Harrison Science Research Presents:

The 24th Annual

HARRISON HIGH SCHOOL
SCIENCE SYMPOSIUM







Thursday, June 4, 2026
6:30 PM - 9:00 PM
HHS Student Union

Scientific presentations of original research projects by Harrison High School Students

Order of Events

6:30-6:50 **Science Research Orientation for 9th Grade (& other 1st Year Parents)**

6:30-7:00 **Open House & Refreshments in the Student Union**

- Students & Parents are invited to informally visit posters.

7:00-7:45 **Poster Presentation Session in the Student Union**

- This session will include students from the Science Research program. Parents and other attendees will be asked to interview Symposium participants. In addition to allowing students to present their work, this will help them prepare for future science fairs.

7:45-9:00 **Program Honoring the Work of Our Students**

- **Montage**
- **Opening remarks** - Mr. Paul Frisch, Director of Science
- **Highlights of the HHS Program** - Allison Blunt & Mary Blount
- **Guest Presenter** - Keon Azar, Harrison SR Alum, Class of 2018
- **Student Presenter -** Emily Salemo
- **Student Reflection**
- **Senior Recognition**
- **Closing Remarks & Group Photo**

In the following pages of our Symposium Booklet you will find:

Senior Research Bio Pages, Abstracts, and Mini-Posters

Junior Abstracts

Sophomore Abstracts

Overview of the Program

The Harrison Science Research program invites all students to participate in authentic and original scientific research. It is designed to provide participants with an understanding of research methodologies in the natural and social sciences, with an emphasis on both laboratory and data-driven research. We encourage students to work with research scientists and professionals within their chosen area of interest so that they may develop a commitment to long-term focused research. Students may conduct independent research in mathematics, life science, physical science, psychology, or the social sciences and are required to use technology to organize research (presentation software and data management systems). Students maintain a portfolio of their work, which provides the basis for assessment. Students prepare to enter local, regional, national, and international scientific competitions. Students involved in the program demonstrate initiative, perseverance, and creativity, in an atmosphere where independent work habits are developed and fostered.

Acknowledgments

Our program could not sustain itself without the support received. We owe a special thanks to the following:

Board of Education

Kelly Kozak, *President*
Kelly Mulvoy Mangan, *Vice-President*
Benjamin Blaustein, *Trustee*
Jerome Valenti, *Trustee*
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Lisa Mulhall, Ed.D., *Assistant Superintendent for Curriculum & Instruction*
Brian Ladewig, Ed.D., *Assistant Superintendent for Human Resources*
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Paul Frisch, *Director of Science and Technology Education*

Building Administration:

Kimberly Beukema, *Principal*
Maria Pace, *Assistant Principal*
Lawrence Mastrota, *Assistant Principal*

Science Research Teachers

Allison Blunt
Mary Blount

Science Teacher Aide

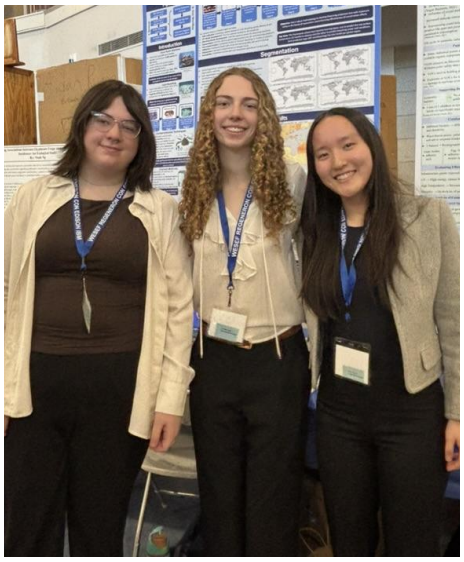
Helen Hluskho

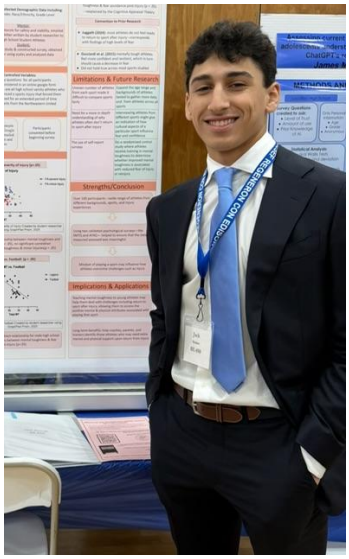
Internal Review Board Members

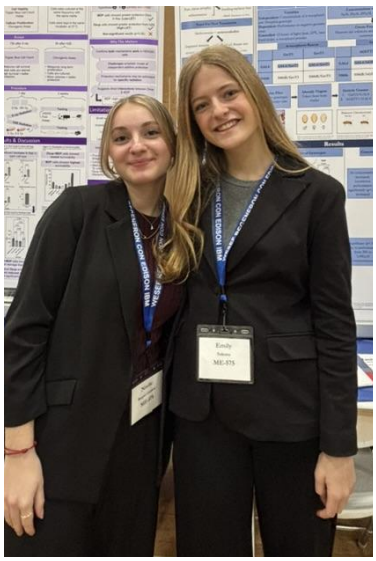
Dr. Christopher Tyler, Ph.D.
Ms. Stavroula Georgoulis
Dr. Brian Ladewig, Ed.D.
Mr. Paul Frisch
Ms. Kimberly Beukema

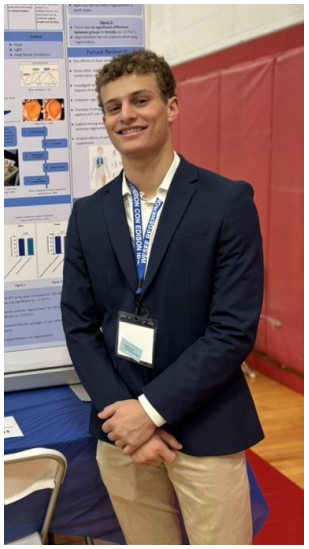
We would also like to thank the High School Faculty, Secretarial, and Custodial Staff for supporting our program throughout the year.

Science Research Seniors

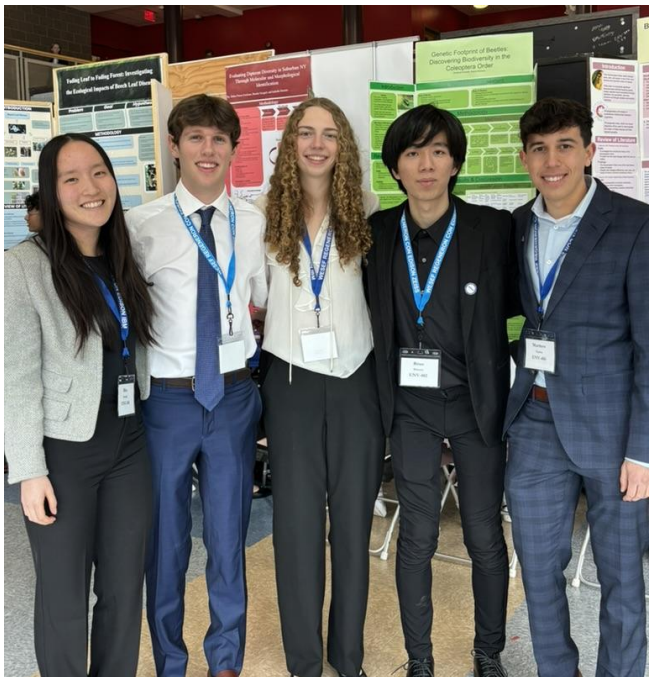




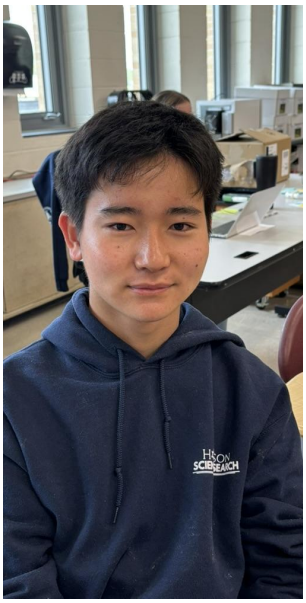




















Liam Azar

Adaptively Generating Novel Quantum Transforms Using QFT



Location of Research:
Northeastern University

Mentor:
Dr. Ning Bao

WIll be Attending:
Yale University

Intended Major:
Physics

Fairs & Awards:
WESEF 2026 - Participant
Regeneron STS 2026 - Applicant
NYSSEF 2025 - Honorable Mention
WESEF 2025 - 3rd Place Physics
JSHS 2025 - NY Upstate PowerPoint Finalist
Somers 2024 - 1st Place Physics
HHS Symposium - 2024, 2025, 2026

Quantum computers have the potential to solve problems that are not realistic to solve using classical supercomputers. However, designing novel quantum algorithms to leverage this capability of quantum computers is a current challenge. This is due to the small number of quantum primitives available for use. This study addresses this issue through the generation of novel quantum primitives by adapting the quantum Fourier transform (QFT). The recursive nature of the QFT is exploited in this pursuit, as this structure yields a guaranteed quantum speedup over classical algorithms. This paper proposes the creation of eight novel quantum primitives possessing this recursive structure. The numerical behavior of each primitive was inductively proven in comparison to the QFT unitary matrix. The behavior of each primitive under noise was calculated as well, which was measured using the state fidelity. To further interpret the usability of these primitives, depolarizing noise and phase-damping noise were tested using a noisy quantum simulator. The state fidelity was calculated as the size of the primitives increased and as the severity of the noise increased, determined by the noise parameter. Beyond expanding the opportunity for novel quantum algorithms to be developed, these primitives may enable the design of classical transforms as well, as quantum transforms can often be converted into classical counterparts. This supports the notion that these findings may facilitate both the advantageous uses of quantum computers in the future and the development of classical numerical processing in the present.

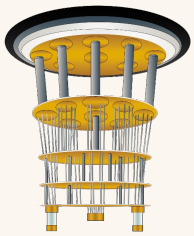
Adaptively Generating Novel Quantum Transforms using QFT

Liam Azar

Introduction

Computers that use quantum mechanics

More efficient problem solving

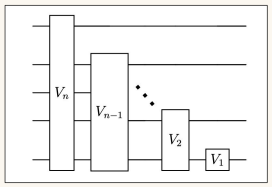


Handful available for use → **Subroutines**

Algorithms: Limited variability in function

Bottlenecked capability, limited potential → **Computers**

Recursion: fruitful structure of subroutines



Recursion yields guaranteed quantum speedup

Goal: Create novel quantum subroutines using recursion

Methodology & Results I

Subroutine Creation

Creation of quantum subroutines: Modifying the **Quantum Fourier Transform**

7 Major Operations

7 Novel Subroutines

Definition: **Inductive proof:** Technique used to prove statement is true for all positive integers

Purpose: Proves numerical difference between QFT and new subroutine

One-Qubit Gate Proofs:

Z-Gate Modification:

Base Case:

$$U_2 = \frac{1}{2}\begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & i & -1 & -i \\ 1 & -1 & 1 & -1 \\ 1 & -i & -1 & i \end{bmatrix}$$

$$U_2' = (Z_n)(U_2) = (-1)^{wt(j)}(U_2)$$

Inductive Hypothesis:

$$U_n' = (Z_n)(U_n) = (-1)^{wt(j)}(U_n)$$

Where:

$$U_n = (SWAP)(I \otimes H)(L_n)(U_{n-1} \otimes I)$$

Inductive step:

$$U'_{n+1} = (SWAP)(I \otimes Z)(I \otimes H)(L_n)(U_n' \otimes I)$$

$$U'_{n+1} = (SWAP)(I \otimes Z)(I \otimes H)(L_n)(Z^{\otimes n} \otimes I)(U_n \otimes I)$$

$$= (SWAP)(Z_n \otimes Z)(I_n \otimes H)(L_n)(U_n \otimes I)$$

$$= (Z_{n+1})(SWAP)\,(I_n \otimes H)(L_n)(U_n \otimes I)$$

$$U'_{n+1} = (Z_{n+1})(U_{n+1}) = (-1)^{wt(j)}(U_{n+1})$$

Methodology & Results II

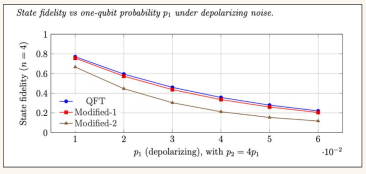
Subroutine Testing

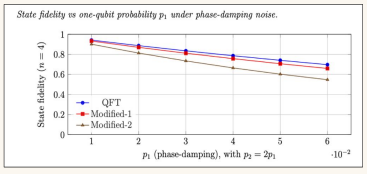
State Fidelity Analysis
Testing method that quantifies noise severity

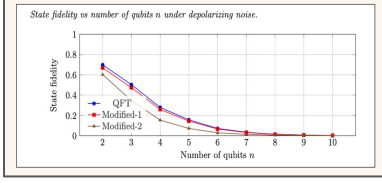
Independent Variables: Subroutine tested, severity of noise, type of noise, size of subroutine

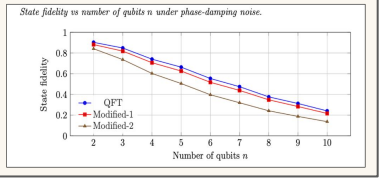
Developed custom & adaptable quantum simulator

❖ Permits modification of noise type and severity









Conclusion & Future Research

First known study to develop ansatz of subroutines

Guaranteed quantum advantage indicates applicability towards novel algorithms

First step towards harnessing the capabilities of quantum computers

Jack Badner

The Effect of Mental Toughness on
Athletes' Fear of Returning to Their Sport Post-Injury



Location of Research:
Harrison High School

Mentor:
Ms. Allison Blunt

WIll be Attending:
University of Pennsylvania

Intended Major:
Philosophy, Politics, and Economics

Fairs & Awards:
WESEF 2026 - Participant
Regeneron STS 2025 - Applicant
Somers Science Fair 2025 - 2nd Place in Behavioral Sciences
HHS Symposium - 2025, 2026

Approximately 2 million injuries occur each year amongst US student athletes who participate in competitive sports. Playing competitive sports has been shown to positively impact physical and emotional well-being and to teach improved communication, social and time-management skills. Sports related injury can result in a fear-avoidance cycle of pain and activity aversion. When student-athletes stop playing, they may experience a loss of identity, decreased physical fitness and symptoms of depression. Mental toughness is a personality trait that measures an individual's ability to maintain focus during times of adversity. By teaching young athletes how to improve their mental toughness, it may build resilience and make it easier to return to their sport following an injury. The purpose of this study was to determine how athletes' mental toughness affected their fear of returning to their sport after an injury. 108 student athletes aged 14 to 20 who reported experiencing a sports-related injury were surveyed using the Sports Mental Toughness Questionnaire (SMTQ) and the Athletic Fear Avoidance Questionnaire (AFAQ). Permission was received to use both measures. Notable results included that there was a significant indirect relationship for male high school football players between mental toughness and fear avoidance post-injury ($p < .05$), but the trend did not hold true for other similarly aged athletes. This could be explained by Cognitive Appraisal Theory where football players may see injury as a challenge associated with the game and an opportunity to prove their mental toughness which could make them less fearful and more ready to return to play post injury.

The Effect of Mental Toughness on Athletes' Fear of Returning to Their Sport Post-injury

Jack Badner

Introduction

Playing Competitive Sports=Positive

- Teaches improved communication, social & time-management skills.
- Injury=impacts ability to return to sport

Injured Athletes=Vulnerable

- More likely to develop depression and anxiety symptoms than their non-injured counterparts (Gouttebarge et al., 2015)



Mental Toughness: Measures an individual's ability to maintain focus during times of adversity

Mental Toughness=

Resilience | Optimism | Emotional Stability

Mental Toughness=

Fear of Reinjury | Self-doubt

Mental Toughness Can be Taught

Mindfulness-based practices help develop mental toughness by promoting cognitive defusion and present-moment awareness (Gardner & Moore, 2012)

Purpose: To determine the effect of mental toughness on athletes' fear of returning to their sport post-injury.

Methodology

Participants

- 108 student athletes who reported experiencing & recovering from a sports-related injury
- Ages 14 to 18 ; 74 males, 31 females
- Severely Injured=25

Male Athlete Sports

Football (M) 26	Baseball (M) 5	Hockey (M) 1	Basketball (M) 15
Lacrosse (M) 9	Rowing (M) 1	Rugby (M) 1	Soccer (M) 5
Volleyball (M) 1	Tennis (M) 6	Wrestling (M) 2	Track and Field (M) 2

Female Athlete Sports

Dance (F) 3	Gymnastics (F) 2	Basketball (F) 2	Lacrosse (F) 8
Soccer (F) 4	Ski (F) 1	Softball (F) 2	Squash (F) 1
Tennis (F) 5	Volleyball (F) 2	Track and Field (F) 1	

Survey Construction

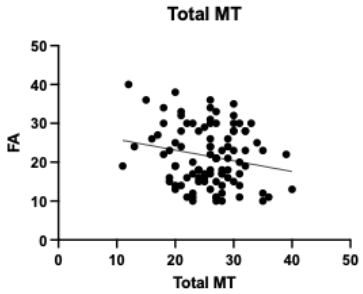
- Informed Consent
- Demographics
- SMTQ Survey
- AFAQ Survey

Procedure

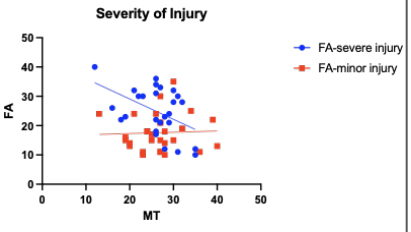
- IRB Approval
- Parental Consent
- Survey emailed to parents & participants
- Participants consent

Results & Analysis

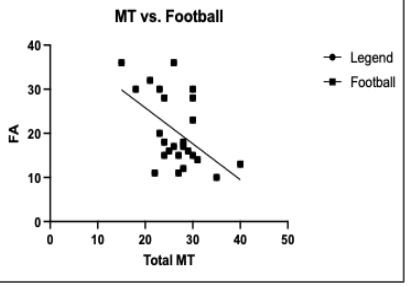
As total mental toughness increases, fear avoidance decreases



Significant relationship between mental toughness and severe injuries($p < .05$), no significant correlation between mental toughness & minor injuries($p > .05$)



Significant indirect relationship for male high school football players between mental toughness & fear avoidance post-injury ($p<.05$)



Conclusion & Future Research

Hypothesis = Partially Supported

- Significant indirect relationship for male high school football players between mental toughness & fear avoidance post-injury ($p < .05$), and for those with severe injuries ($p<.05$)

Mindset of playing a sport may influence how athletes overcome challenges such as injury, especially in football

Future Research

- Expand the age range and backgrounds of athletes tested to gather more data; and from athletes across all sports
- Do a randomized control study where athletes receive training in mental toughness to determine whether improved mental toughness is associated with reduced fear of injury or reinjury

Noélie Boquet Couderc

Determining if Radioprotection Can Be Enhanced Through the Use of *Deinococcus radiodurans* MDP and *Tardigrada* Dsup Protein: Implications for Space Exploration



Location of Research:
Weill Cornell Medicine

Mentors:
Dr. Sylvain Costes and Rafael Colon

Will be Attending:
California Institute of Technology (CalTech)

Intended Major:
Biophysics and Aerospace Engineering

Fairs & Awards:
NYSSEF 2026: 2nd Place BMED
WESEF 2026 - 2nd Place Medicine and Health
Regeneron STS 2026 - Scholar Top 300
ASGSR 2025 - Nominated for Presentation
Somers 2024 - 2nd Place Medicine and Health
HHS Symposium - 2024, 2025,2026

Ionizing radiation is the number one risk to astronaut health beyond low Earth orbit. This type of radiation, consisting of subatomic particles, X-rays, and gamma rays, can strip electrons from atoms, causing severe DNA damage, often leading to cancer. Some organisms, known as extremophiles, can survive substantial exposure to ionizing radiation. The *Tardigrada*, uses Dsup, its damage suppressor protein, to protect its DNA during stress. *Deinococcus radiodurans* protects its repair proteins against radiation using manganese-decapeptides (MDP). The purpose of this study was to determine if radioresistance can be enhanced using both Dsup and MDP, a multimodal therapy that protects both cellular repair proteins and DNA. It was hypothesized that cells expressing both Dsup and MDP would exhibit enhanced radioprotection, resulting in less DNA damage and higher survivability and proliferation. Cells expressing both Dsup and MDP, or Dsup or MDP alone, were irradiated at either 0 Gy or 100 Gy of X-ray radiation or 0.5 Gy of HZE radiation, and DNA damage, viability, and proliferation were assessed. Results showed that irradiated cells expressing either Dsup or MDP alone showed enhanced radioprotection, as previous studies found; however, when the proteins were combined, radioprotection was weaker than in control HEK293 cells, indicating there might be a negative interaction between the two. Subsequent research will use RNA sequencing and a cell cycle assay to measure expression levels and explore the interaction between Dsup and MDP.

