mentor: Dr. Adrienne Correa

Stony corals harbor diverse microbiota, some of which have well documented roles in coral health and functioning. However, the distribution and diversity of specific coral-associated viruses are unknown. The dinoflagellate-infecting ssRNA virus ('dinoRNAVs'), believed to infect coral-associated dinoflagellates (family Symbiodinicaeae), have been frequently detected in coral assemblages, but we lack information about the infection dynamics of this viral group during environmental stress. To address this gap, we repeatedly sampled over 50 colonies of the dominant reef-building coral Porites lobata in Moorea, French Polynesia throughout a thermal stress event. DinoRNAVs were detected by sequencing the viral major capsid protein and characterized into amino acid sequences ('aminotypes'). DinoRNAVs were highly prevalent and diverse (~700 aminotypes). High alpha diversity and dispersion coincided with high temperatures, especially in the abiotically variable fringe reef. Our results suggest that thermal stress events may trigger productive viral infections within Symbiodiniaceae, potentially contributing to coral health declines.

NSCI 63 **Staging the Embryonic Development of ((Biomphalaria glabrata))**

Maura Boerio

Mentor: Dr. Dan Wagner

((Biomphalaria glabrata)) is a freshwater snail whose role as host organism enables Schistosomiasis infection in humans. Following malaria as the second most devastating parasitic disease, Schistosomiasis targets the gastrointestinal tract. The parasitic helminth of Schistosomiasis, ((Schistosoma mansoni)), must first mature within ((B. glabrata)) before it is able to parasitize humans. If infection of the snail by worm might somehow be inhibited, Schistosomiasis could be discontinued. Before ((B. glabrata)) can be studied to gain insight into potential mechanisms of Schistosomiasis intervention, gaps in the basic understanding of ((B. glabrata)) embryonic development must be bridged. A detailed staging of ((B. glabrata)) development would meet this need. In this study, through time-lapse analysis, the first four days of development were differentiated into 17 thoroughly characterized stages. These stages are to be compiled into a flipbook that describes the entirety of ((B. glabrata)) embryonic development through complete descriptions of morphology and movement, as well as extended depth of focus images produced via compound microscopy.

NSCI 64 **Using Community Science to Monitor the Spread of ((Nylanderia fulva)) in the Greater Houston Area**

Lillie Stockseth

Mentor: Dr. Scott Solomon

The US Gulf Coast has been invaded by the tawny crazy ant, ((Nylanderia fulva)), which causes ecological imbalance and decreased biodiversity in affected areas. Yet, surveying large areas for invasive ants is time and resource inefficient. We aimed to determine whether community science could be used to survey the spread of ((N. fulva)) in the Houston area. To make the project accessible during the pandemic, we designed resources that are available online. 112 students from 7 Houston area schools participated in the first round of collections. Participants collected a total of 5872 ants. Although only two specimens were ((N. fulva)), we found that community science is a feasible method for tracking invasive ants. We faced challenges including reaching a broad group of students especially in underserved communities and maximizing the return rate from participants. However, students responded well to educational materials and we developed additional digital resources for students and teachers that are being tested during a second round of collections this spring.

NSCI 65 **The Development of Aggression in ((Drosophila Melanogaster))**

Keshav Wagle

Mentor: Dr. Julia Saltz

Aggression is a behavior that many organisms encounter on a daily basis, and has become ubiquitous with social interaction throughout daily life, and the behavior is highly studied in labs all across the world. ((Drosophila melanogaster)) is a model study system for aggression research, however, we still know very little about the development of aggression and its genetic basis, meaning how different species learn and develop aggressive behaviors. My study aims to investigate the relationship between age and aggressive behavior in male ((D. melanogaster)), as well as the development of aggressive behaviors in different genotypes of ((D. melanogaster)). We will use male flies from three different genotypes that previous studies have identified as low- or high-aggression, and test them for aggressive behavior against a standard opponent at three different ages. We anticipate that flies from the high-aggression genotype will develop aggressive behaviors earlier than the low-aggression genotype. Overall, this study aims to contribute to a better understanding of the development and genetics of aggressive behavior.

NSCI 66 **Comparing Single-species and Mixed-species Groups in Fruit Flies: Differences in Group Dynamics but Not Group Formation**

Anna Girardeau

Mentor: Dr. Julia Saltz

Mixed-species groups are characterized by active associations between individuals from two or more species. They are important to a variety of ecological processes such as predation, foraging, and competition. While mixed-species groups have been well studied in some taxa, previous research focuses on already existing groups rather than ((how)) groups form through active associations. Furthermore, there is very little research on mixed-species groups in insects. In this study, we investigated group formation and the interactions within the resultant groups of ((Drosophila melanogaster)) and ((Drosophila simulans)). We found that individuals formed mixed-species groups as often as single-species groups, indicating that ((D. melanogaster)) and ((D. simulans)) do not actively avoid each other. There was no difference in the composition and size of single-species groups compared to mixed-species groups. However, males showed elevated aggression towards males of a different species compared to males of the same species. Our findings allow us to better understand mixed-species groups in insects and introduce future areas of research on mixed-species group formation.

NSCI 67 **Optimization of CRISPRa as a Modular System of Gene Activation in Bacteria**

Annette Tsong

Mentor: Dr. James Chappell

CRISPR activation (CRISPRa) takes advantage of the CRISPR-Cas system's programmable DNA sequence recognition to activate gene expression at a specific target. An activation domain linked to catalytically-dead Cas9 (dCas9) recruits RNA polymerase (RNAP) to the promoter. CRISPRa is well-studied in eukaryotes, but challenges remain in prokaryotes, including strict requirements of target position relative to the promoter. Here, we show an improved CRISPRa system in ((E. coli)) with the N-terminal domain of the alpha subunit of RNAP (alphaNTD) as the activation domain, and SYNZIP interaction domains to link alphaNTD to dCas9. Our system is highly modular and has potential to activate in other bacterial species. We also explore a novel Type I-E CRISPRa system in ((E. coli)) in which Type I-E CRISPR Cascade complex replaces CRISPR dCas9. Cascade binds DNA differently than dCas9, resulting in activation at target positions not previously observed. This may circumvent distance-dependent requirements that hinder current bacterial CRISPRa systems. Our work contributes to the improvement of prokaryotic CRISPRa, which has diverse applications in metabolic engineering and functional genomics.

NSCI 68 **Does Repeated Starvation Lead to Tradeoffs Between Survival vs Aggression and Survival vs Fertility in ((Drosophila melanogaster))?**

Anja Hartge

Mentor: Dr. Julia Saltz

Starvation is a common stressor that many animals experience in nature. Previous studies have shown that starvation leads to physiological consequences and life history trade-offs, particularly when paired with another stressor. However, a shortcoming of the existing research is that individuals are often starved in repetitive patterns that are not reflective of what occurs in nature. The aim of this research is to study the effects starvation has on aggression, survival, and fertility when the starvation occurs in temporal patterns that are more ecologically relevant. We will use the study system ((Drosophila melanogaster)), to perform starvation trials in two different patterns: an ecologically relevant pattern and a repeating pattern that is not ecologically relevant. It is hypothesized that individuals starved in the ecologically relevant treatment will experience greater stress and therefore lead to greater resource allocation tradeoffs between survival vs aggression and survival vs fertility. Following the starvation period, survival, female lifetime fertility, and aggression will be measured, and data will be analyzed to understand potential resource allocation tradeoffs.

NSCI 69 **The role of pace of life in female Drosophila melanogaster food preference**

Tracey Dibbs

Mentor: Dr. Julia Saltz

Pace of life (POL) refers to the tradeoff between a species, population, or individual's current and future reproduction. An individual's behavior should

correlate with the POL strategy it is employing, yet much is unknown about how or why individuals employ variable POL strategies. The role of ecology has been especially understudied as a factor influencing this variation. Ongoing analyses have suggested that POL may vary across ((Drosophila melanogaster)) genotypes, thus making flies a useful study system to explore how life history strategies affect behavioral preference for an ecologically relevant stimulus. In a future experiment, we aim to study how genotype and life history stage affect food preference among females by subjecting five genotypes that vary along the POL continuum to choice arenas containing different macronutrient ratios. We predict that females will change their preference for protein vs. carbohydrates throughout their life based on the POL strategy employed, as high protein diets are more beneficial for egg production. Results from this study will explore how POL informs preference for an ecologically relevant stimulus, thus incorporating ecology into POL.

NSCI 70 **Mechanisms of Winner and Loser Effects: Literature Review of Proposed Hypotheses**

Priya Trakru

Mentor: Dr. Julia Saltz

Animals display aggressive behavior to conspecifics to gain access to resources, including food, mates, and territory. Arising from aggression are two social phenomena: the winner effect and the loser effect. Generally defined as the probability of an individual to increase aggressive behavior after a win against a conspecific, the winner effect and its opposite loser effect are not always concurrently apparent in species and are not always equal. While the appearances and consequences of these effects are well known, their mechanisms remain largely unexplored. The most recent reviews of the most popular and well established hypotheses for mechanisms were published in 2006 by Hsu et al. and Rutte et al. This project's goal is to update the current understanding of the 3 most popular and likely causes for the winner and loser effect, as discussed by Rutte and Hsu. Through literature review of 25 different papers, the different mechanisms for winner and loser effects are revealed and compared against present and previous consideration of the three most popular mechanistic proposals: the self-assessment hypothesis, the social cue hypothesis, and non-adaptive hormonal hypothesis.