Determining if Radioprotection Can Be Enhanced Through the Use of *Deinococcus radiodurans* MDP & *Tardigrada* Dsup Protein: Implications for Space Exploration

Introduction

Ionizing radiation is the **number one risk** to astronaut health beyond low Earth orbit

IR: particles, x-rays, and gamma rays with enough energy to ionize matter

2 Forms of IR that Damage & Kill Cells

Low-LET: x-rays and gamma rays with low mass and energy

Indirect damage through ROS

High-LET: high energy nuclei (**HZE**) with high mass and energy

Direct damage

Nature's Solution: Extremophiles

Tardigrada: survives over 4,000 Gy using Dsup



Deinococcus radiodurans: survives over 12,000 Gy using MDP



Dsup (Damage suppressor protein): Localizes to the nucleus & acts as a DNA shield

MDP (Mn^{2+}-Decapeptide): Scavenges ROS in cytosol to protect repair proteins

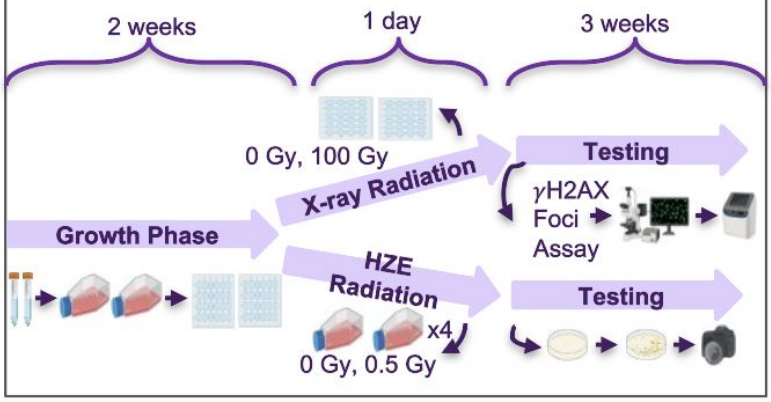
Purpose:
To develop a **multimodal radiation therapy** in human cells that protects both DNA & proteins (Dsup+MDP)

Methodology

Cell Types
HEK293, HEK293+Dsup, HEK293+MDP, HEK293+Dsup+MDP

Radiation Types
Low-LET: 100 Gy of X-ray
High-LET: 0.5 Gy of HZE

γH2AX Foci Assay	Trypan Blue Cell Count	Clonogenic Assay
• Indicator of DNA breaks • Low # of foci = better protection	• Measures cell survival • Higher survival = better protection	• Measures long-term proliferation • More colonies = better protection



Results & Analysis

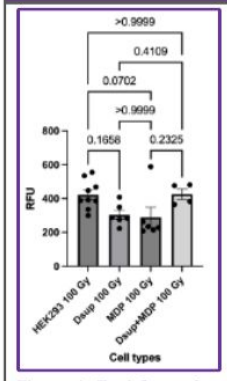


Figure 1: Foci Count for Radiated Cells

Individual **Dsup** and **MDP** cells showed **reduced damage** ($p>0.05$)

Dsup+MDP cells showed **more** DNA damage than control

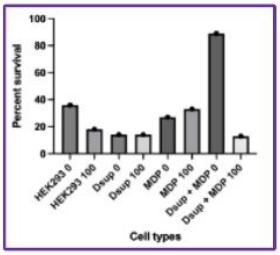


Figure 2: Visualization of Cell Survivability

Dsup cells showed **highest** proliferation

Dsup+MDP cells showed **lowest** proliferation

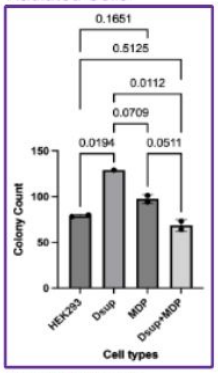


Figure 3: Colony Count Indicative of Cellular Proliferation

MDP cells showed **highest** survivability

Dsup+MDP cells showed **lowest** survivability

Individual proteins **showed protection at high doses** ✓

Dsup+MDP did not provide additive effect, but **destructive effect** ✗

Possible negative interference between Dsup and MDP in HEK293 ✗

Conclusion & Future Research

MDP cells showed greater protection from X-Ray (**Low-LET**) ($p>0.05$) ✓

Dsup cells showed greater protection from HZE (**High-LET**) ($p>0.05$) ✓

Confirms **both** mechanisms **work** in HEK293 cells

Challenges simplistic model of independent additive protection

Suggests direct **interactions** between Dsup & MDP

Protection mechanisms may be optimized for **specific radiation types**

Future Research

Cell cycle assay & RNA sequencing to understand Dsup-MDP interactions

In the lab

In the field

A combination of engineering cellular protection, pharmaceuticals, & physical shielding

Applications

Cancer patients



Medical personnel



Harper Canell

The Impact of Instruction Method on the Retention of Choreographic Movement and the Accuracy of Choreographic Execution In Beginner-Level High-School Dancers



Location of Research:
Harrison High School

Mentor:
Deborah Toteda & Catherine Johnson

WIll be Attending:
University of Texas at Austin

Intended Major:
Corporate Communication

Fairs & Awards:
WESEF 2026 - Participant
Regeneron STS 2025 - Applicant
WESEF 2025 - Participant
Somors 2024 - 2nd Place Medicine and Health
HHS Symposium - 2024, 2025, 2026

Dance education enhances both cognition and physical development, yet access to classes is often constrained due to geographical or socioeconomic factors. The use of technology, such as videos, serves as a potential opportunity for expanding accessibility, however, its effectiveness compared to in-person, traditional learning remains unclear. This study aimed to examine how instructional method impacts retention and accuracy of execution of beginner-level high school dancers. Twenty two participants, assigned to either in-person instruction (n=12), or video instruction (n=10) learned the same choreographic sequence. Performances were evaluated immediately and seven days after learning the choreography based on a standardized rubric developed for this study assessing retention (sequence and memory) and accuracy (timing and energy). Wilcoxon signed rank tests and Mann-Whitney U tests were used to compare results within and between groups. Dancers who received in person instruction performed significantly better than those who learned through video instruction in terms of retention ($p=0.0259$), accuracy ($p=0.0140$) and overall performance ($p=0.0142$). Individual performances suggested improvement over the one week period for the in person learners, while those who learned via video remained constant or decreased in retention, accuracy and performance. These findings indicate that in-person instruction provides greater long term retention and accuracy than video-instruction; likely due to the live feedback and interactivity. Video instruction, however, may serve as an effective supplemental tool to enhance accessibility. Introducing AI tools that provide interactive feedback may expand equitable access to dance education while maintaining effective learning outcomes.

The Impact of Instruction Method on the Retention of Choreographic Movement and the Accuracy of Choreographic Execution in Beginner-Level High-School Dancers

Harper Canell

Introduction

(Canva, 2026)

Benefits and Accessibility of Dance

Enhances **flexibility & learning** (Alpert, 2010), express **culture** (Yijun, 2025) , improve **cognition** (Giguere, 2011)

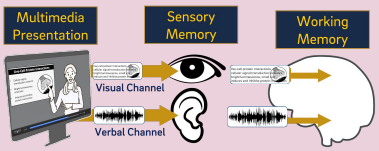
Lack of studios, **inability** to drive students, **$$**

Video=Potential Solution and the Use of TikTok

Technology → arts **more** accessible (Li and Qu, 2023)

TikTok: **Creativity** and **growth** in dance skills,(Canva, 2026) minimal feedback, rewatch video to "pick up" choreo

Cognitive Theory of Multimedia Learning



Better learning from repeated words and pictures than words alone

Video Instruction

Increased control
Pause, rewind, rewatch(Brame, 2016)
Consistency in performance
Less distractions & performance anxiety

Lacks direct feedback (Roy and McMahon, 2012)
Poor habit formation
Less sense of community (Willis, 2013)

Purpose: Examine how method of instruction impacts retention of choreography in beginner level dancers

Methodology

In Person	Video
Interactive → feedback	Stop & start →no feedback

30 minute instruction period & 10 minute performance period

Performances Videoed

7 days Later

In Person	Video

10 minute review period

Option for feedback	Lack of feedback

Performance Period (10 min)

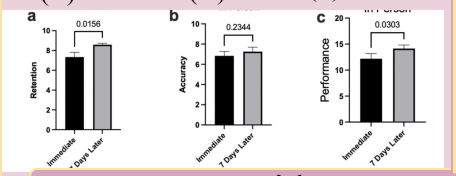
Performances videoed

Measuring accuracy, retention, and overall performance

Results & Analysis

In Person Instruction

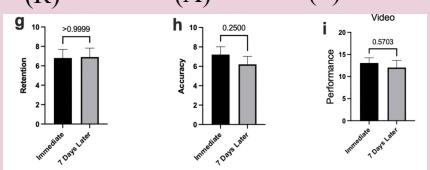
Retention (R) Accuracy (A) Performance (P)



R, A & P improve → choreography remembered (significant: 1a,1c) ($p<0.05$)

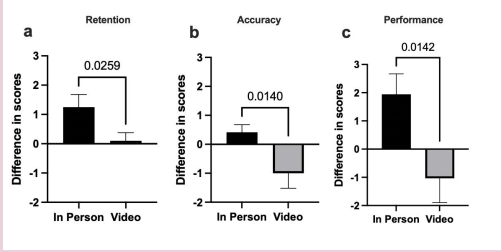
Video Instruction

Retention (R) Accuracy (A) Performance (P)



Scores decreased for R, A & P, → but were not significant ($p>0.05$)

Comparison of In Person and Video



Significant difference in Scores for R, A, P within In-Person & Video Groups ($p<0.05$)

Conclusion & Future Research

Findings: In-person instruction= significantly higher scores than video instruction in terms of R, A & P

However: Still problem= lack of accessibility in dance education

(Made in Canva, 2026)



Video instruction increases access → may not replicate the benefits of in-person instruction

Increased control, greater freedom, self directed

Future Research

- Greater demographics from more locations
- Conduct follow up interview of dancers opinions
- **AI tools for real-time feedback**

Just Dance → motion based dance video game
Avatar **shows** movement, students **copy** (Quennerstedt et al., 2016)
Tracks movement through motion controllers, **offers feedback**, **consistent** with **CTML** → visual and auditory channels

Matthew Carrea

Extracting and Repurposing Textiles for Oil Paints



Location of Research:
Harrison High School

Mentor:
Dr. Julian Silverman
Fashion Institute of Technology

Will be Attending:
Syracuse University

Intended Major:
Architecture

Fairs & Awards:
WESEF 2026 -1st Place**,** Environmental Science
Regeneron STS 2026 - Applicant
WESEF 2025 -BASF Expanding Knowledge in Science Award, Environmental Science
Somers Science Fair 2024 - 1st Place, Chemistry
HHS Symposium - 2024, 2025, 2026

"Fast Fashion" is a response to rapidly evolving fashion trends, resulting in an impulsive disregard for textiles. Globally, as of 2023, the Fast Fashion industry produces approximately 1.92 billion tonnes of fabric each year. It is expected that waste will be doubled by 2030, leading to the crowding of non-biodegradable clothing in landfills, polluting the planet, and depleting habitats for animals (Igini, 2023). The purpose of this study, building on prior work, was to establish that sodium hydrosulfite was the most effective chemical agent at extracting textile dyes. This study also establishes the optimal methodology for isolating pigment particles and repurposing them for application in oil-based paints. Samples of 5cm by 5cm denim blue jeans were tested with and without heat (450℃ hot plate) under varying concentrations of sodium hydrosulfite. Spectrophotometry showed that sodium hydrosulfite at 0.1M on a 450℃ was closest to the standard curve of Royal Blue RIT dye, with an absorption of 0.96-0.97AU. When filtered, the swatch matched with hue 5PB at approximately hue 5BP 3/4, and when mixed with oil in an oil-based paint, matched between Hue 5PB 6/4 and Hue 5PB 7/4. Industries may find dyes extracted from used textiles to be useful, as they may serve as an alternative dye as opposed to manufacturing new ones, saving resources and bringing the volume of landfills down.

Extracting and Repurposing Textile Dyes for Oil Paints

Introduction

Traditional Oil Paints are Toxic

Oil Paints - artist's medium made from powder pigments mixed with a binder (linseed oil)

Traditional Oil Paints are Toxic

Traces of lead, arsenic, and mercury; **need** for a **safer alternative** to toxic oil paints for artists

Fast Fashion → Textile Waste

1.92 billion tons of fabric produced each year (earth.org, 2023)

Fashion trends → excess fabric waste in landfills



Repurposing

- ➢ Reuse of products
- ➢ Decrease waste
- ➢ Limit waste entering environment

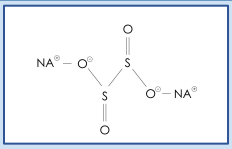
Use textiles for oil paints

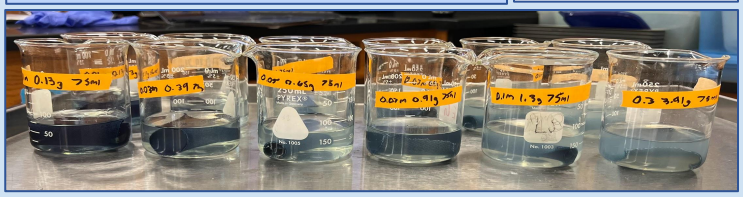
Methodology

Samples used: (Denim 100% cotton 5x5 samples)

Reducing Agent: sodium hydrosulfite

Added to 75 mL of distilled water

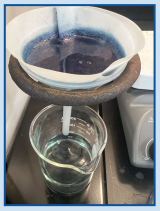




Mordant solution created using equal parts 200mL distilled water and 200 mL white vinegar

1 to 1 ratio of mordant to dye solution left for 5 minutes





Contents dried on filter paper

Dried powder was scraped using scoopula and collected

Results & Analysis

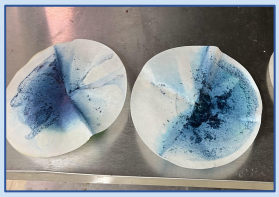
Heat Extraction = Higher Dye Yield

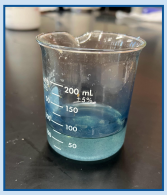
- ➢ With heat: greater overall extracted dye concentration evident
- ➢ Without heat: greater proportion of absorbance variance

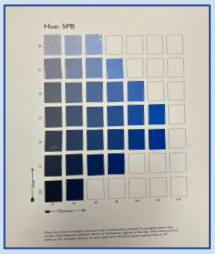
Aluminum Mordant:

- Colorless; does not absorb visible light → enabled clearer dye precipitation
- 1 : 1 was best at precipitating dye



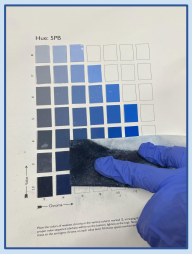






Munsell Color Matching (color identification)

Hue 5PB



Conclusion & Future Research

0.1 M SH

\+ heat = greatest yield

Vibrant Color

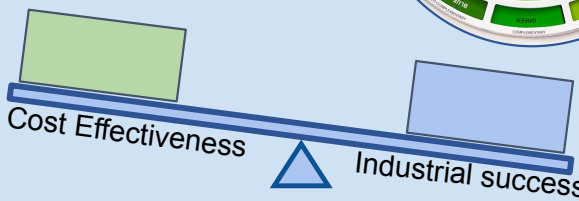
Textile dyes do have the potential to be repurposed into vibrant oil-based paints

Universal Method Needed

Color Theory on Patterns

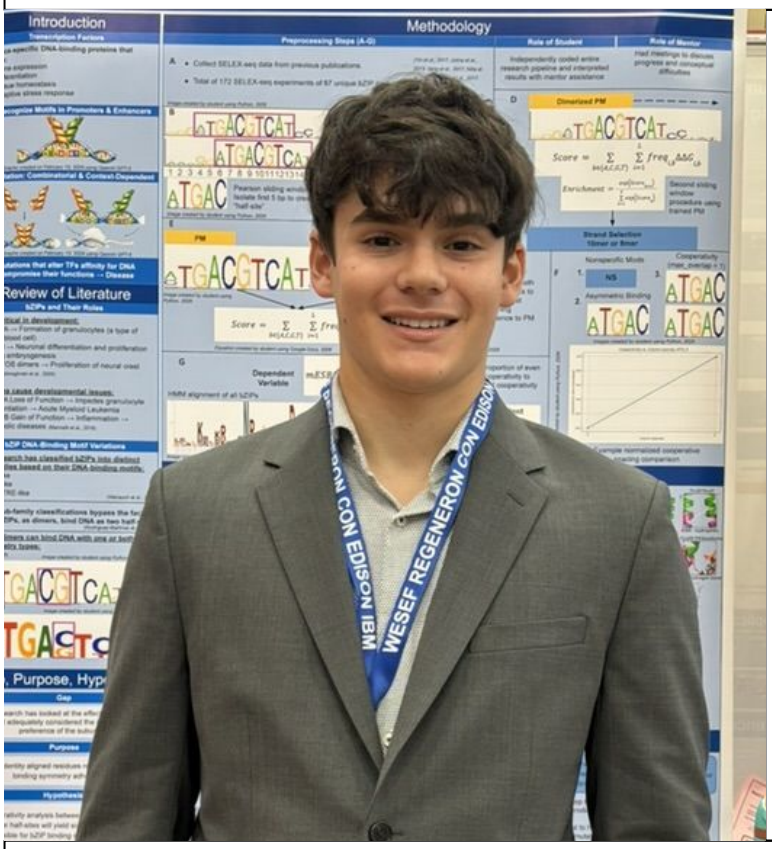






Chase Ende

Decoding Specificity Determinants of bZIP–DNA Binding
Via Half-site Identification and Cooperativity Modeling



Location of Research:
Columbia University

Mentor:
Professor Harmen Bussemaker

Will be Attending:
University of Miami

Intended Major:
Applied Physics

Fairs & Awards:
WESEF 2026 - 3rd Place, Bioinformatics
Regeneron STS 2026 - Applicant
Regeneron ISEF - Finalist
National STEM Festival - Champion
NYSSEF 2025 - 1st Place, Bioinformatics
WESEF 2025 - 2nd Place, Bioinformatics
WESEF 2024 - 2nd Place, Bioinformatics
Somers 2024 - 2nd Place, Computer Science
HHS Symposium - 2024, 2025, 2026

Basic leucine zipper (bZIP) transcription factors (TFs) are key regulators of diverse biological processes and bind DNA through dimeric motifs that vary in length and symmetry. Despite decades of study, the lack of a unified metric for describing bZIP–DNA recognition has limited understanding of how sequence variation determines binding specificity. In this study, 172 SELEX-seq datasets covering 67 unique bZIP homodimers from multiple species were systematically analyzed using ProBound, a biophysically interpretable machine-learning framework. It was found that bZIP binding motifs can be categorized into three symmetry types: even, odd, and asymmetric, where each can be described by a 5-mer half-site and a cooperativity profile. While this symmetry principle has been qualitatively noted before, its quantitative determinants have remained unclear. To address this, a probability-matrix approach was developed to identify 5-mer half-sites from naive SELEX-derived motifs, and cooperativity modeling was performed to quantify each TF's preference for even versus odd symmetry. Finally, family-level association analysis of 67 aligned bZIP sequences revealed key amino-acid residues that govern half-site specificity and symmetry adherence. Together, the results of this study provide the first quantitative framework for mapping sequence-to-symmetry relationships across the bZIP family, and were able to improve prediction accuracies for bZIP DNA-binding profiles.

Decoding Specificity Determinants of bZIP–DNA Binding via Half-Site Identification and Cooperativity Modeling

Introduction

- bZIPs are transcription factors, which are sequence-specific DNA-binding proteins.
- They regulate gene expression, differentiation, tissue homeostasis, and adaptive stress response.



Even



Odd

Gap

Past research has looked at the effector domain and has not adequately considered the individual base preference of the subunits.

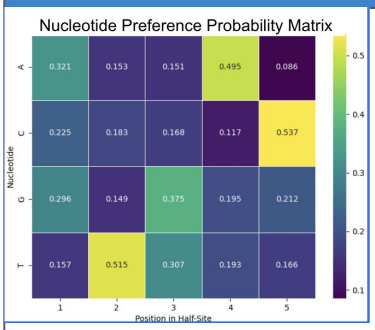
Purpose

To identity aligned residues responsible for binding symmetry adherence.

Hypothesis

A cooperativity analysis between the two homodimer 5mer half-sites will yield significant residues responsible for bZIP binding symmetry adherence.

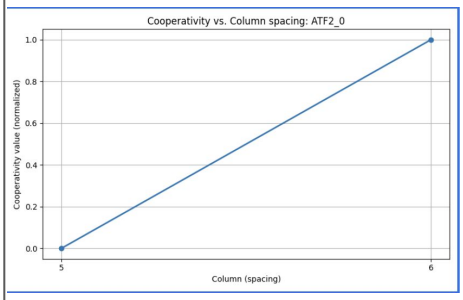
Methodology



Created Probability Matrix (PM) to systematically represent all possible bZIP half-site sequences in the dataset.

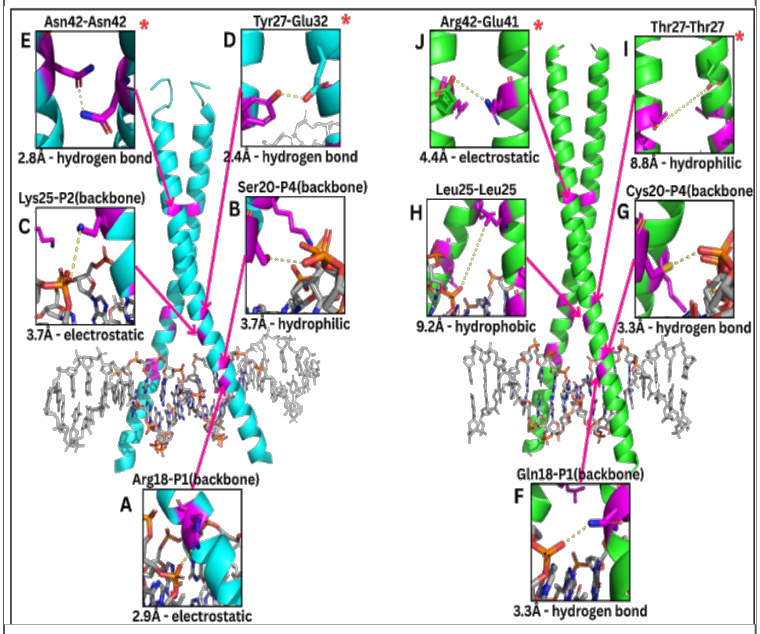


PM allows for refinement of half-site motifs in the dataset.