NSCI 71 **Elucidation of imitative self-grooming in the mouse model of fragile X syndrome**

Rodrigo Gonzales-Rojas

Mentor: Dr. Hye Young Lee

Imitative deficits in patients with autism spectrum disorders (ASDs) foundationally impact their ability to learn and socially interact. However, the exploration of these deficits in preclinical autism mouse models is limited. Fragile

X syndrome (FXS) is a common form of inherited intellectual disabilities with a high risk of co-morbid ASDs. We recently demonstrated that Fmr1 KO mice, the mouse model of FXS, exhibits a deficit in imitative scratching behavior (Gonzales-Rojas et al. 2020, Scientific Reports). We want to expand our previous findings by exploring if our autism mouse model shows similar deficits in imitative self-grooming (SG) behavior. We currently hypothesize that Fmr1 KO mice will show a decreased frequency of imitative SG bouts compared to an age-matched WT group. But we also expect our autism mouse model to imitate SG behavior with higher rates of sequencing errors. Collectively, we hope our study will unveil a complex picture of the role imitative behavior has in learning deficits. We further hope that our novel behavioral assessments will enable the exploration of therapeutic treatments in preclinical autism mouse models.

NSCI 72 **The Role of sSAC GABA and Dopamine Signaling in Olfactory Behaviors**

Aashka Sheth

Mentor: Dr. Ariel Lyons-Warren

Co-transmission occurs when a single neuron releases multiple neurotransmitters. In the olfactory bulb, superficial short axon cells (sSAC) co-transmit GABA and dopamine (DA). sSAC use selective GABAergic signaling in contrast to broad dopaminergic signaling. DA receptor subtypes (D1, D2) create post-synaptic specificity. While the GABAergic and dopaminergic targets of sSAC have been identified, their function in odor detection and discrimination remain unknown. To address this gap, we manipulated sSAC GABA and DA signaling in mice using in ((vivo)) pharmacology, genetic manipulations, and viral delivery of targeted tetanus toxin. We tested the role of sSAC in odor discrimination using a dehabituation assay and found that sSAC GABA and DA signaling are both necessary for odor discrimination. We tested the role of sSAC in odor detection using a buried food assay and found that sSAC GABA and D1 mediated DA signaling each provide some odor detection function. These results demonstrate the role of co-transmission in olfactory behavior which improves our understanding of neurological disorders with olfactory dysfunction, such as Parkinson's or Alzheimer's disease.

NSCI 73 **Computational Analysis of SV2 Regulated Neurotransmitter Release**

Jessica Duan

Mentor: Dr Ruth Heidelberger

Synaptic vesicle 2 (SV2) proteins are a family of transmembrane proteins found on all secretory vesicles. They play a crucial role in calcium-mediated neurotransmitter release and are involved in a range of neurological and psychiatric disorders, but their specific function remains uncertain. This project utilizes a computational model to understand the physiological mechanisms behind SV2 regulated exocytosis. The computational model inputs a set of

physiological parameters of vesicle pool sizes and rate constants, and generates capacitance measurements over time corresponding to cellular exocytosis. Using this model with physiological data allows us to understand the dynamics of exocytosis in specific experimental conditions. The pending results of this project will show how physiological parameters vary between wild-type and SV2B knockout rod bipolar cells in mice (SV2B is the SV2 isoform that is most frequently found in rod cells). Ultimately, gaining a better understanding of the role of SV2 proteins in synaptic transmission and human neurological disorders can allow us to develop targeted interventions that can improve the quality of life of those affected.

NSCI 74 **Plant-Soil Feedback Between Soil Microbes and Dioecious Grasses**

Jessica Su

Mentor: Dr. Tom Miller

Plant-soil feedback (PSF) describes how plants alter biotic and abiotic qualities of the soil they grow in, which in turn affects the ability of other plants of that species to grow in that soil. However, few present-day studies focus on how plant sex affects PSF via soil microbes in dioecious plants which have distinctly only male or female sexes. We hypothesize that the presence or absence of soil microbes in either soil from male versus female plants affects pre-flowering growth in Poa arachnifera. We utilized a 2x2x2 factorial experiment to test the effect of soil from male versus female plants and the presence of soil microbes on plant growth. Male and female Poa arachnifera seeds were collected from the field, transplanted to grow in the greenhouse for several months with either soil microbes from corresponding male or female plants or no microbes via soil sterilization. We collected pre-flowering growth data every two months. Pending data from the study include information on the sex of each plant and soil microbe sequencing data. The results of this study will extend our understanding of the effect of plant sex on soil microbial PSF.

NSCI 75 **Impact of Microbiota on Group Structure of ((Drosophila melanogaster))**

Lilly Snellman

Mentor: Mr. Eric Wice

Microbiota are increasingly shown to influence host physiology and behaviors like mate choice and foraging. Both behavior and physiology impact social group structure. While previous studies have investigated how social group structure contributes to microbiome diversity, we know little about how microbiota affect social group structure. In this study, we explore how the social group structure of axenic (germ-free) and wild-type Drosophila melanogaster differ. After reaching adulthood, flies were placed together in a social group. The three social groups were: all axenic, all wild-type, and half axenic/half wild-type. Each social group was videoed, and the resulting social networks are now being quantified using

motion-tracking software. The social network structures of social groups will soon be analyzed and compared. We predict that axenic flies will form less stable social groups than wild-type flies. Within the mixed treatment, we anticipate that the wild-type individuals will be more central in the social group structure than the axenic individuals. Exploring how microbiota affect group structure can help elucidate how diversity in group structure is generated.

NSCI 76 **Analyzing the effect of MYCN overexpression in the maintenance of a NCC like identity**

Annika Nambiar

Mentor: Dr. Rosa Uribe

Neuroblastoma (NB) is a deadly pediatric cancer that originates from neural crest cells (NCC) and presents tumors along the sympathetic nervous system in the adrenal medulla and the sympathetic ganglion chain. One genetic factor identified as a major driver of NB is MYCN, which is linked to high risk, aggressive tumors. It is believed that NB develops when NCC are unable to differentiate; however, the exact cellular and molecular mechanisms behind early onset of NB remain unknown. We use zebrafish to model NB to dissect the cellular mechanism behind early NB progression from NCC. We use Hybridization Chain Reaction (HCR) to analyze changes in expression of known NCC and sympathetic differentiation genes like crestin, foxd3, sox10, and phox2bb in embryos ranging from 3 days post fertilization (dpf) to 8 dpf. We hypothesize that MYCN overexpression induces cells to maintain an undifferentiated state by promoting retained expression of NCC genes past time of normal expression. Overall, this study will help identify critical genes involved in MYCN driven NB oncogenesis and will advance the field by listing potential candidates for drug targeting to develop more efficient therapeutics.

Other Works in Natural Sciences

NSCI 77 **Investigation of the role of 5-HT2C receptors in SUDEP**

Anika Sonig

Mentor: Dr. Jeffrey Noebels

Sudden Unexpected Death in Epilepsy (SUDEP) is a leading cause of epilepsy related mortality and pathophysiological mechanisms are still largely unknown. Mice lacking X-linked 5-HT2C serotonin receptors (loxTB Htr2c) demonstrate an adult-onset epileptic phenotype and premature mortality in the male mice population. Previous reports indicate 5-HT2C receptors are expressed on inhibitory neurons. To test whether disinhibition underlies seizures and premature death, the receptor was expressed only in GAD2+ GABAergic neurons in loxTB Htr2c mice. We confirmed Htr2c expression with quantitative PCR, but there are no validated antibodies to detect 5-HT2C receptors and characterize expression. We used RNAScope in situ hybridization to quantify and localize

expression of Htr2c within specific neuronal populations in loxTB Htr2c wildtype and mutant mice. RNAscope co-localized Htr2c in excitatory and Gad2+ GABAergic inhibitory neurons in forebrain and brainstem regions. This study utilized new technology to study 5-HT2C expression.These results provide additional insight into potential brain regions and circuits involved in adult-onset epilepsy and SUDEP phenotype in loxTB Htr2c mice.

NSCI 78 **Characterizing the Neural Oscillatory Dynamics of Attentional Performance**

Axel Ntamatungiro

Mentor: Dr. Atul Maheshwari

Given the increasing prevalence of ADHD, there is an urgent need to identify reliable EEG biomarkers of attention. This project evaluates five neural oscillatory candidates – theta, gamma, high-gamma, theta-gamma phase-amplitude coupling (PAC), and theta-high-gamma PAC – as potential quantitative EEG biomarkers of attentional performance. Adult male wild-type mice performed the five-choice serial reaction time task, a visuospatial attention behavioral assay. As mice performed the five-choice task, oscillatory activity was recorded on electrodes positioned on the epidural space over the bilateral frontal and parietal cortical regions. We then employed non-parametric statistical analyses on time-resolved oscillatory powers and PAC. Our recent findings show that 400 milliseconds prior to stimulus onset, relative time-resolved theta power in the right posterior parietal cortex (PPC) and relative time-resolved gamma power in left and right PPCs significantly predict the likelihood of achieving a correct versus incorrect/omission response. These results suggest that theta and gamma oscillations are promising candidates as quantitative, lateralized EEG markers of attentional performance.