Refined half-site sequences used for a cooperativity fit to quantify how much the binding at one half-site increases binding at the other (encoding homodimeric binding).

Results & Analysis



Multiple ANOVA tests isolated positions with p-values greater than a Bonferroni Correction. Among these positions, position 25 and 42 had the greatest p-values and are likely responsible for symmetry adherence.

Conclusion & Future Research

Conclusion

A cooperativity analysis between two 5mer half-sites in bZIP-DNA binding yielded significant residues responsible for binding symmetry adherence.

This is the first step towards a unified model of homodimer and heterodimer DNA-binding preference.

Has the potential to help scientists better understand the impact of bZIP mutations on the progression of various developmental disorders.

Future Research

1. Apply the same pipeline to study cooperativity in bZIP heterodimers
2. Develop more accurate “Closest Homolog” prediction pipelines using p-value weights derived from this analysis.

Juliana Greco

The Impact of Coaching Styles on Athlete Burnout and Dropout in High School Sports



Location of Research:
Harrison High School

Mentor:
Dr. Luke Olsson

Will be Attending:
Indiana University

Intended Major:
Sports Marketing and Management

Fairs & Awards:
Somers 2025 - Participant
HHS Symposium - 2025

In high school sports, stress, pressure, and lack of motivation are all linked to two increasing concerns: burnout and dropout. The self-determination theory is a psychological theory that states people are more motivated and perform better when they are autonomous, supported, and part of groups. Because coaches strongly influence team culture and environment, coaching styles can influence whether athletes feel motivated or overwhelmed. This study investigates the relationship between perceived coaching style, level of burnout, and dropout risk in high school varsity athletes. A survey was taken by 32 high school athletes, male and female, ages 15 to 18. Participants responded to statements using a 1-10 Likert scale measuring burnout and how students perceive coaching behaviors. Additional questions assessed whether athletes had quit or considered quitting their sport and their likelihood of continuing participation. Results showed a moderate positive correlation between controlling coaching and burnout ($r = 0.496$, $R^2 = 0.246$) and a moderate negative correlation between autonomy-supportive coaching and burnout ($r = -0.578$, $R^2 = 0.334$). Athletes who quit or considered quitting had a higher average burnout score than those who did not (5.8 vs. 3.5), but this difference was not statistically significant ($p = 0.121$). Findings suggest that coaching style may play a role in athlete burnout and dropout risk. These results highlight the importance of coaching approaches that prioritize athlete well-being, motivation, and personal development. Future research could expand the sample size or track athletes over time to further examine long-term effects of coaching style on sports participation.

The Impact of Coaching Styles on Athlete Burnout and Dropout in High School Sports

Introduction

- Youth sports play an important role in adolescent development
- The coach-athlete relationship strongly influences motivation and mental well-being
- Burnout in athletes includes emotional exhaustion, reduced motivation, and sport withdrawal

GAP: There is limited research on how coaching styles affect burnout and dropout in high school athletes.
PURPOSE: This study examines the relationship between perceived coaching style and athlete burnout and dropout.



(Buzby, 2018)



Davis (2021)

Hypothesis:
Autonomy-Supportive coaching → lower burnout & dropout

Controlling coaching → higher burnout & dropout

Methodology

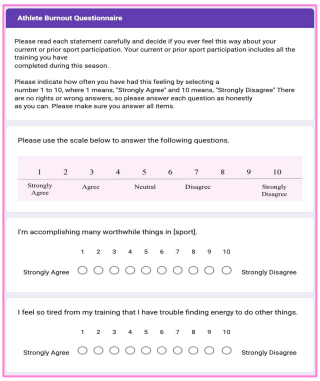
👥Participants
- 32 athletes (14-18)
- Varsity & JV
- All genders

🧪Study Design
- Survey-based
- Correlational

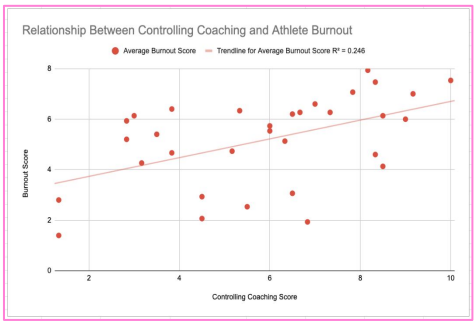
🧰 Materials
- Online survey
- Coaching behavior scale
- Burnout questionnaire

Independent Variable: Coaching Style
Dependent Variables: Burnout level, Dropout history/consideration
Control Variables: age, gender, training hours, school

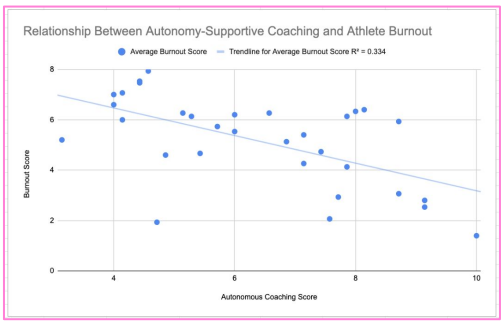
📊Procedure
Recruit participants
→ IRB approval
→ Obtain consent
→ Complete online survey
→ Analyze responses



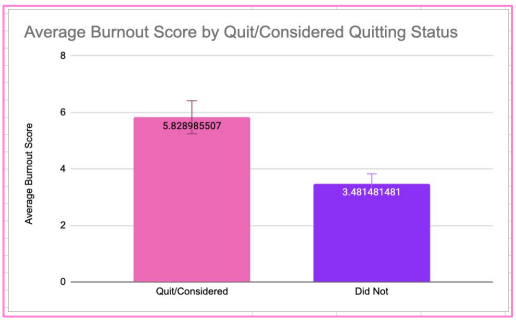
Results & Analysis



Moderate positive correlation between controlling coaching and burnout
($r = 0.496$, $R^2 = 0.246$)



Moderate negative correlation between autonomy-supportive coaching and burnout
($r = -0.578$, $R^2 = 0.334$)



Athletes who quit/considered quitting had a higher average burnout score (5.8 vs. 3.5). This difference was not statistically significant ($p = 0.121$)

Conclusion & Future Research

Hypothesis partially supported:
Coaching style may impact burnout and dropout rates
- Athletes who perceived their coaches as more controlling reported higher burnout while athletes who perceived their coaches as autonomy-supportive reported lower burnout.
- Athletes who quit or considered quitting showed a higher average burnout but this difference was not statistically significant.

Future research could include athletes from more schools to increase the sample size. Also, a longitudinal study over multiple sports seasons. Additional studies could focus more on how academics, playing time, and coach education programs affect athlete burnout and motivation.

Tommy Hazelton

The Extent to which Sensory Filtertering by Astrocytes Impacts Cognitive Flexibility



Location of Research:
Harrison High School

Mentor:
Ms. Allison Blunt/Ms.Mary Blount

WIll be Attending:
Villanova University

Intended Major:
Comprehensive Science

Fairs & Awards:
Somers Science Fair: Participant
HHS Symposium 2025, 2026

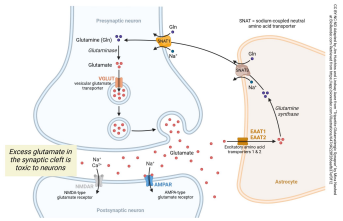
Cognitive flexibility is defined as the ability to switch between thinking about two different concepts or to think about multiple concepts simultaneously. Astrocytes are the most abundant glial cells in the cerebral cortex of the brain, and are responsible for clearing the synapse of neurotransmitters to prevent overstimulation. Glutamate is a key excitatory neurotransmitter, which plays a major role in facilitating cognitive functions. Glutamate is removed from synapses between neurons by sodium coupled neutral acid transporters (SNAT) to prevent neuronal overstimulation by measuring the electrical gradient created by sodium ions. When a neuron becomes overstimulated, it prevents signals from being propagated along the next neuron which inhibits cognitive flexibility. The purpose of this study was to induce sensory overstimulation in adolescents to determine whether it influences cognitive flexibility which could be influenced by astrocyte functions. It was hypothesized that playing continuous repetitive noise at 85 decibels will interfere with the ability for participants to accurately complete the Stroop Color and Word Test. 10 adolescents took an adapted version of the Stroop Color and Word Test to find a baseline for their cognitive flexibility. They were then exposed to a loud continuous noise at 85 db to cause overstimulation and asked to take the Stroop Color and Word Test again to determine if cognitive flexibility decreased. The hypothesis was not supported as there was no significant change in the amount of time it took the participants to complete the test after overstimulation or in the accuracy with which they performed the task. Interestingly, accuracy actually slightly increased indicating that the noise might have improved concentration in the participants rather than distracted them. More research is needed to determine what types of overstimulation affect cognitive flexibility.

The Extent to which Sensory Filtertering by Astrocytes Impacts Cognitive Flexibility

By: Tommy Hazelton

Introduction

Astrocytes Overwhelmed = Sensory Overstimulation



Astrocytes → Glial cells responsible for clearing synapses of neurotransmitters

Glutamate → most abundant excitatory neurotransmitter in the brain.

Excess Glutamate = ⬇ Cognitive Flexibility

Cognitive Flexibility
The ability to switch between different concepts or to adapt behaviors n response to changing, unexpected situations. Measured using Stroop Color & Word Test

Stoop Color & Word Test

Green	Red	Red
Green	Yellow	Green
Yellow	Blue	Blue
Blue	Green	Red
Yellow	Green	Green
Blue	Blue	Yellow
Green	Red	Blue

Purpose: To induce sensory overstimulation in adolescents to determine whether it influences cognitive flexibility which could be influenced by astrocyte functions.

Hypothesis: Playing continuous repetitive noise at 85 decibels will interfere with the ability for participants to accurately complete the Stroop Color and Word Test.

Methodology

Participants
N = 10
Gender: 9 Females, 1 Male
Ages: 15-17

Experimental Group::
Playing loud continuous noise at 85 dB

Control Group: No noise

Procedures

IRB Approval and Parental & Participant Consent Obtained

⬇

Demographic Information Collected Via Survey

⬇

Baseline Cognition Established
Participants completed an Adapted Version of Stroop Color and Word Test created in Scratch

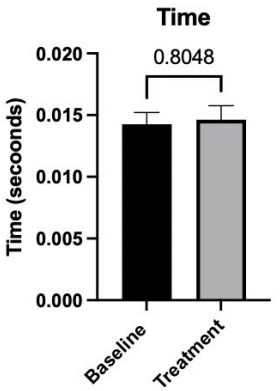
⬇

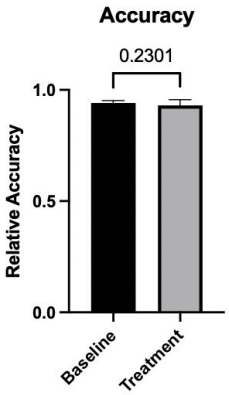
Sensory Overstimulation Induced
Participants exposed to loud continuous noise at 85 dB, then after 90 seconds bagan taking the Stroop Color and Word Test Again

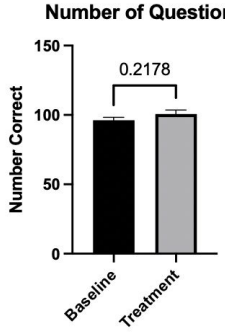
⬇

Measured
Accuracy & Time to Complete Test

Results & Analysis







Unexpected Results:
After overstimulation:

- Time to complete Stroop Color & Word increased slightly ($p>.05$)
- Accuracy increased but not significantly ($p>.05$)
- Number of Questions Completed increased but not significantly ($p<.05$)

Conclusion

Hypothesis = Somewhat Supported

✓ Participants took longer to complete the test after overstimulation

✖ Accuracy of the participants increased after overstimulation

Consistent noise may have masked external distractions and reduced internal chatter

Limitations & Future Research

Jafari et al. (2019) found that loud continuous noise had to be played at 95dB to decrease attention span

⬇

Play noise at higher decibels (95 dB) to cause overstimulation

Implications

Studying astrocytes impact on cognition → New understandings for ADHD treatment can be created

Mizuki Horiuchi

The Epigenetic Effects of Iron Supplementation on the F1 Generation of *Drosophila melanogaster* with the Malvolio Gene over the P1 Generation



Location of Research:
Harrison High School

Mentor:
Ms. Allison Blunt, Ms. Mary Blount

WIll be Attending:
Pace University

Intended Major:
Biochemistry

Fairs & Awards:
WESEF 2026: Participant
Somers 2024: Participant
HHS Symposium 2025, 2026

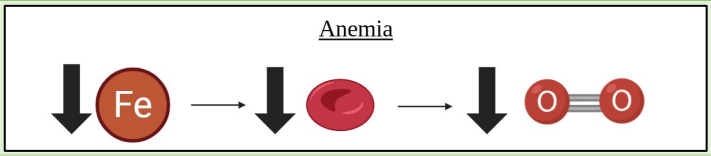
Currently there are over 2 billion people suffering from iron deficiency anemia with about 1.4 billion cases being women and children. Iron deficiency anemia is a common disorder where the body does not receive enough iron for the body to create hemoglobin within the blood. This causes symptoms such as headaches, dizziness, and fatigue. In humans, the gene SLC11A2, is associated with anemia because the SLC11A2 creates the protein divalent metal transporter 1 (DMT1) which allows for the transport of the positively charged iron ions. The *Drosophila melanogaster* with the Malvolio(Mvl) gene is a good model for anemia in humans due to the Mvl gene coding for DMT1's, similar to the human version of the gene SLC11A2. Wu (2022) found that the Mvl mutant experiences iron deficiency and iron supplementation mitigates the effects of the deficiency. However, it is unclear if supplementation in the P1 generation can benefit the F1 generation with a similar genetic makeup. Therefore the purpose was to determine whether iron supplementation in the P1 generation of the *Drosophila melanogaster* with the Mvl gene will rescue the effects of iron deficiency in the F1 generation. The hypothesis was that if the P1 of *Drosophila melanogaster* with the knockdown of the Mvl gene is supplemented with 1 mg/L of FeSO4, then the P1 generation will perform better in the negative geotaxis assay. Iron supplementation of 1 mg/L was mixed with homemade cornmeal food using the BDSC recipe and was administered to the *Drosophila melanogaster.* Iron deficiency can lead to lethargy and decreased locomotor ability. A negative geotaxis assay was conducted to measure changes in locomotor ability on days 2,3,4 of life. Results showed iron supplementation in the P1 generation significantly improved locomotor ability of the F1 generation in the Mvl knockdowns ($p<.01$). However when wild type flies were fed iron, they did worse showing there needs to be a genetic predisposition for iron supplementation to have a positive epigenetic effect.

The Epigenetic Effects of Iron Supplementation on the F1 Generation of *Drosophila melanogaster* with the Malvolio Gene over the P1 Generation

Mizuki Horiuchi

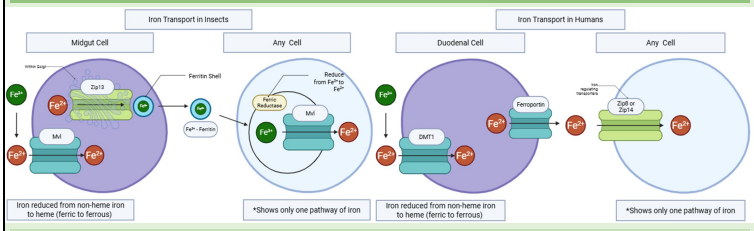
Introduction

Iron Deficiency Anemia = Major World Health Issue



Malvolio(Mvl) = a divalent metal transporter **(DMT1)** which ferrous iron is transferred through
→ homologous to SLC11A2 in humans (metal transporter)

Humans and insects have similar methods of iron transport



Mvl experienced iron deficient(ID) phenotype but restored by iron supplementation → unclear if the supplementation lasts into future generations (Wu et al. 2022)

Purpose: Determine whether FeSO4 supplementation in P1 affects healthspan of F1 generation in Mvl mutants

Methodology

Model Organism: *Drosophila melanogaster*
→ WT, Gal4, Mvl

IV: FeSO4

DV: Locomotor function

Control: 22℃, 12hr Light/Dark

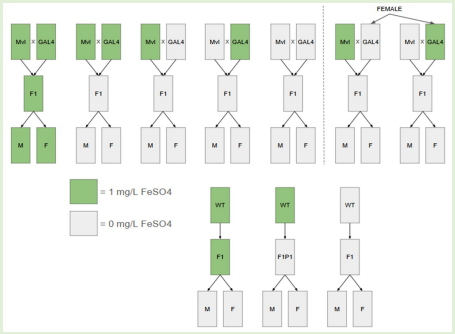
Mvl x Everywhere Gal4/TM3



50% of the offspring should have the desired phenotype

Stubble removed

Procedure:



Performance Assay: Negative Geotaxis

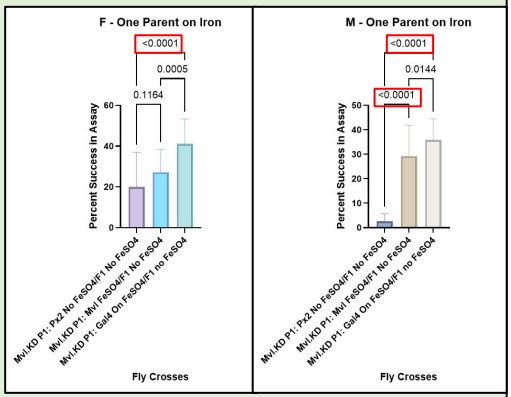


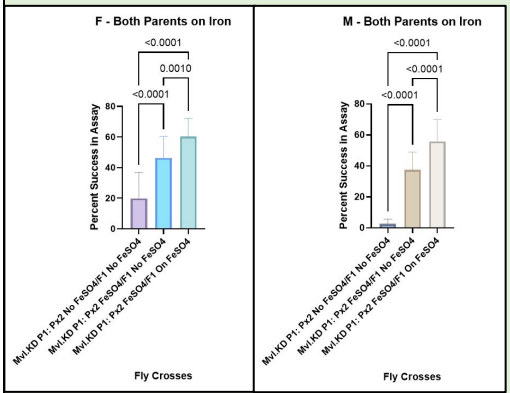
Setting up crosses and layout flies

Locomotor function = Healthspan

Results & Analysis

Even with **only one parent on iron**, the F1 trended to **perform better**





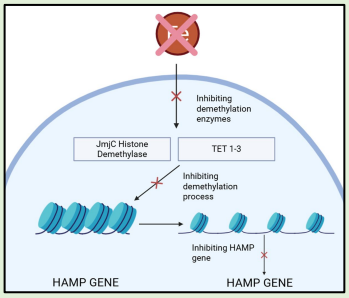
In both F & M, F1 **performed significantly better regardless of whether F1 was on iron** than P1 not fed iron ($p<0.0001$)

Conclusion & Future Research

Hypothesis was supported: flies with Mvl knockdown which were fed iron supplements improved

Epigenetics: Environmental effects can cause changes within gene expression
→Some epigenetic mechanisms can be passed down to the next generation

Suggested Method: JmjC Pathway May Have Been Used



Farida et al. 2023
Iron supplementation demethylates enzymes→

JmjC Histone Demethylase

→encourage HAMP gene

By providing supplementation, improve quality of life within F1 → health and locomotor movement improve

Future Research: Study multiple generations (>F1) and use method molecular sequencing approaches (quantitative RT-PCR)

Stella Johansson

The Extent to Which Acidification Affects the Growth of *Heterocapsa steinii*, and if Elevated Temperature Exacerbates This Effect



Location of Research:
Harrison High School

Mentor:
Dr. Nicole Millette

WIll be Attending:
College of William and Mary

Intended Major:
Economics

Fairs & Awards:
WESEF 2026 - Teatown Young Environmentalist Award
Somers 2025 - 3rd Place Environmental Science
HHS Symposium - 2025, 2026

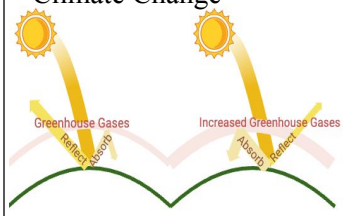
Excess carbon dioxide (CO2) from human activities may be affecting the adaptive capabilities of ocean organisms. Heat trapped by excess greenhouse gases in the atmosphere is being absorbed by the ocean. At the same time, as the ocean absorbs atmospheric CO2 the water becomes more acidic. Scientists have studied the effects of climate change and ocean acidification separately, but few known studies have examined the combined effects. *Heterocapsa steinii* is a type of dinoflagellate that thrives in cooler and more alkaline conditions, so they may be especially affected; they are a keystone species, so changes in their behavior serves as warnings for other species. This study aimed to determine the extent to which the combined stressors of ocean warming and acidification reduce *Heterocapsa steiniis*' growth rates compared to individual stressors. Adaptive capacity is important because if this dinoflagellate cannot adapt to changing ocean conditions, they likely will not survive. *Heterocapsa steinii* was received from VIMS and starter cultures were grown to 1,000 cells/mL using m1v1=m2v2. Four treatments were studied: control, warming only, acidification only, and combined stressors. pH was adjusted by 0.2 units every 3 days using .01M HCl. A Sedgewick-Rafter counting chamber was used to measure cell counts/mL. Results indicate that temperature significantly reduced their growth rate, whereas acidification had no significant effect, even when combined with temperature. Altering human behavior to decrease greenhouse gas concentrations in the atmosphere may be crucial to protecting our ocean ecosystems.

The Extent to Which Acidification Affects the Growth of *Heterocapsa steinii*, and if Elevated Temperature Exacerbates This Effect

Stella Johansson

Introduction

Climate Change



Ocean Warming

Ocean Acidification

Harmful

Heterocapsa stenii = unicellular, microscopic algae

Crucial: base of food web & photosynthetic

Adapt to slight temperature increases → too much = adaptive capacity breaks down (Sautery et al., 2023)

Low pH → harms photosynthesis and growth (Dason and Colman, 2004)

Range of pCO2 → no significant growth rate changes (Eberlein et al., 2013)

Gap: Conflicting evidence & unknown combined stressor interaction

Purpose: Determine whether higher temperature strengthens the pH effect by comparing single-stressor vs combined-stressor treatments

Methodology

	Control Temp	Elevated Temp
Control pH	18°C and pH 8.1	22°C and pH 8.1
Lowered pH	18°C and pH 7.6	22°C and pH 7.6

Creating Initial Solution (1500mL DI water + 40.5g Instant Sea Salt)



Separate

Growing Cultures

Pour in *H. steinii*

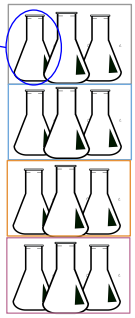


Once at 20,000 cells/mL (≈2 months)

Each flask on day 1: 237.5 mL of 20ppt DI water + 12.5 mL of culture → 1,000 cells/mL



Treatments



Control

Lowered pH

Elevated temperature

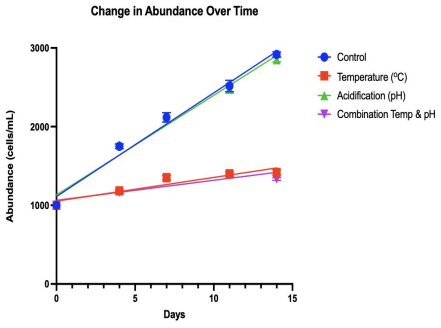
Combination

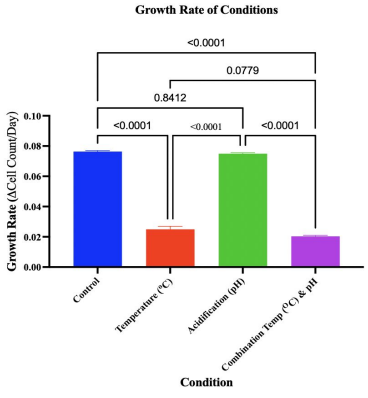
Changing pH
Adjusted by 0.2 every three to four days (8.1 to 7.6) → 0.01M HCl lower pH & 0.01M NaOH raise pH

Results & Analysis

Changes in Abundance Over Time

- No significant slope difference between warming & combo and control & acidification ($p > 0.05$)





Growth Rate of Conditions

- Insignificant growth rate difference when acidification is involved
- Temperature significantly reduces growth rate

Graphs created by student researcher using GraphPad Prism version 10.6.1, 2025

Conclusion & Future Research

- **Acidification resilience**: *H. steinii* can maintain growth under lower pH, even when combined with high temp
  - Gradual decrease, strong internal pH regulation, flexible carbon acquisition
  - May vary by species
  - Interaction effect weak/absent

Climate Change = still impact dinoflagellate populations → **warming** and not acidification

Winter production + nutrient cycling → less seasonal primary productivity, **altering nutrient dynamics** in temperate estuaries

Species composition may shift, **increasing ecosystem vulnerability**

Future: CO2 bubbler, explore more species

Beverly Kang

Constraining Saturn's Internal Oscillations:
Linking Cassini C-Ring Observations to Interior Models of Saturn



Location of Research:
University of Massachusetts Amherst (virtual)

Mentor:
Dr. Janosz Dewberry

WIll be Attending:
Columbia University

Intended Major:
Earth and Planetary Sciences

Fairs & Awards:
WESEF 2026 - IBM Ingenuity in Research Award
STS 2025 - Applicant
WESEF 2025 - 2nd Place Earth and Planetary Sciences
WESEF 2025 - Association for Women Geoscientists SAGE Award
Somers Science Fair 2024 - 1st Place Earth and Planetary Sciences
HHS Symposium - 2024, 2025, 2026

Saturn's C-ring contains spiral wave patterns that are generated through Saturn's internal oscillations and subsequent gravitational potential perturbations. However, the fundamental problem with using Saturn's rings as a seismograph is that the detected waves can be explained by many different planetary vibrations. By merging data collected by the Cassini satellite with fluid dynamic solutions of Saturn's oscillations, I identified internal oscillations with amplitudes so large that they would break. These large amplitudes would render some vibrations a poor explanation for the waves in the rings, in turn helping to address the degenerate problem of identifying which vibrations in Saturn excite the waves in its rings. This new criterion for rejecting oscillation modes can be used to improve the detection of g-modes and evaluate their implications for stable stratification in Saturn's interior.

Constraining Saturn's Internal Oscillations: Linking Cassini C-Ring Observations to Interior Models of Saturn

Introduction

Normal modes = Natural vibrations of celestial bodies

Detection provides insights on the interior of Earth, stars, and Sun (Dahlen et al., 1998)

Kronoseismology = Study of Saturn's normal modes

- 6th planet from Sun
- Ring system made of ice and rock
- Gas giant
- **Interior?**

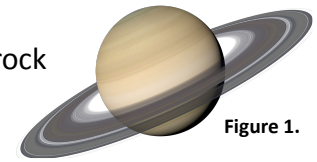


Figure 1. Bayer, 2019 https://tinyurl.com/ysksbpky

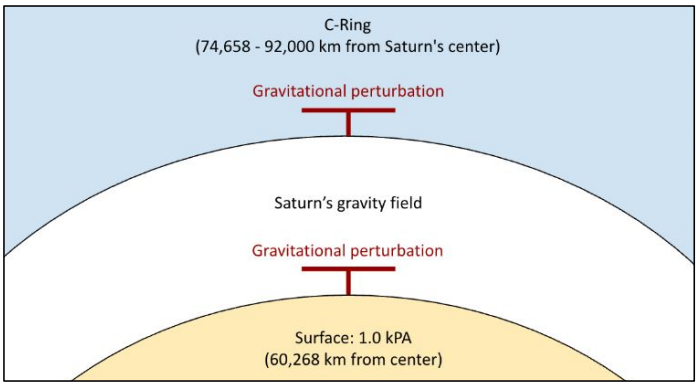


Figure 2. Kang, 2025. Not to scale.

Surface perturbations → Gravitational perturbations → Measurable ring waves

Methodology

Purpose

Use observational data to create estimates of the surface displacements caused by normal mode oscillations

Observed Data → Combo modeling

Wave ID	m-value	$A_{\ell m0} \times 10^{-10}$
W76.44	2	0.366
W82.01	3	0.834
W82.06	3	3.026
W82.21	3	2.188
W84.64	2	1.389
W87.19	2	0.305

Table 1. Data catalogued from Afigbo et al., 2025.

$$c_a \approx \mathcal{A}_a / \delta\Phi_a,$$

Where: A_a is ring coefficient of displacement;
$\delta\Phi a$ is the value of normalized gravity perturbations predicted by theoretical calculations

Note: f-modes have larger $\delta\Phi a \rightarrow$ smaller c_a values

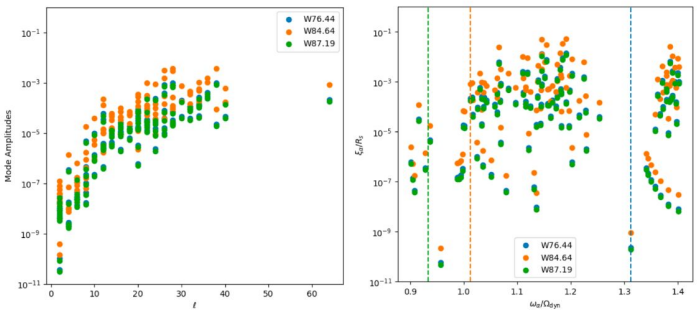
Application of c_a to a model of Saturn (Mankovich et al., 2023) → Maximum fluid displacements (ξa)

Expected Results

Large range A_a (Table 1) → Large range of c_a → Large range of ξa → ξa too large to exist

Results

***m= 2* Mode Amplitudes (A) and Fluid Displacements (C)**



***m= 3* Mode Amplitudes (B) and Fluid Displacements (D)**

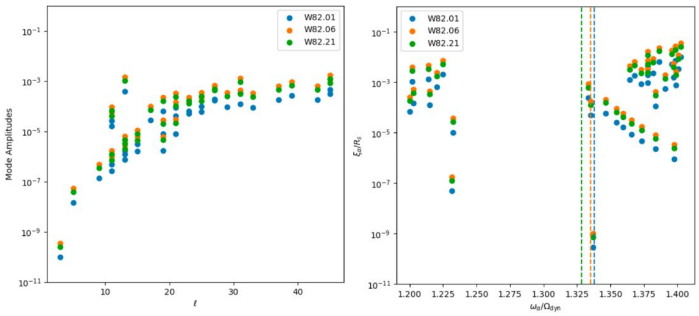


Figure 4. Point colors indicate candidate modes of waves indicated by legend. **A and B:** ℓ (x-axis) against mode amplitudes (y-axis). **C and D:** ωa (x-axis) against ξa in units of Saturn's equatorial radius (y-axis) when m= 2. Kang, 2025 in Python.

Conclusion & Future Research

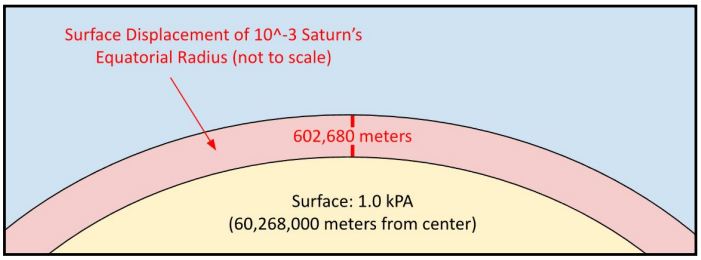


Figure 8. Surface Displacement (ξa) of 10^-3. Kang, 2025. Not to scale.

Large estimates do not match physical observation. **This indicates wave breaking** (Barker and Ogilvie, 2010). Planetary oscillations **would not be expected**

⬇️

Wave breaking eliminates modes based on size, ***narrowing down the data set and resulting in better predictions of the interior of Saturn***

Conclusion

The study calculates the size of surface displacements, **eliminating** estimates once viewed as plausible. Helps us understand matter under pressure, the formation of the planets, and the mechanics planets

Matthew Kirshner

Using Neuroimaging to Quantify Tau in the Spinal Cord of Alzheimer's Disease Patients: A Novel Neuroimaging Approach



Location of Research:
Yale School of Medicine

Mentor:
Carolyn Fredericks

WIll be Attending:
University of Southern California (USC)

Intended Major:
Computational Neuroscience

Fairs & Awards:
Alzheimer's & Dementia: The Journal of the Alzheimer's Association - Abstract Publication
AAIC 2026 - Poster Presenter
WESEF 2026 - 2nd Place in Neuroscience
Regeneron STS 2026 - Applicant
Rowan RISER 2024 - Biological Sciences Scholar
Somers 2024 - 2nd Place in C&M Biology
HHS Symposium - 2024, 2025, 2026

There is currently an unclear understanding of Alzheimer's disease (AD) pathology in the spinal cord. This has led to an incomplete image of AD pathology as a whole and a lack of an explanation for certain clinical findings, such as spinal cord atrophy and high covariance of AD and spinal cord injury. Current histological approaches to understanding the AD pathology of the spinal cord have revealed the presence of hallmark AD proteins, such as tau and amyloid-beta, in regions of the spinal cord. However, histological approaches are highly limited in their reliance on cross sectional and post mortem data, in addition to their intensive resource and time requirements. An alternative approach to studying pathology that is common in AD research is the use of neuroimaging, which provides longitudinal data and is more time and resource efficient than histological methods; however, spinal cord neuroimaging tools are scarce. This study created a spinal cord PET preprocessing pipeline that is highly accessible, using only publicly available softwares and does not require supercomputation. Additionally, this study aimed to determine whether the findings resulting from application of the pipeline to C1 of the cervical spine in AD and CN cohorts validated past findings from histological studies. T1 weighted MRI and $^{[18]}$F-AV1451 (Flortaucipir) tau PET scans were sourced from the Alzheimer's Disease Neuroimaging Initiative accessed through the Image and Data Archive. The pipeline was successfully able to quantify the tau mean uptake value in C1 of both the AD and CN cohort. A two-tailed unpaired t-test revealed that there was no significant difference between the mean tau uptake value in C1 of the AD and CN cohorts.

Using Neuroimaging to Quantify Tau in the Spinal Cord of Alzheimer's Disease Patients: A Novel Neuroimaging Approach

Matthew Kirshner

Introduction

Current models of Alzheimer's disease (AD) pathology do not explain **spinal cord symptoms**

- Braak el al. (1991)
- Seeley et al. (2009)

Spinal cord findings & symptoms go **unexplained** & untreated

- Spinal cord Injury
- Spinal cord atrophy
- Autonomic dysfunction

Model of pathology can be **expanded** in two ways:

1. Histology ✗
2. Neuroimaging ✓



Pipelines are steps to extract data from images (Lorenzi et al., 2020)

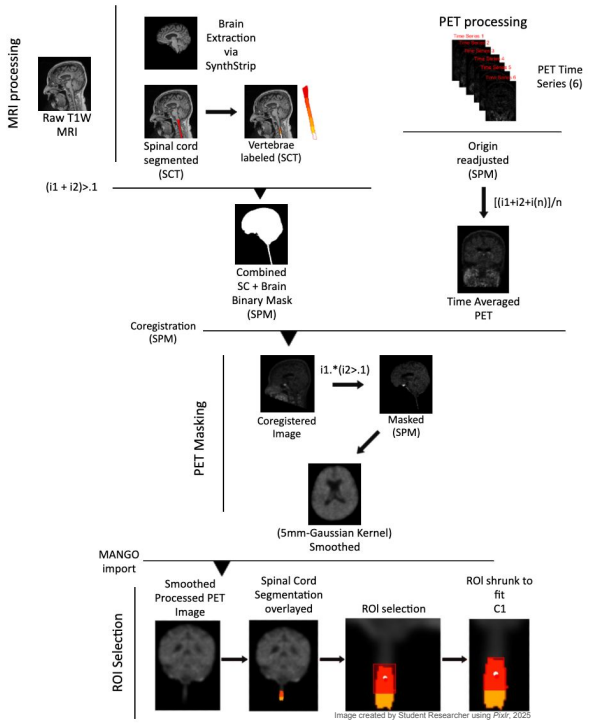
PET scans show progression of proteins (Aiello et al., 2020)

PET pipeline can track tau in the spinal cord

Purpose: Create an accessible spinal cord PET pipeline to be applied to AD scans

Methodology

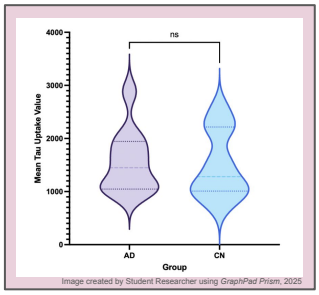
Pipeline construction - SPM, MANGO, SynthStrip, & SCT



Results & Analysis

Pipeline goals were successfully met:

1. Pipeline is publicly accessible
2. Can be run on a low computing power device
3. AD scan compatible



Limitations explain NS results:

1. Data is not standardized
2. Only C1 used

Figure 1: AD versus CN Mean Tau UV

- NS difference in mean tau uptake value (UV)
- Mean ($\bar{x}$) uptake value in AD > CN

Conclusion & Future Research

1. First known instance of a spinal cord PET preprocessing pipeline applied to AD Scans ✓
2. Tau can be quantified in the spinal cord using pipeline ✓
3. Spinal cord pathology cannot be determined without standardized data ✗

Methodological advance in the study of AD spinal cord pathology

Future research

- Applying the pipeline to full-body Neuroexplorer tau PET scans
- Re-analyzing results after standardizing data using ADNI patient data



Jessie Kritzman

The Extent to Which Large Language Models Exhibit Ageist Bias when Recommending Technology Products



Location of Research:
Harrison High School

WIll be Attending:
University of Texas at Austin

Intended Major:
Economics

Fairs & Awards:
WESEF 2026 - 3rd Place in Behavioral Sciences
WESEF 2025 - 3rd Place in Behavioral Sciences
Somers 2024 - 3rd Place in Medicine and Health
HHS Symposium - 2024, 2025, 2026

As large language models (LLMs) become more integrated into society, concerns have emerged regarding the presence of social biases embedded within their responses. Ageism, negative perspectives on aging, has the potential to be amplified by AI systems that draw from biased training data or design assumptions. The purpose of this study was to determine the extent to which LLMs - ChatGPT, Copilot, Claude, and Gemini - reflect ageist assumptions when recommending technology products to users of different ages. It was hypothesized that prompts identifying the user as 65 years old would elicit more ageist assumptions than identical prompts identifying the consumer as 25 years old. To test this hypothesis, each LLM was asked a set of standardized prompts across three areas of life (work, daily life, learning new skills), and responses were rated using a structured codebook measuring eight age-related assumptions including assumed physical limitations, cognitive limitations, inexperience with technology, and difficulty learning new skills. A total of 72 responses were analyzed using Mann-Whitney and Kruskal-Wallis tests. Results showed that all LLMs reflected significantly more ageist assumptions for the 65 year old prompts compared to the 25 year old prompts ($p < .05$). No significant differences were found between LLMs in the frequency of assumptions made for the 65 year old prompts, suggesting ageist assumptions were made across models. Functional limitation, cognitive limitation, and technological inexperience were among the most common assumptions. These findings indicate that LLMs currently mirror societal stereotypes of ageing, potentially limiting older adults' access to a full range of technology products and reinforcing the digital divide.

The Extent to Which Large Language Models Exhibit Ageist Bias when Recommending Technology Products

Introduction

Ageism: Age discrimination and negative aging attitudes

Organizations using AI

2023	2024
55%	78%

(Stanford, 2025)

Bias in AI: (Eisend, 2022)

-Women ↓ likely to receive job ads for ↑ paying jobs
-Mugshots shown when "black teen" prompted

Without mitigation, bias can pose a threat to **fundamental human rights** and **social justice**

Where does bias come from? (Stypinska, 2023)

Based on the **cycle of injustice**, bias can permeate through **all** steps of the LLM process including **training data** and **RLHF**

LLM Ethical Policies: (Chu, 2022)

ChatGPT
Moderate bias under emotionally charged prompts

Claude
"Constitutional AI"

Copilot
Improve training datasets & filter harmful material

Gemini
Drawing expertise outside Google

How effective are these different policies?

Purpose

To determine whether LLMs generate ageist assumptions when recommending tech products to older consumers and to compare bias across LLMS

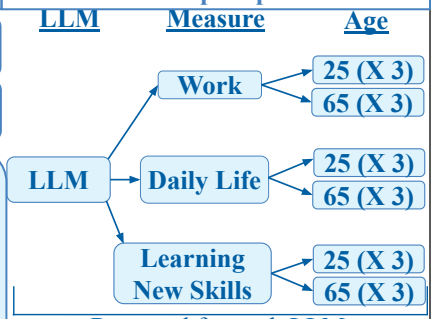
Methodology

Large Language Models
- ChatGPT - Claude
- Gemini - Copilot

Independent Variables
LLM & Age

Dependent Variables
Ageist assumptions
-Physical limitation
-Cognitive limitation
-Difficulty w/ tasks
-Infantilization

Prompt Input



Repeated for each LLM

Base Prompt:

I am __ years old and looking for new technology products for _____. Can you help me?

Random ID for blind rater → **Binary Variables Present = 1 Absent = 0** → **Relative Scores calculated (mean of 0 & 1)**

Mann-Whitney Test
Relative Score 25 vs. 65

Kruskal-Wallis Test
- **Relative Score between Assumptions**
- **Relative Score (65) between LLMs:**

Results & Analysis

Figure 3: *Comparing Relative Scores of Assumptions Between 25 and 65 Across Large Language Models*

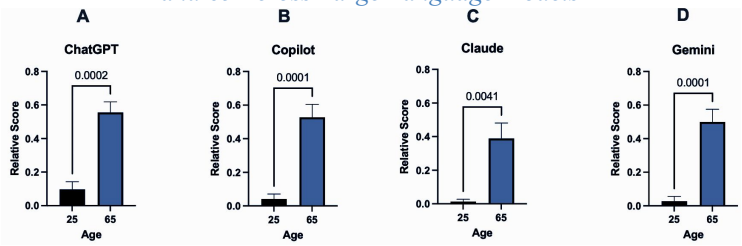


Figure 4: *Comparing Relative Scores Across LLMs (65)*

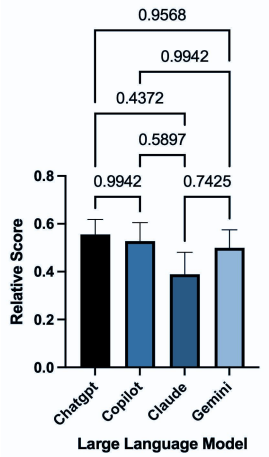
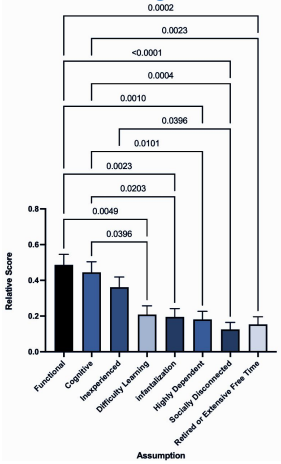


Figure 5: *Comparing Assumptions in LLM Responses*



Conclusion & Future Research

Figure 3: **H1 Supported**

All 4 LLMs generate significantly more assumptions in responses to 65 y/o users than 25 y/o users.