NSCI 79 **Relationship Between Physical Activity Behavior and Self-Perception Among Fifth Graders**

Nicole Limberg

Mentor: Dr. Amanda Perkins-Ball

Participating in physical activity has shown to have many physical, social, and emotional benefits in children. Previous research has found a correlation between one's enjoyment of physical activity and one's propensity to engage in physical activity. The Running WISE physical activity mentoring program was a pilot study pairing college students with fifth-grade students. Through this buddy system, the fifth-grade students were encouraged to exercise twice weekly for thirty minutes each. Students included 22 students from a variety of ethnic backgrounds. Most students were socioeconomically disadvantaged. The aim of this study was to examine the relationship between physical activity behavior, enjoyment, and self-perception (i.e., scholastic, athletic, social, physical, behavioral and global self-worth). Before the study began, students completed a survey to assess various

factors related to self-perception and frequency of physical activity, and also participated in physiological tests (e.g., BMI, PACER). The study's results will aid in increasing our understanding of physical activity and self-perception among economically disadvantaged and ethnically diverse children.

NSCI 80 **Determining Significant Differentially Expressed Genes in the Circadian Rhythm in Opioid Use Disorder (OUD) Subjects**

Sai Movva

Mentor: Dr. Consuelo Walss-Bass

Opioid use disorder (OUD) causes more than 50,000 deaths annually due to overdose. Therefore, understanding the molecular effects of OUD is essential in this opioid epidemic. Opioids and opioid withdrawal can also disrupt the temporal organization of sleep and cause the disruption of CLOCK genes, which are crucial in the regulation of the circadian rhythm. Using data from the post-mortem human brains at the UTHealth Brainbank, we performed next-generation RNA sequencing to analyze whether OUD causes differential gene network regulation in Brodmann Area 9 (BA9) of the human brain. We identified 213 differentially expressed proteins in BA9, and we performed a zTOD correlation on this data. A sine regression in the zTOD analysis revealed significant differentially expressed genes that were found to influence the circadian rhythm, which included 8 proteins and 3 long non-coding RNAs. In the future, we will look at ways to compare the differentially expressed genes in the OUD subjects and in the controls, and try to validate these results in a cell model.

NSCI 81 **Sex Differences in an Aged Mouse Model of Vascular Cognitive Impairment**

Alexis McAlister

Mentor: Dr. Michael Maniskas

Vascular cognitive impairment (VCI) is the second most prevalent form of dementia. Characterized by cognitive decline through white matter loss and neuronal degeneration, one cause of VCI is chronic cerebral hypoperfusion (CCH). Using an experimental animal model of VCI, bilateral carotid artery stenosis (BCAS), we are able to demonstrate CCH resulting in cognitive impairments. Previous BCAS studies primarily utilize young male mice and omit age and sex differences. We hypothesized there would be a sex difference in white matter damage and cognitive impairment using BCAS in an aged mouse model. BCAS or sham surgery was performed on aged C57/Bl6 male and female mice using micro-coils wrapped around the common carotid arteries to induce CCH. Cognitive deficits were identified through behavioral tests to evaluate spatial and contextual working memory, long-term memory, motor function, and depression. White matter damage and astrogliosis were analyzed using cresyl violet staining and immunohistochemistry. Lastly, BCAS in an aged mouse model demonstrates

characteristics of VCI. This study will provide novel information regarding sex differences within this experimental model.

NSCI 82 **Evidence of a Shared Graphemic Buffer in Reading and Spelling**

Vibha Sastri

Mentor: Dr. Simon Fischer-Baum

Neuropsychological research has shown striking patterns of dissociation between reading (written language perception) and spelling (written language production), with brain damage selectively impairing one without the other. However, associations have also been reported, as certain cognitive impairments can result in both reading and spelling deficits. The current work follows up on previous case studies suggesting that the graphemic buffer (a working memory system for orthographic information) is shared between spelling and reading. This is confirmed by parallel impairments in spelling and reading following damage to the component. Specifically, length and letter position have been shown to exert similar influences on error likelihood. In this presentation, I will discuss my work with patient JS and the evidence of her graphemic buffer deficit. Analysis of her reading and spelling performance confirms the presence of length and letter position effects. This supports the hypothesis that reading and spelling rely on a common orthographic working memory system. I will further discuss the relevance of this research as it relates to speech therapy approaches.

NSCI 83 **Understanding the Role of Dopamine on the Evolution of Learning in Drosophila**

Omar Moussa Pasha

Mentor: Dr. Julia Saltz

To invest in increased cognitive ability, fitness benefits must outweigh metabolic costs. Among factors hypothesized to regulate this equilibrium is habitat variability. Particularly, increased cognitive ability should be observed in more variable environments that impose greater cognitive demands. To test this, we took advantage of two closely-related species of Drosophila with natural differences in habitat variability, D. siumlans and D. sechellia. Due to their more variable evolutionary ecology, we hypothesized that D. simulans would exhibit higher learning ability because they invested in better cognition. But our results have shown the opposite. One possible explanation is that our flies were deficient in L-DOPA, a dopamine precursor which has been demonstrated to have numerous behavioral and cognitive functions. This project aims to understand the role of dopamine on the evolution of learning in Drosophila. Having explored the academic literature, we plan to accomplish this by conducting learning trials under treatments with and without dopamine. In addition to analyzing learning behavior, we plan to compare brain dopamine levels using high-performance liquid chromatography.

NSCI 84 **Lickometry and the Macrostructure of Fluid Intake in Mice**

Samuel Lee

Mentor: Dr. Vaishnav Krishnan

Fluid intake is an essential innate behavior. Thirst-inducing stimuli activate specialized neurons within circumventricular organs that are reciprocally connected with neocortical regions (e.g., insula, cingulate cortex). Severely reduced OR excessive fluid intake (psychogenic adipsia or polydipsia) can occur in a variety of neuropsychiatric syndromes. In corresponding mouse models, objective, continuous and automated measurements of fluid intake may serve objective biomarkers of mood, anxiety or executive function. Here, we closely analyze spontaneous drinking behavior in C57BL/6J mice within home-cage chambers fitted with two lickometered spouts (water Vs 0.8% sucrose water). Under these conditions, drinking occupies no more than ~1% of the day (~15 minutes), displays strong circadian-ness, and preference for sucrose (~90%) relates to more frequent AND longer duration sucrose licks. We examine how gender, chronic anticonvulsant exposure and prenatal anticonvulsant exposure impact these parameters. Our results clarify the macrostructure of drinking in C57BL/6J mice and set the stage for ongoing studies that clarify genetic and other environmental modulators of drinking.

NSCI 85 **No Difference in Stress Level Based on Physical Activity During the COVID-19 Pandemic Among Parents of School-Aged Children**

Nikhil Gattu

Mentor: Dr. Laura Kabiri

Stress levels among children and parents have been heightened during the COVID-19 pandemic, especially with changes in school structure. Thus, regular PA is even more important as a way to decrease stress and improve mood during this period of prolonged uncertainty. We look to examine differences in stress levels among parents of school-aged children during the COVID-19 pandemic based upon physical activity. Stress levels were determined by the Perceived Stress Scale survey and participants also completed the Recreational and Sedentary portions of the WHO's Global Physical Activity Questionnaire to examine physical activity levels. The present study demonstrates that there was no significant difference in perceived stress levels based upon physical activity among parents of school-aged children during the COVID-19 pandemic, regardless of intensity of the physical activity. This finding could reflect stress exceeding normal levels due to the novel and unknown nature of the pandemic. However, PA is still important for adults, including parents of school-aged youth, during the COVID-19 pandemic due to the numerous other health benefits it can provide beyond reducing stress levels.

NSCI 86 **A Study of the Detrimental Effect of a High n6/n3 PUFA Diet on Adult Myelin Degeneration**

Esther Lee

Mentor: Dr. Lesley Chaboub

Myelin is a crucial component of our central nervous system (CNS), surrounding axons for metabolic and functional support. 70% of myelin is made of lipids, the composition of which is tightly regulated. Many lipids are derived from our diet, and polyunsaturated fatty acids (PUFAs) are especially important because they are precursors to the lipids found in myelin and are solely obtained through our diet. PUFAs exist as n6 and n3 species, and diets high in n6 compared to n3 PUFAs have been linked to many health defects. In this project, we hypothesize that a diet high in n6/n3 PUFAs will have detrimental effects on myelin morphology. Three groups of mice were either fed high, low, or control n6/n3 PUFA diet for 9 months. Their spinal cords were then imaged for electron microscopy and quantitatively analyzed for myelin thickness (g-ratio) and qualitatively scored myelin degenerative figures.

Our data shows that a diet high in n6 PUFAs decreases myelin thickness without a correlation to obesity.

Future work will focus on scoring other areas of the CNS to assess whether the phenotype is ubiquitous, as well as histological analysis to assess myelin sheath length.

NSCI 89 **Black Athletes at Rice Engaging with Stereotype Threat**

Ikenna Enechukwu

Mentor: Dr. Amanda Perkins-Ball

Stereotype threat is defined as the perceived risk of confirming negative stereotypes about one's member group. Several studies have suggested that the "dumb jock" and other stereotypes relating to college student-athletes may adversely affect their university experiences. Potential outcomes include greater susceptibility to stress, feelings of isolation, and lower academic self-efficacy. Black student-athletes may be more vulnerable to stereotype threat because of their stigmatization as athletes and students of color, especially at elite universities. This research study was designed to examine the relationships between student-athletes' athletic identities, academic identities, and experiences at an elite university. Data was collected from 179 Rice University student-athletes via an online survey conducted during the 2020 Fall semester. Results from this study can be used to identify potential disparities in various outcomes between Black student-athletes and non-Black athletes, and increase our understanding of Black student-athletes experiences on campus.

Social, Behavioral and Economic Sciences Quantitative

NSCI 90 **Examining the relationship between sleep quality, duration and types of sedentary behaviors in Hispanic adolescents and young adults with obesity**

Jessica Cao

Mentor: Dr. Erica Soltero

Increased sedentary behaviors (SB), insufficient sleep, and poor sleep quality are linked to the increased prevalence of childhood obesity and development of type II diabetes. SB can also negatively impact sleep duration and quality; however, there is insufficient evidence regarding whether screen time (ST) and non-screen time SB differentially impact sleep. This is coupled with a severe disparity in research addressing obesity and type II diabetes in Hispanic youth and adolescents. This study examined the impact of screen time and non-screen time SB on sleep quality and duration in Latino adolescents and young adults. Activity was assessed using accelerometry and self-reported surveys were used to assess ST and sleep quality. Pearson correlations were used to examine associations among SB and sleep variables. Our findings suggest that youth engage in more SB (both ST and non-ST) on weekends compared to weekdays, and that decreasing SB is a strategy for improving sleep duration. More research is needed to disentangle the relationship between ST SB and overall SB with sleep quality among high-risk populations.

Social Sciences

Cultural Ethnic and Gender Studies

SOSC 1 **Diversity in the Outdoors: An Analysis of Inclusion Efforts in Outdoor Activities through Place-Making**

Marcus Tierrablanca

Mentor: Dr. Cymene Howe

There are countless ways in which people perceive, utilize, and enjoy the outdoors. In the US, many people appreciate nature by spending time outside and participating in activities that range in duration and skill level. Despite national and local levels of governance that help make these spaces available to everyone, there are clear disparities in diversity and inclusion in outdoor engagement. Because recreational activities like camping and hiking are traditionally oriented towards the heterosexual, white, able-bodied, cisgender male, my research will focus on the ways in which local and large-scale organizations are attempting to increase representation of other groups in outdoor activities. I will push the boundaries of analyzing this topic by using the concept of placemaking to speculate an alternate reality where the outdoors are truly meant for everyone. Using interviews and background research, I found that although many of these organizations face similar obstacles when trying to increase diversity in the outdoors, effective solutions can arise through a combination of structural and place-specific actions.

Human and Medical Lifesciences

SOSC 2 **Telemedicine and Access to Care in the Times of COVID-19**

Anu Singh

Mentor: Dr. Teresia O'Connor

Telemedicine is important in increasing access to medical care. During the COVID-19 Pandemic, telemedicine implementation has increased and should be adopted suitably for vulnerable populations. There is limited data on the perceptions, barriers, and use of Telemedicine by low-income patients.The objective of this study was to create a survey to assess the experience of low-income families with Telemedicine.The study design is an on-going prospective, descriptive, cross-sectional study at three different pediatric clinics in the Greater Houston Area. The survey questions were designed to measure parent perceptions of telemedicine according to the constructs of the Access to Health Care framework. Two surveys were created separately for either in-person or Telemedicine visits, with many overlapping questions. Both surveys were available in English or Spanish via REDCap. The surveys are currently being sent to parents

via text message, Epic MyChart, or email. A response rate of 10-20% is expected for this survey. Results from this study will be important in understanding patient satisfaction, facilitators, and barriers of Telemedicine services among low-income individuals.

SOSC 3 **The Impact of COVID-19 on Mental Health of South Asian Jain Faith Practitioners**

Pranav Mehta

Mentor: Dr. Nitin Shah

Several studies have shown that South Asian populations are largely at risk for mental illness during COVID-19 due to stressors regarding infection, occupation, familial responsibilities, socioeconomic status (SES), and isolation. However, there is limited research on the relationship between mental health (anxiety + depression) and COVID-19 in Jain religious practitioners. To explore this relationship, standardized Qualtrics surveys were distributed to US Jain practitioners and data regarding age, ethnicity, gender, and SES were collected. Anxiety and depression levels were evaluated using GAD-7 and PHQ-9 questionnaires. US Jain respondents did not experience significant symptoms of anxiety or depression during the pandemic. However, upon further analysis, female respondents under the age of 26 were more likely to report symptoms of anxiety and depression compared to older male respondents. As South Asian children + young adults continually experience more stress and anxiety during the pandemic, culturally-appropriate interventions can benefit the mental wellbeing of younger Jain followers during unprecedented times. Further research should be conducted to strengthen findings.

Other works in Social Sciences

SOSC 4 **The effect of emotion regulation on negative affect and memory**

Brandon Hayes

Mentor: Dr. Stephanie Leal

Throughout life, stressful and negative experiences are often encountered. During these times, emotion regulation strategies can be used to mitigate the negative effects of the events. These strategies can range from altering our view of the current situation to actively trying to suppress the negative emotions they convey. Emotional experiences are often better remembered; however, this may not always be beneficial. Depression is associated with a negativity bias, where negative experiences are better remembered. The current study aimed to investigate how emotion regulation strategies can modulate negative affect and memory in individuals with depressive symptoms. Participants completed a memory task with negative and neutral images, in which they rated their negativity towards the stimuli during encoding and retrieval. We found that the use of an emotion regulation strategy was successful in decreasing negative

feelings towards negative stimuli. Further, we found that these strategies also impacted memory, resulting in a decrease in the negativity bias in depressed individuals.

SOSC 5 **The Effect of Antidepressants on Emotional Memory**

Taylor Phillips

Mentor: Dr. Stephanie Leal

Depression is associated with memory impairment as well as a negativity bias. This effect has recently been studied in the context of pattern separation, a hippocampal computation that stores similar experiences using non-overlapping representations. Individuals with depression show reduced hippocampal volume and enhancement of negative pattern separation. Rodent studies have shown that antidepressants reverse hippocampal volume reduction and restore normal memory functioning, but these effects have not yet been tested in humans. The current study investigated antidepressant use and its potential impact on emotional pattern separation. Young adults who were taking antidepressants performed an emotional pattern separation task. Participants reported their current depressive symptoms as well as prior to taking antidepressants. We found that individuals taking antidepressants who reported a greater improvement in their symptoms showed a reduction in the negativity bias and compared to those who were taking antidepressants with no improvement in symptoms. This suggests that antidepressants may be beneficial in alleviating mood symptoms but also reducing the negativity bias in memory.

SOSC 6 **The Effect of Current Perceived Stress on Emotional Memory**

Rishi Vas

Mentor: Dr. Stephanie Leal

Stress can negatively impact one's memory. The hippocampus, a brain region involved in memory, performs a key computation called pattern separation which is our brain's mechanism of distinguishing between similar events. Previous research has examined the impact of stress on pattern separation by inducing stress in the laboratory or examining chronic stress (i.e. depression); however, little is known about how natural variation in current perceived stress levels impact memory. This study examined the impact of perceived current stress on emotional memory using a task that taxes pattern separation. Participants reported their current level of perceived stress using a modified version of the Perceived Stress Scale, which we used to split participants into low and high stress groups. We found impaired pattern separation in the high stress group, especially for positive images. We also found a negative relationship between perceived current stress and emotional memory, where higher levels of stress were associated with worse emotional memory. These results suggest current perceived stress greatly impacts emotional memory, especially for positive experiences.

SOSC 7 **Investigating the White Matter Correlates of Working Memory**

Talha Arif

Mentor: Dr. Randi Martin

Working memory (WM) is the cognitive system responsible for maintaining and integrating information over the short term. Neuropsychological evidence suggests separate WM capacities for phonological and semantic representations, which depend on different gray matter regions (supramarginal gyrus for phonological and inferior frontal gyrus, middle frontal gyrus, and angular gyrus for semantic). Here we investigated the role of white matter tracts connecting these brain regions to other regions in supporting WM performance. Diffusion tensor imaging was used to model tracts of interest and obtain measures of tract integrity (fractional anisotropy and tract volume) for 25 people with left hemisphere brain damage. Contrary to predictions, we did not observe relationships between left hemisphere tract integrity and WM performance after controlling for single word processing abilities. Right hemisphere tract integrity contributions to semantic WM were observed, potentially suggesting neural reorganization with contralesional involvement in WM after brain damage. Future work will collect additional patient data and analyze relationships between tract integrity and WM in age-matched controls.