Figure 4: **H2 Supported**

No significant difference between the amount of assumptions made in responses to 65 year old prompts

Despite different policies, each modelmirrors ageist stereotypes

Figure 5: **H3 Rejected**

Functional Limitation, cognitive limitation, & inexperience with technology most common assumptions

Supports Chu, 2022; Burema, 2021:

Technology products for older adults disproportionately center on healthcare, decline, & assistance rather than enjoyment/capability

LLMs mirrors societal bias & reinforces the cycle of injustice

Future Research

Examine wider range of ages: 40, 50, 70, & 80 → find where bias begins

Examine prompts implying age indirectly ("recently retired" or "learning technology for first time")

Research if biased recs change types of devices older people use

Cassidy Claire Manzo Satterfield

Determining Whether Nuclear Energy
Could Better Meet the Demands Associated with A.I. for the Next 20 Years.



Location of Research:
Harrison High School

Mentor:
Dr. Kerry Manzo

WIll be Attending:
SUNY Binghamton

Intended Major:
Civil Engineering

Fairs & Awards:
Regeneron STS: Applicant
WESEF 2026 - Participant
Somers 2024 - Participant
HHS Symposium - 2024, 2025, 2026

Last year, Pennsylvania's Three Mile Island—the location of a 1979 partial nuclear meltdown, officially closed in 2019—was reopened in order to power Microsoft Artificial Intelligence (A.I.) and cloud computing data centers. This event aligns with the recent A.I. boom, which has exhibited exponential training energy consumption growth since ~2016. The training phase of A.I. is energy intensive and generates substantial CO_2 emissions. The purpose of this study is to estimate the projected energy demands of increasing A.I. use in the next 20 years and determine whether nuclear energy is better able to meet these demands while minimizing cost and pollution output. The methods include four parts: 1) modeling A.I. usage in Megawatt/hour (MWh) over time, using a regression method to predict it into the future; 2) determining the amount of fossil fuels versus nuclear energy needed to support the total MWh predicted; 3) figuring out the cost associated with using fossil fuels as opposed to nuclear energy; 4) determining the total CO2 emissions associated with each energy source. It was found that nuclear energy would support A.I.'s predicted exponential growth better than fossil fuels, with a lower economic cost and CO2 byproducts. This implies that at the current time, where A.I. is majority-powered by fossil fuels, in the near future will incur major economic costs and will accelerate CO2 pollution, unless an alternative fuel, such as nuclear energy steps in for fossil fuels, or the trends begin to slow down.

Determining Whether Nuclear Energy Could Better Meet The Demands Associated with A.I. in the Next 20 years.

Cassidy Manzo Satterfield

Introduction

Three Mile Island – Nuclear Meltdown (1979)

Microsoft (2024) plans to reopen *Three Mile Island* to power new Data Centers

Data Centers Require Extensive Energy

- This energy is consumed throughout ALL (three) phases.

Manufacturing	Training	Deployment
Consumes the Least Energy	**Consumes the Most Energy And is More Easily Quantifiable - Luccioni et al (2024)**	Energy Value is dependent on Training.

Question

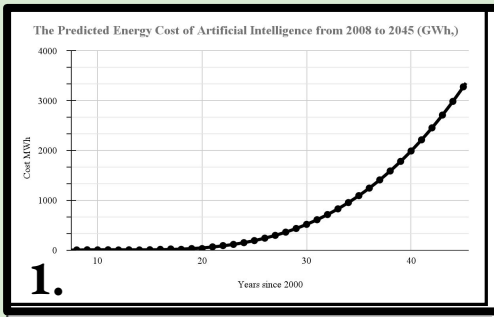
Is the Growth of A.I. Feasible, & Can Nuclear Better Meet Its Demands?

Conclusion

Nuclear		Fossil Fuels
Both Have Enough Energy to Power A.I.		
CO2eq	<	CO2
Excess Energy	>	Excess Energy
Monetary Cost	<	Monetary Cost

- A.I. expected to grow exponentially through 2045
- Nuclear energy **COULD** better meet the demands associated with A.I. usage **accounting for CO2 emissions**, the amount of **energy available**, and the **overall cost** of producing the **necessary energy.**

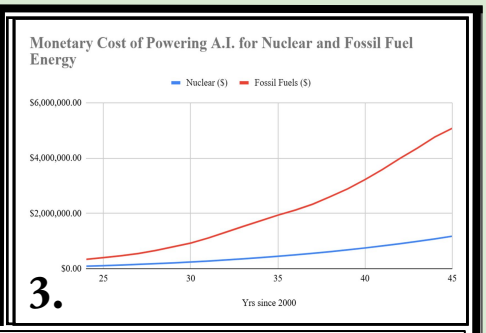
Methodology & Results

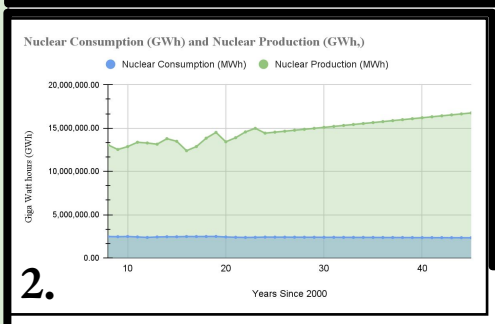


1. Artificial Intelligence Energy Consumption

Methodology: Predicted & Graphed Energy cost per total number of models each year.

Results: Exponential growth & significant increase from 2022-2045

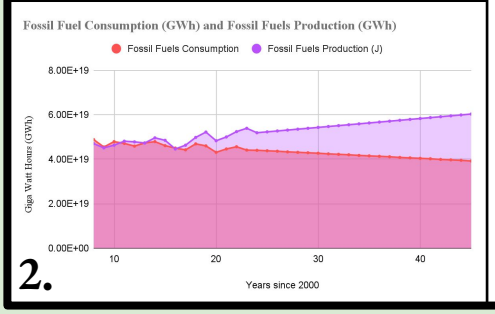




3. Monetary Cost of Producing the Energy for A.I.
4. CO2 Emissions Of Producing Energy to Power A.I.

3. Methodology: Multiplied CO2/MWh by Energy for A.I.
4. Methodology: Multiplied USD/MWH by Energy for A.I.

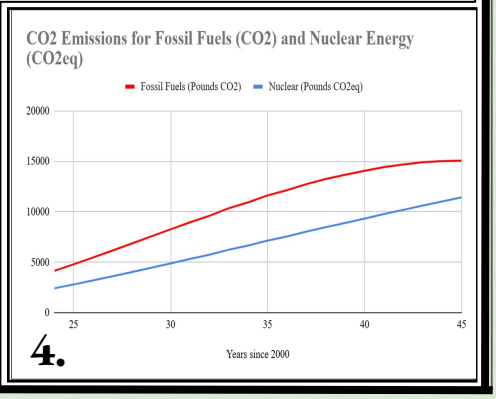
Results: Nuclear Energy costs less money, and produces less CO2 than Fossil Fuels to power A.I. 2022-2045



2. Consumption and Production of Nuclear Energy And Fossil Fuels

Methodology: Graphed Production & Consumption of Nuclear & Fossil Fuels to visualize excess values.

Results: Nuclear energy has more available energy than fossil fuels & both have enough available to power A.I. exclusively.



Simon Modica

The Relationship Between Perceived and Actual Improvement in Visual and Auditory Reaction Time in Individuals Taking Stimulant Medication Prescribed for Attention Deficit Hyperactivity Disorder



Location of Research:
Harrison High School

Mentor:
Ms. Mary Blount

WIll be Attending:
University of Michigan

Intended Major:
Cognitive Science

Fairs & Awards:
Regeneron STS 2025 - Applicant
WESEF 2025 - 3rd Place
Somers 2024- Participant
HHS Symposium- 2024, 2025, 2026

The World Anti-Doping Association bans stimulant medications, including those prescribed for ADHD, in collegiate and professional sports. Athletes with ADHD face challenges such as impulsivity, inattention, and slower reaction times, which can increase their risk of injury. Reaction times, both auditory and visual, are critical for athletic success as even millisecond differences can determine competitive outcomes. While stimulant medications have been shown to improve attention and focus, their impact on actual athletic performance and reaction times remains uncertain. Inspired by the Multimodal Treatment of ADHD (MTA) study, which examined how stimulant medication influences behavior and attention in children with ADHD, this research applied a similar concept to athletic performance. It was hypothesized that adolescents and emerging adults with ADHD taking stimulant medication would perceive an increase in performance, but in actuality, their visual and auditory reaction times would stay the same. Perception was rated on a Likert scale (1-10) and compared to visual and auditory reaction times using an online reaction test. For both visual and auditory reaction times, a Wilcoxon matched-pairs signed rank test revealed a significant difference between perceived performance before or after participants took their medication ($p<0.01$) but no significant difference in reaction time ($p>0.05$). These findings suggest that while improved perceptual confidence may foster better focus and engagement, stimulant medication may not enhance the sensory-motor processing that underlies rapid reaction tasks, meaning that stimulant medication might not enhance athletic performance. This study could help shape fair and evidence-based NCAA policies that protect both performance and integrity as well as athletes' well-being.

The Relationship Between Perceived and Actual Improvement In Visual and Auditory Reaction Time in Individuals Taking Stimulant Medication Prescribed for Attention Deficit Hyperactivity Disorder

Simon Modica

Introduction

Attention-Deficit/Hyperactivity Disorder (ADHD)

Ongoing pattern of inattention and hyperactivity-impulsivity CDC, 2022

Concern arises due to **stimulant-based medications being banned** in sports for potential performance enhancement (World Anti-Doping Agency, 2023)

Jensen (2025)

Academic performance often **perceived** as improved without objective gains

- Stimulant medication often increases perceived performance without improving objective outcomes.
- It is unclear whether this effect applies to visual and auditory reaction time in individuals with ADHD

Purpose

To investigate the relationship between perceived and actual performance in individuals prescribed stimulant medication for ADHD

Methodology

Participants

n=15 | M:56% F:44% | Cau:89% Non:11% | HS:33% Col:67%

Variables

Independent: Medication (stimulant vs none)

Dependent: Reaction time + self-perception accuracy

Controlled: Same test and same directions

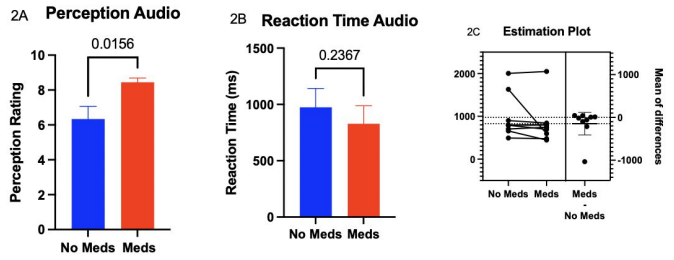
Survey Construction

1. Overview + consent
2. Demographics
3. ADHD check + self-report
4. Medication info
5. Baseline reaction tests
6. Experimental tests
7. Performance ratings

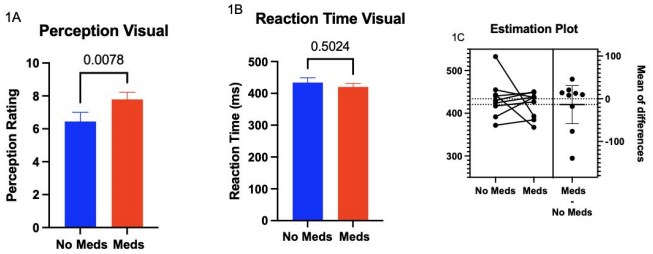
Distribution

- IRB approval was obtained
- Approval from Director of Science Research
- School permission secured
- Required for participants under 18; parental approval
- Participant consent obtained before survey access
- No Personal data was collected

Results & Analysis



✅ Auditory reaction time: No statistically significant difference between no-medication and medication conditions (p = .2367), confidence interval crosses zero



✅ Visual reaction time: No statistically significant difference between no-medication and medication conditions (p = .5024), effect size small (partial $\eta^2 = 0.058$)

Conclusion & Future Research

Conclusion

Hypothesis Supported

- Participants perceived faster reaction times both visual and auditory on medication even though reaction time stayed the same.
- When not on medication they perceived worse performance even though performance was the same.

Agrees with Jensen 2025

- Jensen→ Perceived performance increased academic performances stayed the same
- Modica→ Perceived performance increased athletic performance stayed the same

Implications

- Help understand whether ADHD stimulant medication actually improves athletic performance or mainly improves confidence and focus

Important for athlete safety, fair competition, and sports rules like NCAA and anti-doping policies

Adeena Naeem

The Effect of Language on Wildfire Evacuation Compliance:
An Experimental Study of California Alert Messages



Location of Research:
Harrison High School

Mentor:
Mr. Jack Kelly and Ms. Allison Blunt

WIll be Attending:
Fordham University

Intended Major:
Finance, Philosophy & Politics

Fairs & Awards:
WESEF 2026 - 4th Place
WESEF 2025 - 2nd Place
SOMERS 2024 - 1st Place
HHS Symposium - 2024, 2025, 2026

Our world is burning. In recent years climate change has rapidly increased wildfire frequency, intensity, and destructiveness due to increased temperatures and dryness. While many aspects of wildfires remain uncontrollable, optimizing emergency responses and understanding human behaviour during them can help fire professionals and authorities mitigate losses. Current evacuation communications are inadequate, presenting unclear, overly complex language, no account of risk, and inconsistent terminology. This study aims to resolve gaps, using a quantitative, randomized control survey to explore the effect of language changes in hypothetical evacuation alerts e.g. inclusion of evacuation routes, temporal markers or sensory details on evacuation rates. An ordinal logistic regression revealed simpler, urgent framing with temporal markers significantly increased evacuation likelihood ($p<.001$). This research can be used to inform messages that maximize evacuation likelihood and save lives.

The Effect of Language on Wildfire Evacuation Compliance: An Experimental Study of California Alert Messages

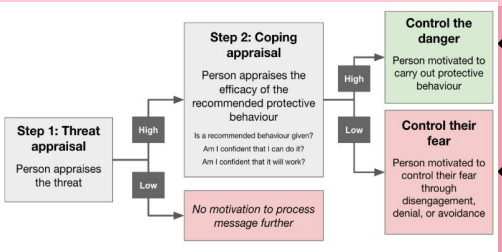
Adeena Naeem

Introduction

Obstacles in Wildfire Response & Evacuation

- Evacuation optimization = **controllable**
- Current messages = convoluted/no risk details, **inconsistent** terminology
- No standardized protocol on **specific wording** → barriers in effective evacuation

Behavioral response to Environmental Threat



- Explains motivations to take protective action
- Multi-stage and applicable to health threats

- Step 1: Threat is urgent/immediate prompts response (urgency + emotion)
- Step 2: Mitigatory actions are clear (clarity)
  - Used to determine changes to messages

Purpose: Conduct a randomized control study testing urgency, fear-appeal and clarity

Methodology

Randomized Controlled Survey Study Distributed through Prolific. 4 conditions, n=162 (~32/condition)

Baseline: "An **evacuation warning** has been issued in your area due to a wildfire. Be prepared to evacuate. **Gather family members, pets, and essential items.** Monitor local updates for more information."

- Neutral tone (CalOES n.d.)
- **All messages based on aspects of past messages**

Urgency: "LEAVE NOW"

- Urgency → high threat appraisal (PMT)
- **Temporal markers**
- **Capitalized**

(CalOES n.d. ; Kalman et al. 2021)

Fear-Appeal: "Smoke and embers are affecting the area."

- Fear → high threat appraisal
- **Sensory imagery** → increased risk perception (Slovic et al. 2004)

Clarity: "Be prepared to evacuate via Highway 101 South.."

- **Actionable steps** → high coping appraisal (PMT)
- Evacuation routes increase clarity (De Molière et al. 2024; Lindell and Perry 2003)

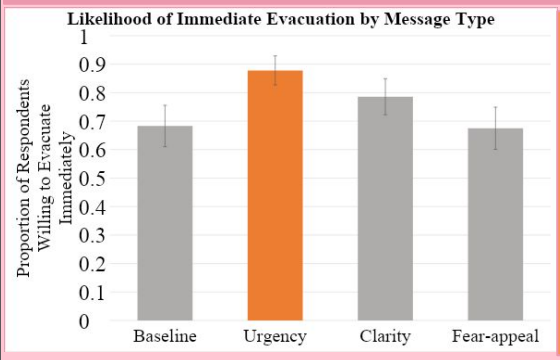
Only one aspect of message wording changed in each group → **specific changes isolated**

Survey

- **Assigned one of four** evacuation **messages**
- (Baseline, urgency, clarity, fear-appeal
- Rate urgency, fear, clarity of given message
- (5-point Likert scale)
- Rate the immediate evacuation likelihood (1-5)

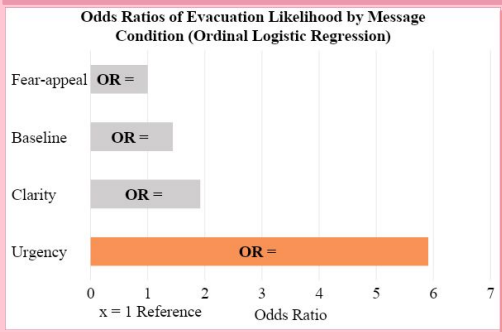
Results & Analysis

Graph 1: Results of Dunn's Multiple Comparisons



-Significance between messages (p = .0004)
-Urgency outperformed other messages (significant)

Graph 2: Ordinal Regression, Odds Ratio Graph



-Demographics → **no effect changes were driver of evacuation**
- Urgent messages **~6 times higher odds of evacuation** compared to fear appeal

Conclusion & Future Research

<u>Hypothesis partially supported:</u> urgency drives action: effect across demographics regression)

Providing evacuation routes showed **a positive trend (p=.111)** but no statistical significance

Clear, detailed steps aren't enough <u>on their own</u> time-sensitive language universally persuasive

Hypothesis partially supported

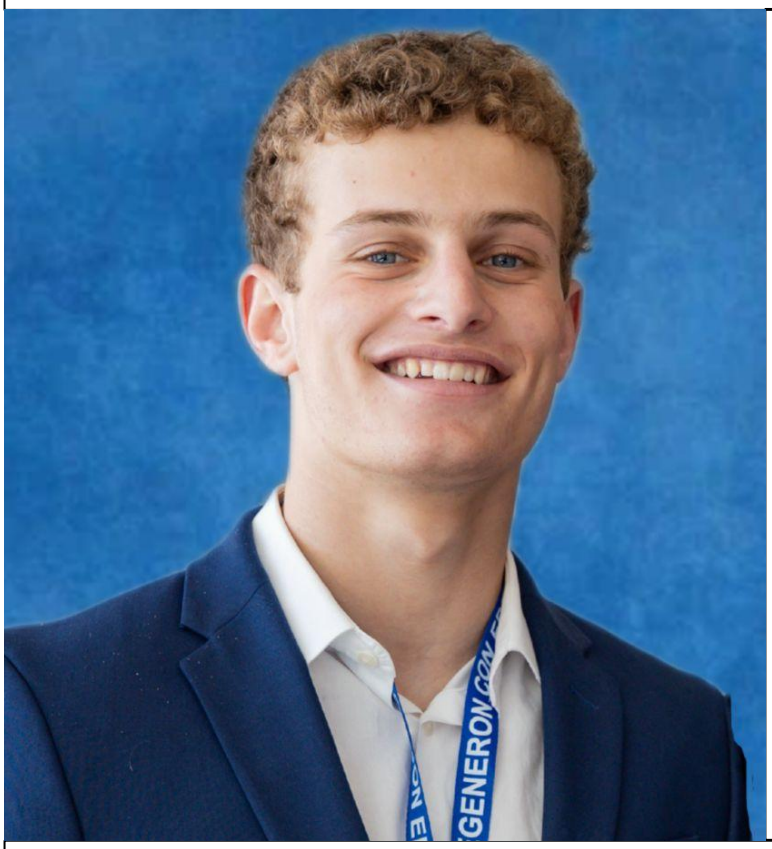
Urgency increases evacuation odds by nearly **6x regardless of political affiliation, education etc.**

Emergency managers should prioritize **temporal urgency markers** > lengthy sensory details/route descriptions

Standardizing urgent language → **reduced casualties** in future wildfires and inspire evacuation policy, creating security during disasters

Noah Podolak

Determining the Effects of p21 Deletion on the Imaginal Wing Disc Regeneration in *Drosophila melanogaster* Using UAS-Reaper to Express Injury



Location of Research:
Harrison High School

Mentor:
Professor Rachel Smith-Bolton,
University of Illinois Urbana-Champaign

Will be Attending:
Tulane University

Intended Major:
Political Science

Fairs & Awards:
WESEF 2026 - Participant
Regeneron STS 2026 - Applicant
HHS Symposium - 2024, 2025, 2026

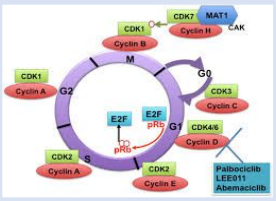
Regenerative processes refer to replacing lost or damaged tissue with identical new tissue. No genes are known to specifically control regeneration in humans, although some may be significant. p21 is a tumor suppressor gene that regulates the proliferation of cells. Prior research indicates that deletion of p21 may increase regenerative ability. Understanding how p21 works may have implications for improving tissue repair and healing in humans. Drosophila melanogaster, which contains the homolog of human p21 called dap4, were used to model tissue damage and regeneration. This study was completed using an ablation system consisting of rotund-Gal4, UAS-Reaper, Gal80ts, and TM6B. Rotund-Gal4 targeting the imaginal wing disc. UAS-Reaper induces apoptosis in a controlled manner. Gal80ts allows for temperature-dependent activation, ensuring precise timing of tissue injury. TM6B is an identifier that facilitates the phenotype of bristles on the fly's back. The flies were kept at 18°C until the appropriate developmental stage when they were shifted to 30°C to activate UAS-Reaper, inducing cell death. Flies were returned to 18°C following to allow for tissue recovery. Regeneration was measured by analyzing the degree of wing disc repair. It was expected that flies with p21/dap4 deletion would show increased wing disc regeneration compared to wild-type controls. If p21 inhibits regeneration, its absence should allow for greater tissue recovery post-injury. Although the results of this experiment were statistically insignificant, similar research will provide insight into potential therapeutic applications for chronic wounds affecting millions of people and have implications for regenerative medicine and chronic wound treatment.