SOSC 8 **Integrating Secondary Voicing Cues and Top-Down Information Within Syllable Perception**

Zachary Murphy

Mentor: Dr. Simon Fischer-Baum

The ability to perceive speech has been shown to depend on both bottom-up, acoustic signals and top-down knowledge. The perception of the English voicing contrast, which separates sound like /d/ vs /t/, primarily depends on the acoustic cue of voice onset time (VOT) with secondary cues, such as fundamental frequency (fθ) onset and amplitude rise rate, providing supplemental information on the probability that the sound was voiced. The goal of the current work is to investigate how the brain incorporates top-down information and secondary cues to yield perception (of /d/ and /t/) and determine at which stage(s) of processing this integration occurs. We manipulated VOT, amplitude rise rate, and fθ ˩ onset in three steps within the context of top-down biased continua to test for interactions between top-down knowledge and acoustic cues. Using mixed effects models, we found interactions between the primary cue of VOT, both secondary cues, and top-down information. These interactions indicate that top-down information is processed alongside bottom-up cues when categorizing speech sounds, rather than initially processing acoustic ambiguity and integrating top-down information later.

SOSC 9 **Dissociation in Reading and Spelling in a Patient with Aphasia**

Shreya Ingle

Mentor: Dr. Simon Fischer-Baum

Aphasia is a language impairment that arises from a stroke or other brain damage. I have been administering tests to stroke patient EW to understand her specific language deficits. The language tests we use fall into the categories of short-term memory, executive function, sentence comprehension, reading, spelling, and language production, as these are the areas of cognitive function most often impaired by a stroke. These language tests are used to gauge if these deficits exist in patients and to what extent. EW shows interesting patterns of errors when presented with identical stimuli in different modalities such as reading, spelling, and writing. She performs with 100% accuracy when asked to read single words, but performs with much lower accuracy when asked to spell the words. Additionally, as word length increases, her accuracy decreases. These results suggest that she has a dissociation between reading and writing, and her lesion seems to only impair her performance on oral spelling and writing, but not reading. I will be administering additional tasks in these different modalities to better understand if EW has a motor, phonological, or semantic deficit.

SOSC 10 **Case Study: Analyzing Language Comprehension in Patient MN**

Krithi Pachipala

Mentor: Dr. Simon Fischer-Baum

This case study presents findings of patient MN, a 64 year old male with a 2015 left-hemisphere stroke who indicates issues in language comprehension. In speech perception, his ability to identify individual sounds was relatively good (e.g. 80-90% correct), but he was close to chance in discriminating between auditorily presented words and nonwords in a single-word format (63% correct). Despite this difficulty, MN performed well in auditorily presented sentence comprehension. We hypothesize his perception in sentence comprehension is supported by reliance on context clues to predict the spoken words. Therefore, his impairment seems to lie between perception of speech sounds and accessing word meaning, which he is able to compensate for with contextual information. This explains his higher performance in sound identification tasks, which have no semantic knowledge attached, purely phonological info, and sentence comprehension tasks, which do include semantic information and syntactic rules. But when attaching meaning to sounds in isolation, he has difficulty. Further testing with MN will provide opportunities to understand how prediction and context can support language processing.

SOSC 11 **The Effects of Depression and Anxiety Symptoms on Work Performance During the COVID-19 Pandemic**

Charlotte Davis

Mentor: Dr. Danielle King

Throughout the COVID-19 pandemic, depression and anxiety symptoms in adults have increased in the United States, and such symptoms can negatively affect one's work performance (de Lorenzo, 2013; Russinova et al., 2011). Receiving work accommodations and social support can buffer the negative effects of depressive and anxiety symptoms (Banks et al., 2001; Plaisier et al., 2007), however, these potential buffers have not yet been compared in a single model using depression and anxiety symptoms to predict work performance. In addition, prior research examines mental health diagnoses, without assessing potential symptomology changes and effects due to times of heightened stress (e.g., during a pandemic). By surveying 227 Rice students through Qualtrics, I explored the effects of depression and anxiety symptoms on one's work performance with work accommodations, social support from the workplace, and social support from friends and family as moderating variables. Although the moderating variables did not yield significant interactions, the significant main effects supported previous literature in that depression and anxiety symptoms were negatively correlated to work performance.

SOSC 12 **What Effects Do Healthcare Systems Have on Vaccine Distribution? Using Case Studies to Examine the Different Effects of Socialized and Privatized Healthcare Systems on COVID-19 Vaccination**

Sophia Pereira

Mentor: Dr. Melissa Weininger

The COVID-19 pandemic is a healthcare crisis affecting countries around the world. While responses to the disease have differed, a major goal throughout the world has been vaccination allocation to prevent the further spread of COVID-19. Interestingly, different healthcare systems, namely private and universal healthcare systems, have differed in their approach to COVID-19 vaccination strategies. This paper will analyze the effects and correlation between healthcare systems and vaccine distribution. More specifically, it will utilize two case studies, the United States and Israel, to analyze the differences in vaccination allocation between universal and privatized healthcare systems. Ultimately, this research will provide policy recommendations based on the findings, both the strengths and weaknesses, of each healthcare system's vaccination programs in response to COVID-19.

SOSC 13 **Passing the Test of Leadership: Gender, Competence, and Diversionary Conflict**

Krithika Shamanna

Mentor: Dr. T. Clifton Morgan

Many seem to believe that state leaders resort to international conflict when they need to distract their populace from domestic political and economic problems.

Few systematic studies have found evidence supporting this notion, however. One possible explanation for this rests with the fact that theoretical arguments producing diversionary hypotheses have lacked nuance; that is, they draw very few distinctions allowing for the possibility that different leaders could be affected quite differently by similar situations. For example, a five-percent loss in approval ratings might matter less to a leader who came to office with overwhelming support than would a one-percent loss in approval to a leader whose margin of victory was razor-thin. We address this by developing a novel formal theoretic model of diversionary behavior. This model is based on principal-agent theory and assumes that leaders can remain in power only by convincing their "selectorates" that they are competent. The model incorporates a number of modifications to previous PA models applied to diversionary theory.

SOSC 14 **"To punish or to assist? Divergent reactions to ingroup and outgroup members disobeying social distancing" Replication Study**

Helena Leal

Mentor: Dr. Sandra Parsons

This paper addresses how well the public responds to certain COVID policies and how individuals feel about the public health behaviors of people both within their in-group (US) and out-group (New Zealand). We theorize that people will have less support for retributive than assistance measures overall and that there will be increased support for retributive measures when norm deviation is involved with in-groups and out-groups. Participants will read a paragraph about covid regulations in either their ingroup or outgroup countries and rate statements regarding moral emotions and support for different measures in that group. Our study is being replicated within the Rice student population, who we expect to have an overall negative view on current US covid regulations. We expect our results to demonstrate a black sheep effect in which participants will more negatively view deviant ingroup members, making them more likely to support punitive measures for the ingroup (US). This research shows that it is vital that we do not frame situations that involve public health with an "us-versus-them" mentality but rather, foster solidarity around the world.

SOSC 15 **Case Study: BC**

Catherine Chen

Mentor: Dr. Simon Fischer-Baum

Careful investigations of patients who suffer language impairments following brain damage can provide clear insights into the cognitive representations and processes involved in language. The present study reports a case study of an individual, BC, who presents with a difficulty in retrieving words following brain damage. When asked to perform tasks that involve processing single, familiar words, BC performed well, including picture naming, reading, repetition and comprehension. However, whenever BC was given nonwords to produce, in tasks

such as reading, repetition, and spelling-to-dictation, he performed poorly. I will discuss the particular challenges of why nonwords are particularly informative for understanding a patient's underlying cognitive impairment and why greater impairments on nonwords should be observed in these tasks.

Social Behavioral and Economic Studies Qualitative

SOSC 16 **“I'm Anxious But I Don't Have Anxiety!”: How Stigma Exacerbates the Effect of Anxiety Disorders in the Workplace**

Eli Mendoza

Mentor: Dr. Eden King

Anxiety disorders are the most common mental illness around the world and in the U.S., impacting around 284 million people worldwide and about 40 million U.S. adults each year. As more organizations start to emphasize employee well-being, honest conversations on how to accommodate those with anxiety disorders and other mental health issues in the workplace are often barred due to the stigma surrounding them. This research examines how different anxiety disorders impact job performance, the stigmas surrounding mental illness that serve as barriers to optimal job performance, and individual, ally, and organizational level interventions that have been researched to treat anxiety and/or reduce mental illness stigma. The culmination of this research is presented in a proposed model showing how anxiety symptomatology and stigma impact job performance, through cognitive interference and self-regulatory processes, and how individual, ally, and organizational level interventions can help improve outcomes for employees with anxiety disorders.

SOSC 17 **Going Green to be Seen: The Effect of Status and the Public Eye**

Phillis Range

Mentor: Ms Sandra Parsons

This research examines the underlying factors that contribute to pro-environmental product purchases. The work will bring pertinent insights regarding the constructs of competitive altruism and costly signaling and can help to combat climate change by influencing consumer behavior. Focusing on the effects of social influence and purchase setting (public/private), we hypothesize that status-elicited feelings will lead to more pro-environmental product purchases. Similarly, we argue that a public purchasing setting will lead to more pro-environmental product purchases. In this 2x2 ANOVA design, participants are asked to decide between identically priced luxury and pro-environmental products after reading a short story and being instructed to shop in either public or private (online) with a staring face or no staring face on their screen. The results should align with our hypotheses, with the purchase setting results being more significant than in the original study. The work lays the foundation for

detailed analyses on the strength of social influence factors. Future directions might include the investigation of gender differences and Big-5 Personality Traits.