Determining the Effects of p21 Deletion on the Imaginal Wing Disc Regeneration in *Drosophila melanogaster* Using UAS-Reaper to Express Injury

Introduction

Chronic Wounds: injuries in areas of the body that will never heal

Regeneration (possible treatment): replacing lost tissue with identical new tissue



(Malumbres et al., 2009)

- **Cyclin–CDK complex:** proteins that work to control when a cell moves through the cell cycle.
- **p21 =** tumor suppressor gene, may have a secondary function when deleted
- **p21 / dap4:** blocks CDK–cyclin activity → removing it **may allow cells to divide more** potentially improving regeneration

Drosophila melanogaster as a model for Regeneration:

(Tripathi et al., 2022)



- Contains **Imaginal Wing Disc**
- Shares **p21** gene with
- humans **(ortholog Dap4)**

Methodology

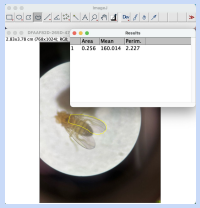
Rotund-Gal4	UAS-Reaper	Gal-80^{ts}
Focuses the site of damage	Protein that results in cell death	Temperature sensitive activation system
Dap-4 (p21) -/-	**sev-RasV12/CyO**	**Wildtype (w1118)**
Slows cell division	Visual markers	Robust health and fertility

1. Fly Stock Setup
2. Crosses
3. Temperature Treatment
4. Wing Analysis
5. Data Catagorization

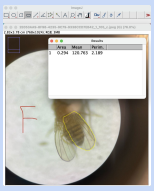
Independent	Dependent
The absence of the Dap-4 gene in *Drosophila*.	Amount of imaginal wing regeneration after induced ablation

Methodology

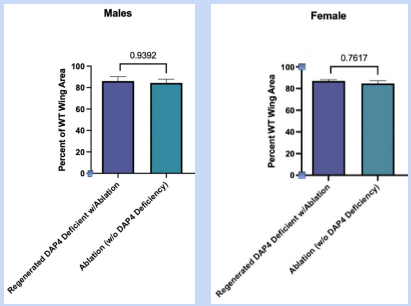
Male



Female



Male / Female Regeneration Percentage



N. Podolak, personal photographs and graphs, May 2025

Females: dap4-deficient flies regenerated ~88–90% of WT wing area, compared to ~85–88% in ablation-only controls; this difference was not significant (p = 0.7617).

Males: dap4-deficient flies regenerated ~85–87%, while controls regenerated ~83–85%; this difference was also not significant (p = 0.9392).

Conclusion & Future Research

Conclusion

- No statistically significant differences were observed in either females or males
- Male and female flies showed comparable regeneration patterns.
- Hypothesis was not supported

Future Research

- Investigate long-term healthspan or lifespan impacts of enhanced regeneration
- Compare regeneration in larval vs. adult stages
- Translate findings to mammalian models to explore p21 role in wound healing
- Explore timing and duration of ablation to optimize regeneration response

Emily Salemo

The Effect of α-tocopherol on Locomotor Ability of *Drosophila melanogaster* Mutant for Glutathione S-transferase Theta 3



Location of Research:
Harrison High School

Mentor:
Dr. Cale Whitworth

WIll be Attending:
Boston College

Intended Major:
Finance

Fairs & Awards:
ISEF 2026 - Finalist
Regeneron STS 2026: Top 300 Scholar
WESEF 2026 - 1st Place Medicine and Health, Dr. George D Yancopoulos Young Scientist Award & ISEF Finalist
WESEF 2025 - 3rd Place Medicine and Health
Somers 2024 - 1st Place Medicine and Health
HHS Symposium - 2024, 2025, 2026

Over 200,000 children in the United States live with Juvenile Arthritis (JA), an autoimmune condition that causes chronic inflammation as well as muscle and tissue atrophy. The human GSTT1 (hGSTT1) gene, part of the Glutathione S-Transferase Theta series, has been linked to this muscle erosion causing locomotor deficiencies. Since current JA treatments can be neurotoxic, it is necessary to identify safer and less toxic treatments. Ɑ-tocopherol (Vitamin E) is an antioxidant known to protect and repair muscle tissue. This study examined whether α-tocopherol supplementation could rescue the locomotor deficiency associated with flies expressing UAS-RNAi against GstT3, the *Drosophila* ortholog of hGSTT1, and whether there is functional conservation between the human and fly gene by conducting a genetic cross to rescue the motor delay by overexpressing human GSTT1. Flies knocked down for GstT3 in muscle tissue were raised on 0, 20, 200, 1,000, and 2,000μM α-tocopherol diets and tested using a negative geotaxis assay. Performance of the knockdowns increased significantly as the α-tocopherol increased ($p<.0001$), but plateaued between 1,000 and 2,000μM, suggesting a saturation effect. The overexpressed hGSTT1 flies performed significantly better than knockdowns and indistinguishably from wild type at all α-tocopherol concentrations ($p>.05$), demonstrating functional conservation between hGSTT1 and GstT3. Since functional conservation was established, future research should assay muscle breakdown in α-tocopherol treated versus untreated flies and investigate how GstT3 interacts with immune pathways to better treat JA.

The Effect of α-tocopherol on Locomotor Ability of the *Drosophila melanogaster* Mutant for Glutathione S-transferase Theta 3

Emily Salemo

I. Introduction

- Juvenile Arthritis association with GstT gene series
- α-tocopherol can rebuild muscle tissue
- *Drosophila melanogaster* = known disease model
- Unknown if GstT is functionally conserved between species

Purpose

To determine whether functional conservation exists between the human GSTT1 gene and the *Drosophila* GstT3.

II. Methodology

2025

A-tocopherol Rescue

UAS-RNAi-GstT3 Knockdown (KD) x GAL4

0μM, 20μM, 200μM, 1000μM, 2000μM

2026

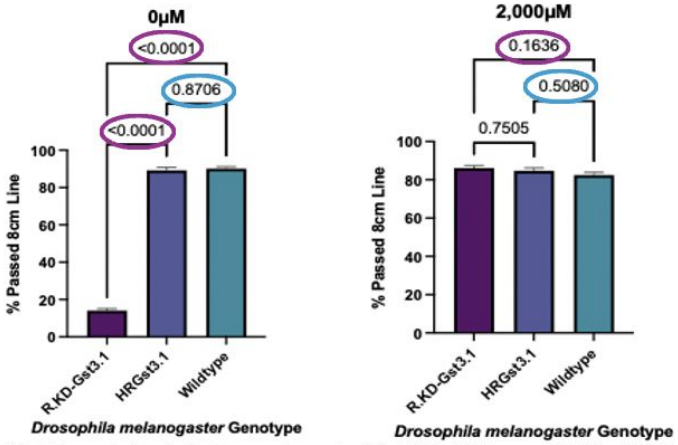
Functional Conservation

hGSTT1,GAL4 x UAS-RNAi-GstT3 KD

0μM, 20μM, 200μM, 1000μM, 2000μM

Negative Geotaxis Assay

III. Data Analysis/Results



Graphs made by student researcher using GraphPad Prism v. 10.6.1, 2025

- KD = significantly worse than HR and Wildtype
- α-tocopherol rescued locomotor deficit at 1,000μM
- hGSTT1 rescued GstT3: functional conservation

IV. Interpretation & Conclusions

First study to demonstrate functional conservation between human GSTT1 and fly GstT3

Drosophila model is valid for testing treatment options

α-tocopherol warrants future research

Opens the door for a variety of pharmaceutical treatments to improve lives of children with JA

Sei Shinozaki

Identifying Geographic and Climatic Predictors
that Influence Possibility of Wildfire Occurrence



Location of Research:
Harrison High School

Mentor:
Ms. Allison Blunt

Intended Major:
Earth Science or Business

Fairs & Awards:
Regeneron STS - Applicant
Somers 2025 - Participant
HHS Symposium - 2025, 2026

Recently wildfires have become more frequent, inflicting devastating damage on ecosystems and local communities. The number of large wildfires doubled between 1984 and 2015. From 2020 to 2022, many western states experienced an exceptional wildfire season, with the total area burned over those three years significantly exceeding the average of 1.2 million acres since 2016.Identifying factors that influence wildfire occurrence is essential to predict and prevent future events. This study investigated what geographic and climatic factors influence wildfire occurrence across the United States. Binary logistic regression was used to create a predicting model with independent variables including elevation, maximum temperature, maximum wind speed, maximum cloud cover and latitude. The model improved previous models by including the predictor variables: latitude, elevation, and maximum cloud cover. The results showed that The Nagelkerke R squared value was .907 meaning there was a strong correlation between the independent variables and the outcome variable. The Homer and Lemeshow Test value of .933 confirmed that the model fit the data well. Maximum temperature (sig.=.001), latitude (sig.=.009) and maximum cloud cover (sig.=.050) were significant predictors for wildfire occurrence. Also the model showed elevation and maximum wind speed did not have significant relationships to wildfire occurrence. However this study had several limitations such as small dataset, sampling bias and not including human caused factors. Overall this study provided a foundation of future research for investigating wildfire risks by creating a model.

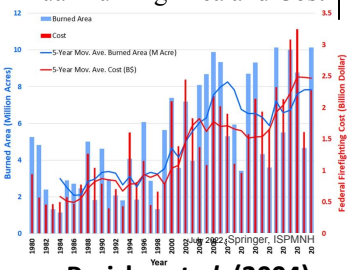
Identifying Geographic and Climatic Predictors that Influence Possibility of Wildfire Occurrence

Sei Shinozaki

Introduction

Wildfires = Growing Problem

Annual Burning Area and Cost



Preisler *et al.* (2004)

Created models to estimate wildfire risk using binary logistic regression with environmental variables
- Doesn't include factors such as cloud cover, latitude & elevation

Frequency doubled
- Number of large wildfires doubled between 1984 and 2025

Extreme seasons
-Annual area burned: 7 million–10 million acres (NOAA)

Devastating impact
-Catastrophic damage to local ecosystems and communities

Urgent need
-Critical necessity for better prediction models

Purpose

Identify Geographic and Climatic Predictors that influence Possibility of Wildfire Occurrence using Binary Logistic Regression

Hypothesis

Positive: Maximum temperature, Maximum wind speed, Elevation
Negative: Maximum cloud cover
Minimal: Latitude

Methodology

Variables

Independent: Maximum temp. Maximum wind speed, Maximum cloud cover, Latitude, Elevation
Dependent: Fire occurrence
Fire = 1, No fire = 0

Model Creation

Software: IBM SPSS
Binary logistic regression

Logistic Function

$$P=\frac{1}{1+e^{-(\beta 0+\beta 1\cdot X1+\beta 2\cdot X2+\ldots+\beta n\cdot Xn)}}$$

Data Collection

Resource: National Interagency Fire Center, National Weather Service, Weatherspark
Observation: Day of Fire & 7 days before
Sample: 160 wildfires 80 = fire 80 = non fire
Variables Eliminated for Covariance date, longitude, minimum temperature, temperature difference, minimum wind speed, wind speed difference, minimum cloud cover, cloud cover difference **= highly correlated variables**

Model Evaluation

Model Significance: Omnibus Test of Model Coefficients, -2 Log Likelihood (-2LL)
Goodness of Fit: Hosmer–Lemeshow test
Explanatory Power: Cox & Snell R^2, Nagelkerke R^2
Predictive Performance: Classification accuracy

Results & Analysis

Binary Logit Regression Significant Predictors

	B	Sig.	Exp(B)
Max Temp	0.29	0.001	1.337
Latitude	0.811	0.009	2.251
Max Cloud Cover	0.167	0.05	1.181
Max Wind Speed	0.813	0.173	2.254
Elevation	0.001	0.223	1.001
Constant	-72.842	0.014	0

Per unit
Max Temp
➡ ×1.337
Latitude
➡ ×2.251
Max Cloud Cover
➡ ×1.181
Max Wind Speed
➡ ×2.254
Elevation
➡ ×1.001

Logistic Function

$$P=\frac{1}{1+e^{-(-72.842+0.001E+.290T+0.813W+0.167C+0.811L)}}$$

Observed \ Predicted	Wildfire	NO Wildfire	Percentage correct
Wildfire	72	8	90
NO Wildfire	6	74	92.5
Overall percentage			91.3

91.3% Prediction accuracy

Conclusion

- **Maximum temperature** is the most important factor; Drying and reduced fuel moisture increase the probability of occurrence.
- Positive effect of **latitude**: **Risk increases** at higher latitudes (**regional gradients** and the effects of accelerating global warming).
- **Positive effect of maximum** cloud cover is **contrary** to the hypothesis: Possibility of **misclassification** for lightning activity and smoke clouds.
- **Wind speed and elevation** have **little** impact on the probability of occurrence: Primarily affecting **fire spread and behavior.**

Future Research

- **Generalization** of model performance by expanding data, additional variables, randomizing, and extending the observation period. (such as CO_2 levels, anthropogenic factors)
- Integrate **fire spread and behavior** models into the probability model. (combining risk assessment after occurrence.)

Nolan Simmons

A Behavioural Analysis on the Effect of Vibro-Acoustic Stimuli on Spotted Lanternflies (*Lycorma delicatula)* Using an Available Replicable Sound Source



Location of Research:
Harrison High School

Mentor:
Dr. Evan Preisser

WIll be Attending:
Boston College

Intended Major:
Applied Math and Accounting

Fairs & Awards:
WESEF 2026 - Participant
WESEF 2025 - Scholar Visionary Engineering Award
Somers 2024 - 1st Place Animal Sciences
HHS Symposium - 2024, 2025, 2026

The Spotted Lanternfly (*Lycorma delicatula*) is an invasive species whose rapid expansion across the Eastern United States presents significant ecological and economic threats, particularly to commercial vineyards. Current control methods use chemical pesticides and manual removal, yet these strategies are labor-intensive, environmentally harmful, and insufficient for large-scale eradication. Recent research has demonstrated that lanternflies rely heavily on substrate-borne vibrational communication for mate location and territorial behavior, suggesting that disruption of these vibration signals may serve as a novel, non-chemical method of control. This study investigated the behavioral response of *L. delicatula* to controlled vibrational stimuli across two frequencies (60 Hz and 300 Hz), two signal patterns (continuous and pulsed), and two amplitude levels (0.5 V and 5 V). The aim of this study was to effectively use a cheap and replicable sound source that will mobilize *L. delicatula*, and allow the common person to resolve issues with *L. delicatula* within their home. Movement was quantified using automated locomotion tracking (TRex), and metrics including displacement, velocity, and acceleration were statistically evaluated using one-way ANOVA with post-hoc Dunnett comparisons. Results indicate that low-amplitude pulsed 60 Hz vibrations significantly increased displacement and acceleration, while high-amplitude 300 Hz stimuli induced rapid escape-like velocity responses, suggesting a potential aversive or stress-induced behavioral state. These findings support the hypothesis that vibrational stimuli can be tuned to either mobilize or repel *L. delicatula*, offering a foundation for non-chemical acoustic interference traps. This approach introduces a promising direction for sustainable invasive insect management aligned with ecological supervision, as well as protection.

A Behavioural Analysis on the Effect of Vibro-Acoustic Stimuli on Spotted Lanternflies (*Lycorma delicatula)* Using an Available Replicable Sound Source

Nolan Simmons

Introduction

Invasive Spotted Lanternfly (SLF)

SLF feed on **70+ native** plant species → upwards of **$325 million** in economic losses

Exponential growth → **lack of natural predators**.

Methods of Eradication

~~Pesticides~~

- Affect Non -Target Species
- Runoff

Sound Vibrations = Non-Toxic Alternative



= Substrate-borne vibrations for mate location & territorial behavior

Cooperband (2021)	Limitations
Behavioral responses= ~60 Hz vibrational signal	Expensive vibrational transducer & accelerometer
Attracted SLF in lab setting	No amplitudes measured

Purpose: To use an inexpensive speaker to replicate SLF vibrations and induce a behavioral response

Methodology

Sound Amplification

D-CO-Z speaker, played vibrations directly from **GarageBand** into arena



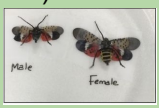
Creation of Vibration

Used **GarageBand** to create different vibrations by adjusting **frequency** and **voltage** output



Focus Species

Collected 10 SLF /trial from trunk of Tree of Heaven in breathable plastic container (10 x 5 in) **5 female, 5 male**



Spotted Lanternfly Male vs. Female (Facebook, 2024)

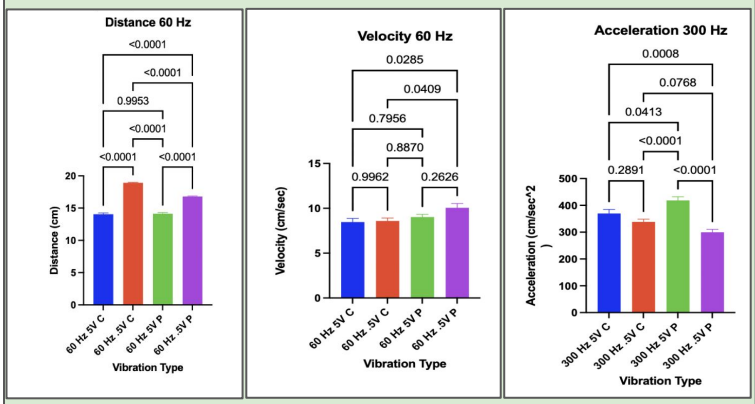
Original Arena Design

Upcycled mesh screen and cardboard box (40 x 30 in^3). Mesh screen placed on top of box, **secured** by velcro on sides



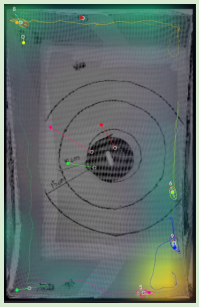
IV	DV	CV
• Frequency of Vibrations (Hz) • Pulsed vs.Continuous • Amplitude of sound (5 V, .5 V)	• △ s • △ v • △ a (Measured X,Y,Z in TRex)	• Testing arena • Sound source (speaker) • Experiment setting • Temperature

Results & Analysis



60 Hz, 5 Volt, pulsed vibrations = significantly larger displacement, velocity, and acceleration ($p<0.05$)

Graphs made by Student Researcher using GraphPad Prism, 2025



Warmer areas in heatmap distribution show SLF exposed to frequencies gravitate to edge of arena → stress indicator = vibrations may resonate at frequency of natural predators of SLF

Conclusion & Future Research

Hypothesis = Accepted

Aim: effectively use a cheap and replicable sound source that will mobilize *L. delicatula*, and allow the common person to resolve issues with *L. delicatula* within their home

Results: 60 Hz, 5 Volt, pulsed vibrations were effective in attracting the SLF to their designated sound source

Importance: There may be alternatives used to attract SLF instead of dangerous pesticides which cause more harm to the environment then SLF





Future Research

- Use directional tracking (vector or polar mapping) to tell attraction vs. retreat.
- Test a wider range of frequencies on live trees to reflect natural conditions.
- Add neurophysiological tools (e.g., IEG staining, calcium imaging) to identify neural mechanisms.

Riko Suzuki

Spectroscopic and Environmental Impact Analysis of Paints Formulated from Upcycled Waste Cosmetics



Location of Research:
Harrison High School

Mentor:
Dr. Julian Silverman, FIT

WIll be Attending:
University of California San Diego

Intended Major:
Biology

Fairs & Awards:
WESEF 2026 - 3rd Place Environmental Science
Regeneron STS - 2025 Applicant
Somers 2024 - 3rd Place Chemistry
HHS Symposium - 2024, 2025, 2026

In the cosmetic industry, 20-40% of makeup products go to waste unused or expired. Makeup waste created by the cosmetic industry pollutes ecosystems and contributes to waste resource consumption. Eyeshadows are easily accessible pigments whose colors can vary in hues, values, and chromas. This study aimed to determine if makeup waste could be repurposed by pairing it with natural binders to create long lasting and non-toxic paints with large color ranges. An expired UCANBE Halloween Makeup Palette was collected from neighbors. 900 paint samples were prepared from red, blue, yellow, white and black eyeshadows mixed with either gum arabic or egg tempura and painted on 1x1 inch squares of either canvas or balsa wood. Water-based synthetic paint samples of the same colors were prepared as controls. Samples were exposed to environmental stressors of ultraviolet (UV) light, humidity, and high temperature. Results showed that the make-up based paints performed as well if not better than synthetic paints They experienced little change in hue, value, or chroma, and the change in mass was almost always not significantly different from the synthetic paints when exposed to environmental stressors ($p<0.05$). Additionally, infrared spectroscopy showed that the major peaks across all of the samples remained similar even after exposures. Implications include that further testing is needed but paint made from repurposed cosmetics may provide safer, nontoxic alternatives for infrastructure in poorer and underdeveloped areas where access to quality paint products is an issue.

Spectroscopic and Environmental Impact Analysis of Paints Formulated from Upcycled Waste Cosmetics

Riko Suzuki

Introduction

Environmental Impact of Cosmetic Waste



20-40% waste unused or expired (Vogue Business, 2021)

Paint Toxicity

Industrial paints have volatile organic compounds

Exposure to VOCs → damage to nervous system, liver, kidneys (EPA, 2025)



Supporting Developing Nations

Economic barriers → No access to quality paints → Use of lead paint

3 Natural + Biodegradable Binders → Gum arabic, Egg Tempera, Casein

Purpose

To reduce the environmental impacts of consumer products by repurposing cosmetic waste into an accessible and abundant resource for the development of alternatives to synthetic acrylic paints and tested under various environmental stressors.

Methodology

Creating Paints



Ucanbe Eyeshadow Palette



Binders = Gum Arabic & Egg Tempera

Environmental Test Matrix

	Temp.	Hum.	UV
Temp.	32℃	44%	No UV exposure
Humidity	23℃	90%	No UV exposure
UV	23℃	44%	Constant UV: 60 Hz 120 V

Munsell Color Matching System	IR Spectroscopy	Mass Change
Coded system to assess changes of hue, value, chroma	Spectral peaks to determine chemical composition	Final Mass - Initial Mass = Change in Mass

Results & Analysis

Munsell Color Matching System

✅ Cosmetic pigments with natural binders **successfully** created usable paint for canvas and wood

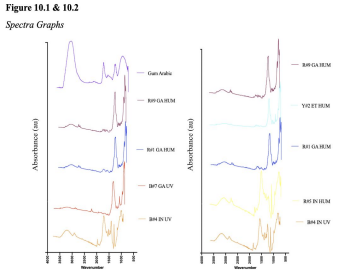
	Day 0	Day 4	Day 8	Day 12
canvas ET UV	10YR 9/2	10YR 9/2	N10/	N10/
balsa wood GA UV	7.5PB 2/4	7.5PB 3/4	7.5PB 3/4	7.5PB 3/4

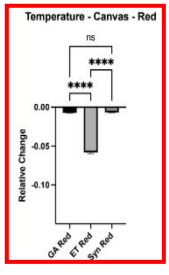
IR Spectroscopy

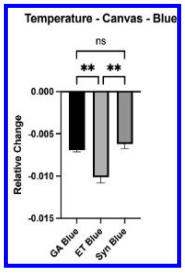
✅ Cosmetic-based paints maintain **similar** chemistry to synthetic paints and remain chemically **stable**

Mass Change

✅ Cosmetic-based paints often performed **as well or better** than synthetic paints in resisting mass loss







Conclusion & Future Research

Study aimed to: reduce the environmental impact of consumer products by repurposing cosmetic waste

Found that: Cosmetic pigments paired with non-toxic natural binders successfully produced water-based paints with a wide range of hues, values, and chromas that performed similarly or better than synthetic paints when exposed to UV radiation, humidity, and high temperatures.

Future Research

- Different cosmetic products containing pigments
- Toxicology tests to provide evidence of the paints' safeness on skin and for ingestion

Implications

Can be used by developing nations → need for quality paint → improve infrastructure and aesthetic

Easily be used to create art media

Science Research Juniors

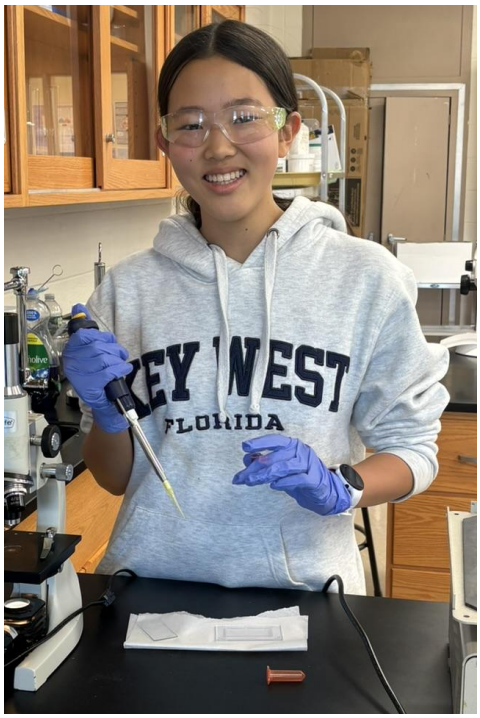


















Michelle Aldana

Investigating Whether Short-Term Temperature Increases Impact Movement Rate and Feeding Response in Brine Shrimp as Indicators of Temperature Stress



Ocean temperatures, especially surface waters, have increased significantly as greenhouse gas emissions have increased over time. Many organisms that live in the water are sensitive to temperature changes because they are ectotherms. Temperature changes can impact their movement, feeding, metabolism, and overall survival. Prior research has shown that temperature increases can impact aquatic organisms, but less is known about how short-term temperature increases impact organism behavior as an early sign of temperature stress. The purpose of this study is to investigate how short-term increases in aquatic environment temperature impact movement rate and feeding response in brine shrimp as a model for small organism response to ocean warming. It is hypothesized that brine shrimp exposed to warmer temperatures will exhibit faster movement rates and faster feeding response times. The methodology will involve 4 groups, one at brine shrimp natural temperatures and three experimental groups at slightly warmer non-lethal temperatures in order to avoid potential thermal shock. After a brief acclimation period, movement rate will be measured by observing them move over grid lines per minute under the microscope and feeding behavior will be measured by timing how long it takes them to move towards food when added. Average movement rate and feeding response will be compared between groups. It is expected that this study will help us understand if brine shrimp behavior changes can serve as early indicators of temperature stress in aquatic ecosystems.

Stella Artuso

Determining If Phenethyl Isothiocyanate (PEITC) is an Effective Tumor Suppressant in Yki-S168A *Drosophila melanogaster* Mutants



Cruciferous vegetables, commonly consumed vegetables, contain a cancer fighting compound, phenethyl isothiocyanate (PEITC). PEITC has been found to inhibit cell proliferation and induce apoptosis. Drosophila melanogaster possesses Yki, a validated functionally conserved ortholog of YAP, the human gene. When crossed with a GAL4, mutant Yki-S168A is overexpressed in the fly eye, producing tumors. This study determined whether PEITC suppressed tumors in Yki-S168A mutants. A dose response study was conducted that exposed Yki-S168A Drosophila melanogaster mutants to 0, 0.05, 0.1, 0.25, 0.5 mM concentrations of PEITC. ImageJ was used to measure the fly eye area and a metric was created to compare eye phenotypes. A one-way ANOVA revealed a significant difference in relative eye area between experimental groups compared to the Wild Type, especially in females ($F(6, 30)=[1.225]$), $p<0.0001$), and no significant difference between any experimental groups raised on PEITC ($p>.05$). Additionally, fly eyes in the experimental groups, regardless of concentration, exhibited the most severe phenotype. Two potential reasons could be that PEITC did not reach the tumor site in vivo, or that the tumor suppressor WTp53 in the nucleus was not able to suppress overactive Yki. A recent study found that when p53 is mutated, the gene is not functional and can not interfere with PEITC targeting the YAP oncogene in human cancer lines. Tumor suppression was not effective in Yki-S186A mutants, indicating the use of mtp53 may be needed to reduce the ophthalmic tumors.

Sydney Atanasio

Evaluating the Extent to which Different Gut Microbes Impact Stress Resistance in *Caenorhabditis elegans*



Intuition is the process in which the brain uses past experiences, internal signals and environmental cues to make a decision. Typically, individuals with strong intuition can make decisions and exhibit better stress resistance than those who rely on conscious analysis. Stress resistance is the ability to function in stressful situations. The gut-brain axis represents a bidirectional communication system that links the brain's emotional and cognitive centers with the digestive system's physiological processes. Gut microbes produce a variety of substances including neurotransmitters, hormones, and metabolites, that can directly influence brain function, behavior and mood. The purpose of this study is to test the impact of different gut microbes on stress resistance in the model organism *Caenorhabditis elegans*. It is hypothesized that *Bacillus subtilis* will have the greatest effect on stress resistance because it maintains nitric oxide homeostasis which regulates neurotransmitter signaling. The methodology will entail bleaching the guts of *C. elegans* to remove all present gut microbes. Subsequently, the gut will be recolonized with desired bacteria by transferring the *C. elegans* onto a liquid culture containing one strain of microbe in probiotic powder: *Lactobacillus rhamnosus*, *Bacillus subtilis*, or *Lactobacillus plantarum.* Stress resistance will be evaluated through an Osmotic Ring Assay. Future research will evaluate if adrenaline influences stress resistance in *C. elegans,* because adrenaline acts as a hormonal signal in the gut-brain axis that can modulate gut microbiota.

Kaylee Ausserlechner

Determining if Lasting Cognitive Effects in Meniere's Disease Come From Vestibular Dysfunction Using *Drosophila melanogaster Dyb Mutants*



Meniere's disease is an inner ear disorder associated with vertigo and cognitive impairment. It is unclear if cognitive symptoms in Meniere's are attributed to dizzy spells or vestibular dysfunction. The human gene α-Dystrobrevin (DTNA), involved in muscle function, has a *Drosophila melanogaster* ortholog, Dystrobrevin (Dyb), which has been validated as a model for vestibular dysfunction. Even though the vestibular system in the fly is slightly different from in a mammal, there is similarity in the underlying principles of the neurons that respond to mechanical stimuli and have the ability to detect movement. The purpose is to determine if Dyb mutants have longer lasting cognitive impairment than wild type flies after being spun in a vortex to induce dizziness. It is hypothesized that after being spun, the Dyb mutants will take longer to recover than the wild type because of vestibular dysfunction. The flies are trained in a T-Maze with a reward on one side only. The flies will then be vortexed and tested immediately after, 24 hours, and after 48 hours. It is expected that the Meniere's Dyb flies will take longer to recover than the wild type fly after being spun. Also, it is expected that vestibular dysfunction will play a role in the lasting cognitive effects in Meniere's disease.

Nils Boman

Determining Whether Assessment Design Influences the Effectiveness of Multimedia Glosses in Second-Language Vocabulary Acquisition



Second-language learners often depend on multimedia glosses, like images, text definitions, or audio explanations, to acquire unfamiliar vocabulary. While prior research has demonstrated that learning with multimedia glosses can aid in vocabulary retention, measured effectiveness of this strategy may be skewed as many studies rely too heavily on recognition-based assessments, such as multiple choice or matching. The purpose of this study will be to investigate if the design of a vocabulary test can misrepresent the effectiveness of certain multimedia glosses used for vocabulary acquisition. It is hypothesized that participants will perform better on recognition-based tests than recall-based tests, demonstrating that recognition-only testing overestimates the effectiveness of multimedia glosses for second-language vocabulary acquisition. In this study, students in grades 9-12 will learn the same unfamiliar vocabulary words using the same multimedia glosses, where each vocabulary word will be presented with an image, audio pronunciation, and written definition. Participants will then complete both a multiple choice test (recognition-based) and written definition test (recall-based). Assessment scores will be compared using descriptive statistics and a paired t-test will be done to determine whether scores significantly differ. The expected outcome is that conclusions based on gloss effectiveness will change depending on which style of test was used. Teachers could utilize this information to create more effective assessments that more accurately assess vocabulary retention and gauge student learning. Future research could involve delayed post-tests to determine how long-term retention among participants was impacted.

Dylan Bouteneff

Designing a Novel Approach to Sample Atmospheric Bioaerosols at Altitudes



Mentor:
Dr. David J. Smith
NASA

The collection of bioaerosols, airborne microbes, is an important process to understand the biological composition of the atmosphere. However, there is no standard way to sample microbes hundreds of meters up, and many methods of doing so are expensive, making the study of bioaerosols somewhat inaccessible. This study designed, 3D printed, assembled and tested a cost effective lightweight bioaerosol sampling device that was attached to a F11 Pro Ruko drone. Bioaerosols can be dispersed through the atmosphere, and this dispersal causes greater diversity. To test the viability of the bioaerosol sampling device, the device was used to measure this diversity at different altitudes in a suburban environment. Fungal spores were chosen as a bioaerosol to be collected due to its abundance and easily identifiable traits for colonies. Samples of fungal spores were collected using the device at ground level and 100 meters five different times, and it was predicted that the 100 meter samples would have a higher average diversity. The Gini-Simpsons and Shannon Evenness Indices (GSI and SEI) revealed that the 100 meter samples had an average of 7% ($p=0.1465$) and 9% ($p=0.1872$) greater diversity than the ground level samples. Although this value was not significant ($p<0.05$), the trend may mean that there is a greater diversity at 100 meters, implying that long distance bioaerosol transport may occur in suburban areas. Future uses include collecting samples at varying temperatures, humidities, and wind speeds.

Emma Cabral

Determining the Extent to Which an AI FaceCode Algorithm Accurately Predicts Personality Traits and Motivators From Facial Images Without Bias



Mentor:
Roman Kikta, Phenometrix
Jennifer Larsen,
Assessments 24x7

AI systems, although seemingly autonomous, are algorithms coded and designed by humans to perform specific tasks, make decisions, and process data. Since they are coded by humans, it is possible that AI algorithms may exhibit human-like biases. Human facial features provide cues about personality and behavior, with previous studies linking composite facial images to personality traits. Facial recognition technology operates by analyzing individuals and comparing their facial features against a trained database with inputted images or videos. A Texas-based company uses an original AI FaceCode algorithm to predict personality traits and motivators based on facial phenotypes depicted in a photo of an individual; however, it is unclear if the predictions made by the algorithm contain biases based on stereotypes. The purpose of this study is to determine the extent to which an AI FaceCode algorithm accurately predicts personality traits and motivators from facial images without bias. The methodology will involve the AI FaceCode algorithm generating a report for each teenage participant on personality traits based on the Big Five Inventory and motivators based on the Spranger and Allport test using a neutral photo. Participants will also complete a standardized version of the same tests as a self-reported measure. Multiple statistical analyses will be used to compare the data sets. It is expected that the AI FaceCode algorithm's results will not be equivalent to either self-reported test, and these differences will be larger for certain genders and ethnic groups due to biases that exist within the algorithm. Further research will explore ways to improve AI FaceCoding technology in order to determine ways to limit bias based on stereotypes.

Lori Chin

The Effectiveness of TNIK Inhibition on Cell Proliferation in Squamous Cell Carcinoma Cells



Mentor:
Dr. Kwok-Kin Wong
NYU Langone

TNIK amplification occurs in approximately 50% of squamous cell carcinoma (SCC) patients and has emerged as a potential oncogenic driver. Despite its prevalence, no FDA-approved targeted therapies currently exist for SCC patients harboring TNIK-amplified tumors. Pharmacological inhibition of TNIK may suppress aberrant cell proliferation and provide an effective therapeutic strategy for this population. In this study, TNIK-expressing lung SCC and esophageal SCC cells derived from mouse organoids and the TNIK inhibitor CGT017478-02 were used to evaluate the inhibitor’s ability to reduce tumor cell proliferation. Cell viability following drug treatment was quantified through a CCK-8 assay. As hypothesized, higher concentrations of the inhibitor effectively reduced the percentage of viable SCC cells—decreasing viability to below 50% compared with untreated controls. These findings support the potential value of TNIK inhibition in limiting the growth of TNIK-driven SCC. However, additional studies are required to distinguish TNIK-specific effects from potential off-target toxicity. Overall, these results indicate that TNIK inhibition is a promising therapeutic direction for SCC patients.

Karinah Evangeline Diaz

Determining Whether Estrogen Hormone Therapy Moderates the Relationship Between Stressful Life Events and Depressive Symptoms in Perimenopausal Women



Mentor:
Dr. Olivia Hendriks
Liverpool John Moores University

Perimenopause is the transitional period before menopause associated with low, irregular fluctuations of the hormone estrogen in women. This can contribute to increased psychological distress, including depressive symptoms. Stressful life events can further increase psychological distress and, in turn, increase the intensity of depressive symptoms. Estrogen hormone therapy (EHT) is commonly used among perimenopausal women to maintain generally stable levels of estrogen. It is known that stressful life events are associated with an increase in depressive symptoms, especially in perimenopausal women, but it is unclear if the association between the two can be strengthened or weakened by the use of EHT. Therefore, the purpose of this study is to examine whether EHT moderates the relationship between stressful life events and depressive symptoms in perimenopausal women. It is predicted that there will be a weaker association between stressful life events and depressive symptoms in women who receive EHT compared to those who do not. The methodology will include an analysis of the Study of Women's Health Across the Nation (SWAN) dataset using a linear mixed effects model. Data from the baseline visit, visit 5, and visit 10 will be used to determine EHT use, stressful life events, and depressive symptoms. Women will be grouped as EHT users or non-users, and an interaction term between stressful life events and EHT use will be used to determine if EHT use is a moderator. Future research can explore what other menopausal treatments could potentially moderate the relationship between these factors.

Isabella DiMarino

Determining Whether There is an Existing Correlation Between Family Structure and Moral Competency in Adolescents



Adolescence is a critical stage of development in which individuals begin to form a stronger sense of morality and ethical reasoning. The family environment plays a major role in shaping this development as different family structures may expose adolescents to varying levels of support, stability, and guidance. Moral competency, defined as the ability to consistently make ethical decisions, demonstrate empathy, and distinguish between right and wrong, is an important aspect of adolescent behavior. However, the extent to which family structure influences moral competence remains an area requiring further research. The purpose of this study is to determine whether there is a correlation between family structure and moral competency in adolescents. It is hypothesized that adolescents from broken or unstable family environments will score lower on measures of moral competency, as they may be exposed to harsher conditions that negatively impact their development. The methodology will involve collecting data through a questionnaire administered to adolescents, examining family structure and family affluence to account for socioeconomic factors. In addition, the questionnaire will include adapted questions from the already established Moral Competency Test by Georg Lind, modified using AI to ensure age appropriateness. Establishing a relationship between family structure and moral competency could be instrumental for organizing successful interventions, for adolescents who score lower on the Moral Competency Test. Further research may explore additional variables that contribute to moral development, such as gender differences, and how interventions can better support adolescents.

Elle Dinour

Determining the Optimal Drought Priming Interval to Enhance Stress Tolerance in *Brassica rapa*



Mentor:
Professor Liming Cai, PhD
University of Florida

Droughts have a major impact on plant growth and agricultural productivity. Plants can experience stress priming, where the exposure to an initial stress improves tolerance to that same stress in the future through molecular signaling and epigenetic mechanisms. Short-term drought responses are usually linked with hormonal signals like abscisic acid while long term stress priming has been linked to epigenetic modifications like DNA methylation. The optimal timing between two droughts that would cause the lowest wilting severity as a measure of stress tolerance remains unclear, particularly in rapid growth models like *Brassica rapa* which have demonstrated stress memory capability. The aim of this study is to find the optimal time between two droughts that would produce the lowest wilting severity during the second drought. The hypothesis is that *Brassica rapa* exposed to a second drought 3–5 days after an initial drought will show the lowest wilting severity, a potential result of hormonal signaling. All plants will be grown under controlled conditions and given 10 mL of water a day. Experimental groups will receive an initial two-day drought on days 4-5, 6-7, 8-9, or 10-11. The control group will not receive any initial drought. All groups will experience a second drought on day 13-14. On day 14, all plants will be observed and scored using a standardized scale to evaluate the wilting severity based on leaf condition. A one way ANOVA will be used for group comparison. This study may provide insight into whether stress priming is more likely driven by short-term hormonal signaling or longer term epigenetic mechanisms, with potential agricultural applications.

Cayla Ende

Studying the Effects of a Ketogenic Diet on Decreasing Seizures in *Drosophila melanogaster* with the para[ST76] allele and a GAD1 Mutation



Mentor:
Dr. Cale Whitworth
Indiana University

Epilepsy is a neurological disorder characterized by recurrent seizures. A ketogenic diet is a high-fat, low carbohydrate diet that has been linked to decreasing intensity and frequency of seizures. The SCN2A gene controls the Nav1.2 sodium channel responsible for neuronal firing. Influxes in sodium can cause misfiring and seizures. The ketogenic diet decreases insulin levels which could decrease sodium levels. GAD2 is responsible for synthesizing GABA inhibitory neurons needed to limit excessive electrical activity that causes seizures. An inability to synthesize these neurons can cause seizures. The ketogenic diet allows for the production of a ketone body called β-hydroxybutyrate that directly aids in the synthesis of GABA, which limits electrical activity. This study used para[ST76] and GAD1, functionally conserved orthologs of SCN2A and GAD2 in *Drosophila melanogaster* that show a temperature dependent paralysis phenotype, on a reformulated ketogenic Teklad diet for flies. It was hypothesized that GAD1 flies would benefit more from the ketogenic diet because of its more direct effect on GABA. A two-way ANOVA showed there was a significant main effect of diet on recovery time, $F(1,24)=48.96$, $p<0.001$, with significant Šídák post-hoc differences between diets ($p<0.05$). However, the mutation type did not have a significant effect $F(2,24)=0.72$, $p=0.496$; and there was no significant interaction between the Diet x Mutation on recovery time $F(2,24)=0.48$, $p=0.624$. More work is needed to identify the mechanism, but a ketogenic dietary intervention could provide a viable approach to treating epilepsy.