SOSC 18 **Motivating Social Distancing among College Students in the COVID-19 Pandemic: Studying Framing Effects**

Sofia Flores-roas

Mentor: Dr. Sandra Parsons

During pandemics social distancing is an effective strategy to flatten the growth curve, so informational campaigns and advertising could have a significant impact on how willing people are to socially distance. This study could help health officials decide how to best frame public messages for maximum effectiveness. The aim of this study is to determine whether framing messages in a more personal, emotional manner is more motivating than non-personal framing. We hypothesize that having identifiable persons and emphasizing transmission rates in messages will more effectively motivate social distancing than a non-personal control.

To examine the effect of cautionary posters on intentions to practice safety measures for COVID-19, one of three posters including a control was shown to a small sample through an online survey platform. After being exposed to the poster, participants' attitudes regarding intentions to comply with precautionary COVID-19 behaviors were measured, indicating the poster's effectiveness. These findings will impact advertising both during and after COVID-19, changing the content of targeted ads to increase effectiveness and compliance with preventive behaviors.

SOSC 19 **Effects of the COVID-19 Pandemic on Resident Mental Health**

Ashna Karpe

Mentor: Dr. Britanny O'Brien

The COVID-19 pandemic has presented unprecedented challenges and led to increased levels of psychological distress among healthcare workers. First-year medical residents may be at an even greater risk given difficulties inherent to transitioning into a provider role. In this study, we analyzed survey data from first-year residents (N=47) at an American academic medical center who participated in virtual mental health support groups. Prior to the groups, residents were asked to complete an anonymous survey which included a mental health screening (Kessler Psychological Distress Scale) and questions about difficulties in transitioning to a provider role, impact of COVID-19 on mental health, and mental health care attitudes and barriers. About 15% of residents reported moderate to severe levels of psychological distress. Important barriers to accessing care included time constraints, lack of confidence in treatment, stigma, and concerns about confidentiality. Institutions ought to consider identified barriers in developing mental health support for not only first year residents, but all

healthcare workers. Benefits of such efforts will go far beyond the scope of the pandemic.

SOSC 20 **Online Dating at Rice University**

Eva Cai, Claudia Di Bonaventura

Mentor: Dr. Sandra Parsons

This research is important because online dating has become increasingly more popular among individuals seeking a romantic relationship. The main claim of this study is that having more choices and the ability to reverse a choice when choosing a potential partner on an online dating site will decrease the satisfaction of choice. There are two independent variables: choice reversibility and number of potential partners. Each variable will contain two groups, totaling 4 conditions. Participants will be randomly assigned to one of the four conditions. Participants will be asked to choose someone they would like to go on a date with among the given options. After a 15 minute period, they will be asked to answer questions on a survey. Questions on the survey will ask about satisfaction level with the chosen partner. The results should show that participants in the larger choice conditions and changeable conditions will be less satisfied with their chosen partner than participants in the smaller choice conditions and unchangeable conditions. This study adds further evidence for the choice overload and choice reversibility effects.

SOSC 21 **Remote Reproduction: Midwifery and Birth during the COVID-19 Pandemic**

Saniya Gayake

Mentor: Dr. Beverly Mitchell

The COVID-19 pandemic caused many health services, including maternity care, to implement precautionary measures and social distancing to prioritize safety. As hospitals treated people with Coronavirus and limited the number of people allowed in delivery rooms, pregnant people and their families reconsidered the role of biomedicine and hospitals in birthing processes. Meanwhile, midwives gained coverage in national and local news, causing many people to seek midwives for out-of-hospital pregnancy and labor support. My research aims to understand how risk and choice were conceptualized and re-conceptualized by midwives and pregnant people in Houston, Texas as the crisis progressed. Because midwifery care is traditionally based on intimate, flexible, in-person interactions with their clients, I also examine how midwives adapted their technologies, practices, and protocols to meet safety and clientele demands while balancing their humanistic philosophy of birth. Based on semi-structured interviews, my research is novel, timely, and exploratory as I uncover the factors that impact birth processes and relationships of midwives and their clients as they navigate care during the pandemic.

Social Behavioral and Economics Sciences Quantitative

SOSC 22 **Challenges for using Representational Similarity Analysis to Infer Cognitive Processes: A Demonstration from Interactive Activation Models of Word Reading**

Xuanyi Chen

Mentor: Dr. Simon Fischer-Baum

Representational Similarity Analysis (RSA) is a powerful tool for linking brain activity patterns to cognitive processes via similarity, allowing researchers to identify the neural substrates of different cognitive levels of representation. However, the ability to map between levels of representation and brain activity using similarity depends on underlying assumptions about the dynamics of cognitive processing. To demonstrate this point, we present three toy models that make different assumptions about the interactivity within the reading system, (1) discrete, feedforward, (2) cascading, feedforward and (3) fully interactive. With the temporal resolution of fMRI, only the discrete, feedforward model provides a straightforward mapping between activation similarity and level of representation. These simulations indicate the need for a cautious interpretation of RSA results, especially with processes that are highly interactive and with neuroimaging methods that have low temporal resolution. The study further suggests a role for fully-fleshed out computational models in RSA analyses.

SOSC 23 **Developmental Dysgraphias in Students of Braille**

Rose Click

Mentor: Dr. Simon Fischer-Baum

This study examined the manifestations of developmental dysgraphia in children who use braille as their primary script. Blind and visually impaired children face many systemic barriers to accessing literacy, and research into the further challenges that cognitive reading and writing impairments pose in this population is virtually nonexistent. For this study, I examined the passage transcription data from several levels of the 2019 Braille Challenge for characteristics of three different dysgraphic patterns: phonetic misspellings, letter order mistakes, and shape-based character mistakes. I will analyze the data to determine which of these systematic mistakes exist distinctly from equally likely random errors, and at what rates they occur. I expect to find evidence of the first two patterns, but no evidence of the third, as existing research suggests that shape processing does not play a significant role in braille processing. Ultimately, the analysis of these writing error patterns will inform us on braille processing and specific writing differences, as well as contribute to general developmental writing differences research from the perspective of a distinct writing system.

SOSC 24 **The Fear of Missing Out During the COVID-19 Pandemic**

Vincent Lai

Mentor: Dr. Angie LeRoy

The COVID-19 pandemic has put people at risk for negative physical and mental health consequences. Some of these consequences, such as depressive symptoms, are also associated with the fear of missing out (FOMO), or the apprehension felt when absent from others' rewarding experiences. FoMO has largely been studied in the context of social media and Internet usage among college students, but few studies exist using an older community sample. In this study, we collected data from 103 older adults (M = 69.23, SD = 5.41 age) during the COVID-19 pandemic (2020) to assess whether FoMO was related to depression among people at risk for the negative consequences associated with COVID-19. Preliminary results indicate that FoMO is significantly associated with depressive symptoms above and beyond the effects of age, $F(2, 221) = 45.64$, $p < .001$. Specifically, FoMO is positively related to depressive symptoms such that people who reported experiencing more FoMO also reported worse depressive symptoms, compared to those who reported less FoMO ($b = .46$, $p < .001$). Future research should assess additional health outcomes influenced by FoMO to inform intervention development among older adults.

SOSC 25 **Neural Mechanisms of Emotion Regulation and Heart Rate Variability in Bereaved Spouses**

Rohini Kumar

Mentor: Dr. Bryan Denny

The loss of a spouse can lead to debilitating effects such as a higher risk of cardiovascular events and complicated grief. However, some bereaved individuals are more resilient than others. Recent research suggests that heart rate variability, a marker of resilience, may promote brain networks involved in emotion regulation. Cognitive reappraisal is an adaptive emotion regulation strategy also associated with well-being. The current study aimed to explore the connection between heart rate variability and cognitive reappraisal within the context of bereavement. Heart rate variability was collected from 21 bereaved spouses, along with psychological questionnaires. Participants also completed a cognitive reappraisal task while undergoing fMRI. We found that neural correlates of reappraisal did not mediate the relationship between heart rate variability and complicated grief. Additionally, there was no significant correlation between neural correlates of reappraisal and reappraisal frequency or ability. Due to the low power of this study, these findings suggest that future exploration with larger samples may provide a better understanding of the mechanisms involved in bereavement.

SOSC 26 **Belief in an Afterlife on Healing During Spousal Bereavement**

Arya Jones

Mentor: Dr. Christopher Fagundes

Bereaved spouses are at heightened risk for poor mental and physical health. This study investigates how belief in an afterlife affects grief and cellular immune function (measured by EBV and CMV antibody titers) over 6 months after the spousal loss. Belief in an afterlife may facilitate adaptive coping during loss and thus may decrease grief severity. Cellular immune functioning is closely related to psychological distress. Through decreased grief, belief in an afterlife may likewise improve immune function. We found no differences in the change in grief, depression, or EBV/CMV antibody titers between afterlife believers and non-believers during the first 6 months of loss. Grief/depressive symptoms and EBV antibody titers significantly decreased among those who believed in an afterlife. In contrast, only grief substantially reduced among those who did not believe. There was no difference between afterlife believers and non-believers in the starting level of any outcome. These results are early evidence that believing in an afterlife is adaptive to psychological and physiological well-being during loss but calls for further research using more specific afterlife belief measures.

SOSC 27 **The Effects of Tension on College-Aged Children of Immigrants**

Ashley Snell

Mentor: Dr. Danielle King

The children of immigrant (COI) population in the United States is steadily growing. With this increase, the preexisting perceptions of, attitudes towards, and the hierarchical power structures which exist in society today exacerbate the tensions this population experiences. This study examines the effects of tension, measured on the well-being and self-efficacy of college-aged COI through an online survey. We also examined resiliency and social support as protective factors that buffer the negative effects of tension. Findings from 163 participants at a university in southeast Texas suggest that dimensions of tension relating to racial identity threat significantly predict academic self-efficacy, where children of immigrants who experience more racial identity threat report less academic self-efficacy. Neither dimension of tension significantly predicted career self efficacy. Acculturative stress dimensions predicted both psychological and physical wellbeing, where greater stress predicted worse wellbeing outcomes. Neither social support nor resiliency significantly moderated these relationships. We conclude with a discussion of theoretical and practical implications.

SOSC 28 **Examining Source and Type of Support for Employees with Mental Illness: Coworker Support Helps with Feelings of Belongingness**

Shelly Zhou

Mentor: Dr. Eden King

Existing research shows that social support in the workplace has many benefits. However, fewer research studies have looked at how these benefits impact

individuals with mental illness, or how specific sources or types of support might impact different outcomes. In this study, we explore how distinct sources (supervisor, coworker) and types of support (instrumental, emotional) impact job self-efficacy and belongingness in employees with mental illness. Based on the compatibility principle, we predicted that different sources and types of support would impact individual outcomes differently, depending on the proximity of support source and type to outcome. We surveyed 144 employees with a diagnosed mental illness, and using multiple linear regression analyses, our results show that coworker support (both emotional and instrumental) was significantly related to feelings of belongingness among employees with mental illness. Although the other support types we examined did not reach statistical significance, our relative weights analysis still provides helpful insight into the relative importance of different sources and types of support for employees with mental illness.

SOSC 29 **Family Income is Positively Correlated with College Students' Work-School Facilitation and, Paradoxically, Conflict.**

Beth Buchanan

Mentor: Dr. Eden King

Many college students are balancing not only school demands, but also work demands. Involvement in these roles could create a form of interrole conflict called work-school conflict, referring to the negative impact of work on school (Markel & Frone, 1998). Meanwhile, work-school facilitation refers to the positive impact of work on school (Butler, 2007). This study tests a model of work-school conflict and facilitation that also includes family income and financial security. I hypothesized that family income would negatively predict work-school conflict and positively predict work-school facilitation, and that financial security would mediate the relationship between family income and work-school conflict/facilitation. Based on survey data from 183 participants, family income was a statistically significant positive predictor of work-school conflict. Family income was also a statistically significant positive predictor of work-school facilitation. Finally, financial security was not a statistically significant mediator in the model. The findings suggest that high income students may experience greater work-school conflict and, paradoxically, greater work-school facilitation.

SOSC 30 **The Look of Punishment: Intersectional Invisibility in Elementary School Discipline**

Nicole Lennon

Mentor: Dr. Michelle Hebl

Past research suggests that racism and sexism impact disciplinary decisions for elementary students. Extending this work, we examined the extent to which racial stereotypicality(styp) affects harshness of punishments that children receive. In this study, elementary teachers viewed 20 reports describing students' moderate-severity infractions, each accompanied by a photo and name of the

student. The reports varied within-subjects on gender, race and racial styp. Each report was followed by 6 questions for participants to answer about infraction severity and student punishment. We examined the effect of child race, gender, and styp on disciplinary recommendations. Most notably, within girls, there was an effect of styp for White students, with high-styp girls receiving less punishment than low-styp girls. Within boys, there was an effect of styp for Black male stimuli, with high-styp boys receiving less punishment than low-styp boys. These findings are aligned with intersectional invisibility theory; the salience of the high-styp Black boy's race and the high-styp White girl's gender may cause teachers to be more aware of their biases and lower evaluation severity for these students.

SOSC 31 **Is the Media Against Me? Personality Traits as a Predictor of Hostile Media Bias**

Lauren Palladino

Mentor: Dr. Matthew Hayes

Nearly three decades ago, scholars coined the hostile media phenomenon when reflecting on cold war politics and the advent of radio coverage of current events. Today, hostile media has evolved from the talk radio of the 1980s to Facebook and Twitter in the 2010s. The literature on hostile media effects and bias must also evolve with this shift. This work explores how personality traits can predict who consumes hostile media, and who acts upon this consumption. Using data made available from the American National Election Study (ANES), personality will be assessed by the ten item personality inventory (TIPI) metric of the Big Five personality theory. Using a multivariate linear regression analysis, this project examines which personality metrics predict hostile media consumption. Ultimately, this study finds that an individual's level of conscientiousness and degree of agreeableness can predict propensity to consume media with a slant against their own ideology. These results hold critical implications in the realm of media strategy and rhetoric in the American political landscape.

SOSC 32 **Investigating the Relationship Between Conceptual Short-Term Memory and Semantic Working Memory**

Maggie Wang

Mentor: Dr. Randi Martin

Conceptual Short-Term Memory (CSTM) and semantic working memory (SWM) are related but distinct theories of how semantic information is maintained over the short term. This study aimed to elucidate the relationship between these theories by assessing the correlation between measures typically used to tap these capacities. 44 Rice University undergraduates completed three tests used to tap CSTM (recall of words, pictures, and digits presented at rapid rates, e.g., 8 items per second) and two tests used to tap SWM (synonym probe and conceptual span using slower presentation rates, e.g., 1 item per second). To obtain converging evidence, 7 individuals with chronic brain damage and varying degrees of SWM

deficits were tested on a subset of the same tasks. Our data for both participant groups showed that SWM measures and performance on the CSTM were generally correlated (r values from .32 - .84). Among the participants with brain damage, no significant patterns of dissociation were observed between performance on the CSTM and SWM measures. The results support the conclusion that CSTM and SWM measures are tapping into the same construct and that the theories should be combined.

SOSC 33 **The Great Awakening: How and Why the Q-Anon Conspiracy Theory Motivates Voters**

Amelia Lindell

Mentor: Dr. Robert Stein

American politics is often described as having a paranoid style, and the far-right, anti-Semitic Q-Anon conspiracy theory is the most recent and extreme iteration. While conspiracy belief is traditionally thought to discourage electoral participation, in 2020 over one hundred candidates ran for office on a platform promoting the Q-Anon conspiracy. This thesis looks to understand how and why conspiracy theories attract voters, and how conspiracies can be used by political candidates to win campaigns.

Past literature gives reason to believe that conspiracy theories can mobilize believers. However, little research has been done into the mobilization of conspiracy believers into traditional forms of political action, such as voting, and no research has been done into the mobilizing effects of Q-Anon. I identify components of the Q-Anon conspiracy that may be capable of mobilizing a base of believers as a populist frame, a religious deviant frame, an identified enemy, and a right wing authoritarian appeal. I then field a vignette study through MTurk to test those four frames, with the goal of identifying which aspects of Q-Anon are most powerful in attracting voters.

SOSC 34 **The Effect of Language on Memory Recall, Injury Perception, and Safety Perception**

Adrien Quant

Mentor: Dr. Sandra Parsons

Research by Loftus and Palmer (1974) showed that words alter memories of events, revealing the malleability of memory and the influence of language on memory. Our study examines the effect of word cues on memory recall and perceptions of injuries and safety. In our study, we examine how word cues alter participants' memory and perceptions of an auto-bicycle accident. Participants will watch a video of an auto-bicycle collision and are asked to (1) estimate of the speed of the vehicle, (2) estimate the severity of the bicyclist's injuries using the Abbreviated Injury Scale, (3) and subjectively rate the safety of the intersection. We expect greater vehicle speed and injury severity estimates, and lower

intersection safety ratings, for higher energy verb cues. Our findings may reinforce the notion that word cues can alter memories of events, potentially making eyewitness testimony unreliable if questions are asked uncarefully. Additionally, our findings may suggest word cues can alter safety perceptions of past events. Understanding the effect of word choice on memory and perception may allow first responders to gain more accurate histories from witnesses.

SOSC 35 **Neural Correlates of Lexical Selection and Semantic Working Memory in Acute Left Hemisphere Stroke**

Sarah Siddiqui

Mentor: Dr. Tatiana Schnur

Left hemisphere stroke creates speech impairments that may be due to underlying impairments in cognitive capacities like working memory (WM) and the ability to select words from alternatives (lexical selection). The brain regions differentially critical for these cognitive capacities are unknown. To avoid confounds from brain reorganization and adaptive strategies developed during recovery from stroke, we examined this question in an acute stroke population where patients had isolated damage to the anterior left inferior frontal gyrus (aLIFG; n=3), the posterior LIFG (pLIFG; n=4), or the supramarginal gyrus (SMG; n=4). Patients completed tasks assessing WM and lexical selection. We expected that aLIFG damage would be associated with impaired WM and that pLIFG damage would be associated with impaired lexical selection. There were no significant differences between group performance in WM or lexical selection (p's > 0.15). This suggests that the LIFG is not uniquely implicated in lexical selection or working memory abilities. We suggest future research using larger sample sizes to increase power and ability to differentiate performance among those with dissociable lesion patterns.

SOSC 36 **Roll Call Votes in the 1874 Texas Senate Legislative Session**

Thomas Kovac

Mentor: Dr. Mark Jones

The historical impact of just one legislative session in one year should not be overlooked. My research with the Texas Legislative History Project attempted to provide a greater understanding of Texas history and politics by collecting the voting records of senators in the Texas Senate's 14th Legislative Session in 1874. The research was important because it contributed to the construction of the most comprehensive and extensive records of voting in Texas legislative history. I gathered data by using senate journals from 1874 to track votes, bills, and debates and I recorded observations and patterns in these votes. Votes and debates on the senate floor mirrored trends in Texas history and provided insight into the most pressing issues of the time. Through using voting data that I helped compile, scholars will be able to assess the effect that the 1874 Senate Legislative Session

had on multiple ideological, public policy, ethnic/racial and geographic dimensions of Texas political history.

SOSC 37 **Expressive Writing During COVID-19: A Novel Stress-Reduction Intervention Tailored for those most at-risk**

Nyla Vela

Mentor: Dr. Angie Leroy

The COVID-19 Pandemic has led to increased anxiety and stress all around the world, especially amongst those most at risk of suffering major consequences associated with the virus. Expressive Writing has been used in the past to mitigate emotional responses to stressful experiences. The current study tested the efficacy of a novel stress-reduction intervention that addresses the unique stressors of the pandemic. 275 older adults (age M= 69.12, SD= 9.65) participated in this study. Participants completed a baseline questionnaire, were randomly assigned to one of three expressive writing prompts: Security, Self-regulation, and Control, and responded to each of the writing prompts (3 per condition) over the course of three days for 20 minutes per day. Then, participants completed a follow-up survey. We plan to conduct a one-way ANOVA to assess whether there are group differences between the means of each writing condition on main mental and physical health variables of interest. If significant, we will conduct pairwise comparisons to compare the means for each condition. This study may identify a helpful strategy for individuals to cope with the stress of the COVID-19 pandemic.

SOSC 38 **The Effect of Chinese Outward FDI in Africa on Wages**

Joseph Hubner

Mentor: Dr. Connor Huff

Given the increased importance of China on the global stage, and its increased investment activity, both official development aid (ODA) and foreign direct investment (FDI), there have been a number of questions surrounding the effects of these actions on domestic policy outcomes in the states where they invest. Using state-level time series data on monthly minimum wage and FDI inflows, I investigate the effects of investment on domestic labor policy. Theoretically, I apply both the neoliberal race to the bottom and the Shanghai effect frameworks to understand and parse out the differential pathways using both a strategic interaction model (race to the bottom) and linear regression model (shanghai effect). This aims to better understand the effects of Chinese FDI on the domestic policy space contributing to past research on Chinese FDI behavior, and past research on the emergence of a counter hegemonic system based purely on economic flow or on anecdotal evidence regarding institutional change, and the effect of Chinese soft power, as well as applying previously explored methods regarding the race to the bottom to a novel case.

SOSC 39 **COVID-19 Experiences Research Study**

Aliza Brown

Mentor: Dr. Danielle King

COVID-19 has impacted the way people work, including forcing employees to adapt to more stringent safety protocols and balancing increased role demands. Those in “essential” occupations have faced difficult changes. Based on interactional justice theory (e.g., Bies & Moag, 1986), this study focuses on two such essential occupations, teaching and nursing, to examine the effects of organizational communication processes on experienced role stress and subsequent work attitudes and behaviors. We gathered quantitative and qualitative data concerning how communication (i.e., adequacy of COVID-19 organizational messages and employee opportunities to voice their suggestions) affects employee role overload and also burnout and turnover intentions. In a survey completed by 214 essential employees, we find that the specificity and sensitivity of organizational COVID-19 related messages to employees directly affect their experience of role overload and reported burnout and turnover intentions, and that voice opportunity directly predicts turnover intentions. These results underscore the importance of interactional justice during times of substantial change and challenge.

SOSC 40 **The Benefits of Mental Health Support for University Students: Do Expectations of Support Matter?**

Betel Hernandez

Mentor: Dr. Eden King

This study used psychological contract theory to understand how the extent to which university students expect to be supported in their mental health by faculty and peers in their organization (i.e., their university) impacts their perceived organizational support, life satisfaction, and organizational commitment. It was expected that experienced support from faculty and peers would be positively related to the outcomes, and that this relationship would be moderated by expected support – such that the relationship would be stronger for individuals with high expected mental health support. We also predicted that the moderated effect of expected support would be stronger for individuals with worse depression and anxiety symptoms. Using hierarchical linear regression analyses, the results demonstrated that experienced mental health support from faculty was a significant predictor of student's perceived organizational support and organizational commitment. Experienced support from peers was a significant predictor for all three outcomes, supporting the primary relationship we predicted. However, none of the two-way or three-way interactions were statistically significant.

SOSC 41 **Gender Differences in Verbal References and Referrals**

Julia Iacono

Mentor: Dr. Michelle Hebl

Previous research has found differences in the way men and women are perceived in the hiring scenarios. In this study, we examined how women and men are described in verbal recommendations. Specifically, how agentic and communal language is used in these recommendations. We gave 227 participants a set of application materials (resume, email request) in which the applicant gender and the gendered language the applicant used (agentic, communal) were manipulated. Participants then gave verbal recommendations for the applicants sequentially. We examined whether the content of the application (applicant gender and language) influenced the type of language that recommenders used. We predicted that 1) women would be described more communally than would men, with an increase in communal language in the second recommendation and 2) men would be described more agentically than women, with an increase in agentic language in the second recommendation. We found that women were described with a large amount of communal words even during the first recommendation when recommenders read resumes with gendered (agentic and communal) language included, but this was not found for male candidates.

SOSC 42 **He Said, She Said: Gender Differences in Experiences of Idea Dismissal and Stealing**

Lily Cao

Mentor: Dr. Michelle Hebl

This study focuses on gender differences in experiences of idea dismissal and idea stealing in team settings, specifically if and how women and men reintegrate themselves back into group conversations after their ideas are dismissed and attributed to another person. I created a conversation scenario between a participant, another ostensible participant (trained confederate), and moderator and incorporated distinct instances of the participant's idea being dismissed and then repeated later on. I investigated the relationship between the participant's gender (male or female), the idea dismisser/stealer's gender (male or female), and the dependent variables–participation and their reported affect. The preliminary results demonstrated that regardless of the confederate's gender, male participants were significantly more likely to defend their ideas and less likely to nod in response to dismissive comments compared to female participants. Additionally, although confederate gender and participant gender did not have significant main effects affect scores, participants with higher self-esteem reported significantly less negative affect after the conversation.

SOSC 43 **The Effects of Media Depictions of Race and Proximity to Community Gun Violence on Fear of Crime**

Lindsay Josephs

Mentor: Dr. Eden King

Research has shown that, although the US is in the midst of a gun violence epidemic, mass shootings are statistically quite rare ("Mass Violence in America," 2019). While Americans are fearful of becoming mass shooting victims, there is limited research on what factors have exacerbated this fear (Brenan, 2019; Langer, 2019). We manipulated current news tweets to explore whether Americans' fear of gun violence is related to race (white or Black shooter) and proximity (near or far). We had three hypotheses: 1) when a mass shooter is Black, people will report a greater fear of crime; 2) when mass shootings occur in closer proximity, people will report a greater fear of crime; and 3) when a shooter is Black and a shooting occurs in closer proximity, people will report a greater fear of crime. We distributed a survey to 117 Rice undergraduates with one of the four scenarios, a fear of crime inventory, a positive/negative affect inventory, measures of implicit and explicit racial bias, and demographic questions. Our MANOVA revealed that there was no evidence of a main effect of race and no evidence of an interaction; however, our analyses showed evidence of a main effect of proximity.

SOSC 44 **The Effects of Power Posing and Eye Gaze on Risk-Taking and Power**

Hannah Cho

Mentor: Dr. Sandra Parsons

Body position can influence the way we feel and induce certain psychological states. There is growing evidence in the scientific literature considering how body posture can lead to feelings of power and confidence. Current research has also studied how these findings can be extended into behavioral changes. This research would be useful in a variety of settings, however, recent attempts to replicate these findings have been unsuccessful. For our replication of Garrison's power pose study, we predict that body posture and eye gaze participants hold will have a significant effect on their psychological state and behavioral responses. Participants held either an expansive or contractive pose while gazing directly or indirectly at an image for 2 minutes. Following this, participants engaged in a gambling task to test risk-taking and self reported how powerful and in charge they felt. This work will help clarify the dispute between whether or not power posing is a useful practice for motivating and encouraging people to use power posing and eye gazing as a way to feel more powerful and confident.

SOSC 45 **Emotional Affect and Own-Race Bias: A Replication**

Audrey Kuykendall

Mentor: Dr. Sandra Parsons

In this study, we seek to identify the effect of emotion on own-race bias (ORB) in a population of college students. We investigate the hypothesis that induced positive emotions decrease ORB by examining the effect of induced emotions on facial processing in White individuals for same-race and cross-race faces. Participants

undergo emotional induction and are shown various faces. They later identify the faces they recognize from the initial viewing. Half of the faces are same-race and the other half cross-race to the participant. Positive emotions were found to decrease the effect of ORB, supporting the notion that facial processing is affected by emotional state, as well as the theory that own-race faces are processed more holistically than cross-race faces. These findings may be used to inform our understanding of race relations, and the factors which affect perceptions and interactions across racial groups.