Hannah Feldman

The Effect of Alpha Tocopherol on the Rate of Regeneration in the Planarian *Dugesia tigrina*



Mentor:
Professor One Pagan
West Chester University

Tissue regeneration may be an effective treatment for specific diseases, such as Multiple Sclerosis, where nerves begin to deteriorate over time. Planaria are a valuable model organism for studying regeneration due to their unique ability to regrow missing limbs. Vitamin E is an antioxidant that has been shown to promote the growth of cells; however, its role in regeneration has remained understudied. Vitamin E can aid in the process of cellular regeneration due to its ability to increase the proliferation of fibroblasts and neoblasts, which are a form of stem cells that help to speed up the regeneration of tissues, which will increase the rate of regeneration. The purpose of this study was to determine the extent to which Vitamin E can help speed up the process of regeneration in the Planarian *Dugesia tigrina*. It was hypothesized that the worms treated with higher amounts of Vitamin E would regenerate at a faster rate than the worms that were not treated with Vitamin E. A dose-response study was conducted in which Planaria worms were placed in 0, 0.5, 1, or 2 mM solutions of Vitamin E after being cut in half. In order to determine the amount of time it took for the fragmented part to grow back, pictures of the Planaria were taken every 3 days, and then ImageJ was used to measure the amount of tissue regenerated compared to the overall size of the planarian body. Preliminary results show that the worms treated with higher doses of Vitamin E regenerated fastest. Implications include that this is a first step to determining whether Vitamin E could be a potential treatment for regenerating tissue within patients who have been affected by Multiple Sclerosis.

Alessandra Ferrara

Determining if Socioeconomic Status Impacts Lymphedema Rates in Women Undergoing Axillary Lymph Node Dissection

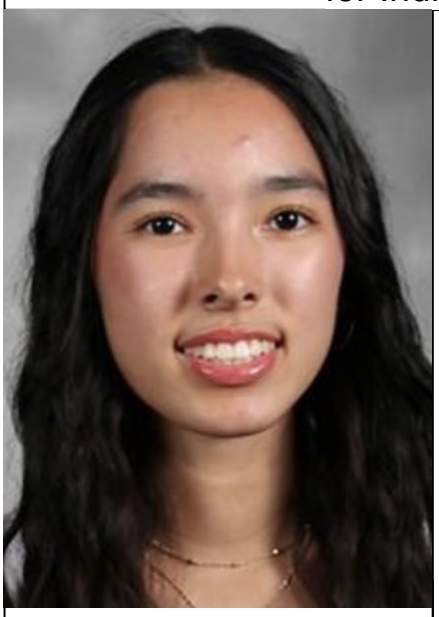


Mentor:
Dr. Andrea Barrio, MD
MSKCC

Existing research has identified substantial disparities in breast cancer treatment and survival based on socioeconomic status (SES). Approximately 20% of women undergoing breast cancer treatment, including surgery to remove lymph nodes, may experience lymphedema. Lymphedema is a condition causing chronic swelling in the arm or leg near the surgical area. An axillary lymph node dissection (ALND) involves removing multiple lymph nodes under the armpit. Because it disrupts more of the normal tissue in the underarm area, axillary lymph node dissection is likely to affect arm function and cause lymphedema. It is known that lymphedema is a post-surgical complication, however, it remains unclear whether SES is associated with the likelihood of developing lymphedema after ALND surgery. The purpose of this study is to determine whether a woman's SES impacts her likelihood of developing lymphedema post-ALND. The methodology includes analyzing deidentified patient data from a local hospital, including SES markers, QoL scores, and lymphedema development. SPSS will be used to create box plot graphs and R software will be used to create cumulative incidence graphs to compare lymphedema diagnosis over time across SES groups. Findings may guide improvements in care quality and identify other factors that influence patient QoL after breast cancer surgery.

Emma Fonteboa

Investigating the Relationship Between Self-Reported Heavy Metal Exposure History and Symptom Onset, Severity, and Progression for Individuals with Progressive Supranuclear Palsy



Mentor:
Carrie Milliard
FTD Disorders Registry

Progressive supranuclear palsy (PSP) is a rare, fatal neurodegenerative disease that leads to a progressive inability to carry out basic functions related to balance, movement, speech, and vision. PSP is associated with an abnormal accumulation of tau protein in the brain which disrupts cell function and leads to cell death. While some studies have shown potential genetic markers for PSP, there is currently no definitive cause of this disorder. Few known studies have examined whether environmental metal exposure proxies are associated with earlier onset or faster progression among PSP patients. Therefore, the purpose of this study will be to investigate the relationship between self-reported heavy metal exposure history and symptom onset, severity, and progression for individuals with PSP. The methodology will involve distributing a survey through the FTD Disorders Registry where individuals with PSP or their caregivers can opt to participate. The survey will gather information about diagnosis, age of onset, symptom severity, disease progression, and lifetime environmental and occupational exposures. It is expected that individuals with higher levels of lifetime heavy metal exposure will have earlier symptom onset and faster progression of the disorder. This study could provide preliminary insight into the role of environmental risk factors in PSP and a better understanding about potential causes.

Lianni Forbes

Determining whether Rosemary Oil Decreases Bristle Loss in *Drosophila melanogaster* with the Scutoid Mutation



Alopecia is a broad term used to describe any type of hair loss condition. Various factors, including stress, genetics, autoimmune diseases, and medication, can cause alopecia. The essential oil, Rosemary oil improves hair thickness by enhancing cellular generation. Rosemary oil has the properties of flavonoids, which support the maintenance of hair follicle health, as flavonoids contribute to countering hair loss by stimulating the WNT/B-catenin signaling pathway. The scutoid mutation causes the gradual loss of 3-4 bristles on the posterior scutellum of *Drosophila melanogaster*, mimicking hair loss in humans. This study will determine whether rosemary oil could upregulate the gene of *Drosophila melanogaster* with the scutoid mutation. The methodology will entail feeding mutant *Drosophila* with the scutoid mutation 0% .2%. .5%, 1%, 5%, rosemary oil infused cornmeal food. Photos will be taken of the posterior scutellum of the flies using an iPhone 15 under a STEMI 305 stereo microscope, 7 and 14 days post eclosion, and the number of bristles will be counted and recorded. It is expected that as the concentration of rosemary oil increases, the number of bristles present will also increase. This would demonstrate rosemary oil having a rescuing effect on the scutoid mutation so the bristles would remain longer in comparison to the control group. Implications include that more research is needed, but rosemary oil could be an effective treatment for hair loss.

Atharv Gandhi

Developing a Microbial Fuel Cell Using Post-Consumer Textiles as Substrate



Ninety-two million tonnes of textile waste are produced annually, disproportionately harming energy-insecure areas through disrupting clean energy infrastructure. Unlike technologies that produce pollution to release energy, microbial fuel cells (MFCs) produce clean energy from waste as bacteria metabolize substrates. While pure cellulose has been used as substrate and textiles have been repurposed into cathodes, few studies have harnessed post-consumer textiles as metabolic substrates in MFCs. Substrate surface area influences voltage by altering the number of active oxidation sites. This study set up four MFCs using identical 100 cm^2 pieces of a cotton t-shirt cut into 0 cm^2 (control group), 0.25 cm^2, and 4 cm^2 pieces, with the goal of producing 0.5-1V/cell within 7 days. Three of the cells included sodium acetate as a starter fuel because it can efficiently initiate bacterial metabolism. The fourth cell lacked sodium acetate, and consisted only of 4 cm^2 pieces to determine whether sodium acetate impacted voltage. By Day 7, the fuel cell with the highest surface area of textiles achieved 0.53 V, demonstrating proof of concept. By Day 35, the cell reached 0.807 V, while the cell running solely on textiles achieved 0.292 V. Additionally, regressions of voltage produced over time for all 4 cells showed a significant relationship ($p<.0001$), meaning textiles may provide a viable source of substrate. While voltage needs to increase to reach commercial viability, this study highlights how waste textile-based MFCs can release energy for frontline communities.

Sasha Geller

Identifying Volumetric Differences in the Amygdala and Its Substructures Correlated with Menstrual Cycle Hormonal Fluctuations



Mentor:
Dr. Elizabeth Rizor
UC Santa Barbara

This study aims to analyze and compare centromedial (CeM) and basolateral (BLA) amygdala complexes volume changes, to correlate follicle stimulating hormone fluctuations with the complexes volumes, and to examine hemispheric amygdala asymmetry of volume across the menstrual cycle. A secondary data analysis of the open source dataset by Rizor et al., (2024) was conducted. A ROI-based morphological analysis was completed using FreeSurfer and Python software. Linear mixed-effects models were used to perform statistical analyses with repeated measures. An Intra Subject design was used to minimize confounding variables like head size. Results found a significant leftward volumetric asymmetry of the whole amygdala across all cycle phases, changes between cycle phases were not statistically significant. The study also found that the CeM was negatively correlated with FSH levels during the periovulatory phase, but not in any other phase. The BLA showed no significant changes in relation to FSH. Results indicate there is stable leftward volumetric asymmetry of the amygdala in women, functional asymmetries to the left hemisphere and phase changes of leftward structural asymmetry have been found in women. Stable structural leftward asymmetry is not well documented. The idea that certain regions are more hormone sensitive was upheld, the CeM showed stronger responses to FSH fluctuations than the BLA. Finding significant negative correlations between FSH and the CeM during the periovulatory phase is novel. Due to the CeM's role in the neuroendocrine and autonomic nervous systems, a link between brain structure and ovulation symptoms may exist.

Jonathan Hanna

Determining the Optimal Regimen of IF to Increase the Locomotor Function and Lifespan of Transgenic Aβ42 *Drosophila melanogaster*



Alzheimer's disease (AD) cases are expected to nearly triple and impact 153 million people by 2050. AD is associated with aggregates of Aβ-peptides which can form amyloid plaques and lead to neuronal inflammation and cellular death. This results in the symptoms of AD, including memory loss, cognitive decline, behavioral changes, and decreased lifespan. While there is no current cure for AD, intermittent fasting (IF), a dietary restriction that limits food-eating periods, may lessen these effects. Previous research shows IF can reduce amyloid in the brain, improve cognitive function, enhance locomotor function, and increase lifespan in non-AD studies. However, the optimal IF regimen to improve both locomotor function and lifespan in an AD model is still unknown. The purpose of this study is to determine which IF regimen most increases locomotor function and lifespan of AD model transgenic Aβ42 *Drosophila melanogaster* expressing the “Arctic” AβPP mutation. Transgenic Aβ42 flies will be given different feeding regimens: every other day feeding, 8 hours of feeding/16 hours fasting, or *ad libitum* feeding. A negative geotaxis assay will be conducted on days 3, 8, 13, 18, 28, 33, 43, and 53 to measure locomotor function. Kaplan-Meier curves will be used to analyze lifespan probability. Males and females will also be separated to evaluate for sex-dependent differences. Flies subjected to the every other day IF regimen are expected to have the greatest increases in lifespan and locomotor function because IF will enhance autophagy and promote neuronal repair, reducing Aβ plaque formation.

Valeria Huerta

Determining Whether an Association Exists Between Musical Factors of Pitch/Tempo and Moral Competence in Adolescents



Mentor:
Dr. Alexandra Cooper
Duke University

Little is known about how external emotional stimuli, such as music, influence the moral competence of adolescents. This study aimed to determine whether specific musical characteristics of pitch and tempo impact moral competence, the consistency with which individuals apply moral principles in the evaluation of arguments. This is a valuable question because music is a regular feature in the daily environments of adolescents, and understanding its effects may provide insight into the ways in which emotional states contribute to ethical decision-making. To examine this, four moral dilemmas based on the Moral Competence Test (MCT) were constructed with the use of Notebook LM, then validated through adult reviewers. Adolescents, ages 16-18, completed pre and post test adaptations of the MCT before and after listening to one of five variations of an original music composition (high pitch/fast tempo, high pitch/slow tempo, low pitch/fast tempo, low pitch/slow tempo, or silence). C-Scores were calculated and Wilcoxon ranked test, and Kruskal-Wallis test, were used to determine the difference between pre and post test and differences across groups and individual scores. Results indicated that the change in C-scores was significantly greater in the Low Pitch/Slow Tempo than the control group ($p<.05$) and there were individual increases in C-score across all groups, the most significant being Low Pitch/Slow Tempo. These findings suggest that the pitch/tempo of a musical composition could confer an effect on the moral competence of adolescents. Clarification of this association could inform how music can be used in classrooms, therapy, or youth programs.

Kailah Hunter

Determining Whether Societal Gender Stereotypes Mediate the Relationship Between Attitudes Towards Mental Health and Access to Mental Health Services



Attitudes, both personal and communal, influence whether or not an individual will access mental health services. Gender stereotypes are harmful beliefs and assumptions about the differing characteristics men and women possess. They may explain the relationship between attitudes towards mental health and access to mental health services. For example, Social Role Theory suggests that men are often expected to appear both mentally and physically strong and are discouraged from showing vulnerability. Therefore, they are taught that expressing emotions and seeking help are signs of weakness. This may contribute to a social stigma surrounding attitudes towards mental health services. This stigma not only impacts the individual's mental health and access to helpful services, but also, data on disorders and mental health is missing due to the lack of male participation and/or male resentment to mental health services. Therefore, the purpose of this study will be to determine whether societal gender stereotypes will mediate the relationship between attitudes towards mental health and access to mental health services. 82 adult males and females were surveyed using three scales: the Mental Health Seeking Attitudes Scale (MHSAS), the Gender Roles Belief Scale (GRBS), the Community Attitudes toward Mental Illness (CAMI), and the Attitudes Towards Mental Health Problems Scale (ATMHP). Permission was received to use each scale within the survey. The results of the mediation did not support the notion that gender roles act as a mediator. However, the relationships between all three variables for Hispanic men were approaching significance ($p<0.1$). Additionally, results reinforced the role of attitudes in influencing an individual's likelihood of seeking mental health services. Further research should explore other mechanisms that could explain the relationship between attitudes towards mental health and access to mental health services.

Ryu Irahara

Investigating The Combined Effects of Temperature and Acidification on *Dugesia tigrina*: Impacts on Survival, Motility, and Regeneration



Mentor:
Professor One Pagan
West Chester University

Global warming and freshwater acidification driven by human activities can disrupt ecosystems, affecting behavior, survival, and regeneration in organisms. Freshwater organisms are particularly sensitive to small changes in temperature and pH, making *Dugesia tigrina* a valuable model due to their environmental sensitivity. The purpose of this study was to determine the effects of combined stressors of temperature and acidification on the survival, motility, and regeneration of planarians. It is hypothesized that higher temperatures and lower pH will impair these traits. *Dugesia tigrina* planarians were maintained at 19^{o}C or 23.5^{o}C and gradually exposed to decreasing pH over 11 days(7.5 to 6.0). Motility was assessed using a locomotor activity assay, survival was recorded daily, and regeneration was measured every 48 hour interval using Image J analysis. Results showed increased mortality starting from day 8, when pH reached 6.2, while survival at 19.0^{o}C remained stable. Motility was lower at 19^{o}C compared to 23.5^{o}C, and motility increased for both groups as pH decreased ($p<0.05$). Regeneration rates were higher at 23.5^{o}C compared to 19.0^{o}C on Day 11. These results suggest that the combined environmental stressors can interact in complex ways. While warmer temperature may also enhance motility and regeneration temporarily, they also accelerate under acidic conditions, indicating that multiple stressors can have compounding negative effects. This highlights the importance of studying stressors in combination to better predict how freshwater species and ecosystems may respond to climate change and acidification.

Jonida Ismajlukaj

Determining Whether Increased Susceptibility to Ferroptosis in Cancer Cells of UAS-Yki.S16A Mutant *Drosophila melanogaster* Results in Decreased Tumor Development



Ferroptosis is an iron-dependent programmed cell death. Cancer cells have shown to have a higher base iron intake than healthy cells, since the cancer cell proliferation rate is higher than that of healthy cells. An excess amount of iron in the extracellular environment can lead to an increased susceptibility to ferroptosis. The study aimed to determine whether there was a dietary way to reduce cancer cell proliferation through increasing cancer cells' susceptibility to ferroptosis using $FeCl_3$. A good model for ferroptosis in humans is *Drosophila melanogaster* since the major mechanisms which ferroptosis occurs in humans are conserved in flies. The hypothesis was that when mutant Drosophila melanogaster with the expressed UAS-Yki.S16A mutation are fed increasing concentrations of $FeCl_3$, they will have decreased tumor development due to ferroptosis occurring in the cancerous cells. UAS-Yki.S16A mutant *Drosophila melanogaster* were crossed with a GAL4 to produce eye tumors and raised on 0 mM, 2 mM, and 4 mM of $FeCl_3$. The F1 generation was tested to determine if the severity and relative size of the fly eyes better resembled those of the wild type after $FeCl_3$ supplementation. Results showed that 50% of the female fly eyes fed 4 mM of $FeCl_3$ scored a 1 on the metric and resembled the Wild Type. Additionally, there was no significant difference between the average relative eye area of these flies and the Wild Type ($p>.05$). More research is needed but iron supplementation to induce ferroptosis in cancer cells may warrant more attention, especially in females.

Priya Kaji

The Effects of Different Complexities of Dissolved Organic Nitrogen on the Growth of Phytoplankton



Mentor:
Dr. Daniel Repeta, PhD
Woods Hole
Oceanographic Institution

Nitrogen is a vital part of the environment that supports the growth of many organisms, including phytoplankton. Phytoplankton is extremely important to the environment because not only are they the foundation to most marine food webs, they are also one of the main producers of oxygen. Phytoplankton can utilize many types of nitrogen to grow but normally they utilize dissolved inorganic nitrogen (DIN), nitrogen that doesn't contain carbon, because it is easier to break down but there is also dissolved organic nitrogen (DON), which does contain carbon. There are many different complexities of both DON and DIN ranging from very simple such as urea and nitrate to very complex such as chitin. This study evaluated the effects of different complexities of DON on the growth of coastal phytoplankton. It was hypothesized that the less complex forms of DON will stimulate more growth than the complex forms. Seawater was inoculated with different complexities of DON and cell counts were completed for 7 days. Results showed that urea facilitated the greatest amount of growth over the course of the 7 days while trypsin supported the least amount of growth. The differences in growth were not statistically significant ($p=0.0683$) which suggests that there is unlikely a correlation between the growth of phytoplankton and the complexity of DON.

Ritsu Kimura

Application of Bacterial Cellulose Produced from Kombucha to Improve Soil Properties for Agricultural Use



Mentor:
Dr. Julian Silverman, FIT
Morgan Irons, Cornell

Resulting from climate change and aggressive farming practices, desertification is a major threat to the environment and survival of millions. As according to the United Nations, desertification deteriorates over 250,000,000 acres of fertile land per year, resulting in a loss of over $878 billion to the global economy. A novel approach to solve this problem is Bacterial Cellulose (BC), which transports NPK nutrients and water from deeper soil layers to topsoil and catalyzes soil nutrient cycles with increased oxygen diffusion, utilizing the absorptive properties of hydrogels. Additionally, the Mean Weight Diameter of the soil particles are determined by the equation [MWD = Σni=1 (Xi*Wi)] to analyze the improvement in the aggregation between the soil particles. Also, through the FTIR analysis and yield of the Bacterial cellulose, in terms of the cost, it reduced 85.3% of the cost of the Cellulose Nanofiber production from other methods(TEMPO-oxidation), and the 16% concentration of the black tea in kombucha produced the optimized BC to increase water capacity. This forecasting also follows the standard exponential smoothing equation [St = aXt + (1-a)St-1] to estimate the most cost-effective production methodology of BC using the kombucha. While the concentration of the NPK won't significantly be affected, the water capacity increased 34–54% and 3-11% by adding 1%w/w of BC, showing soil and nutrient cycle revitalization. Novel approach of the BC amendment into the soil is crucial in containing desertification to prevent social and economic crisis to achieve long-term sustainability of the agriculture.

Tessa Konnari

Determining whether Using AI to Create Interactive Life Story Books Increases Interaction with the Book, Time on Task, and Demeanor in a Dementia Population



Life story books have traditionally been used as a reminiscence therapy for people suffering with dementia to help them recall information from the past and preserve their sense of identity. However, these books are static so they may fail to hold the attention of dementia patients. Artificial intelligence (AI) could help in treating dementia patients by making the life story books interactive. This study will determine if utilizing AI to create interactive life story books increases time on task and demeanor in dementia patients. This research hopes to help nursing homes find an effective therapy that engages dementia patients. After IRB is obtained, the methodology will entail surveying family members to get information from the patients' lives. Only first names will be used to protect privacy. The Magic School AI Chatbot and Image Creator will be used to write and illustrate a story using the information provided. The book will be downloaded and a staff member will read it with the patient. The amount of time spent engaged with the story will be recorded and the Observed Emotion Rating Scale will be used to measure the patient's demeanor. Seven days later, the patient and staff member will read the story book again. This time, they will be able to interact with the book using the AI Chatbot and Image Maker to add to the story. Once again, time on task and the patient's demeanor will be recorded. It is expected that the dementia patients will show increased time on task and more positive demeanor when being exposed to AI based interactive life story books compared to traditional life story books. This is because the AI based life story book provides more of an opportunity to participate, which may make it easier to connect emotionally and recall memories.

Dylan Kozak

Examining the Impact That Family Narratives About Traumatic Events Have on the Distress and Resilience Responses of Survivors' Children and Grandchildren



Hearing stories of trauma can have long-term effects on both survivors and their successive generations. Prior research has shown that hearing these narratives about trauma can have effects through various mechanisms; however, it is unclear how stories about family trauma impact both distress and resilience-related emotional and physiological responses in the descendants of trauma survivors. The purpose of this study is to determine whether individuals who have been exposed to stories about family trauma or traumatic events report different levels of distress and resilience compared to individuals who have not. It is expected that descendants in families who frequently discuss their traumatic events and their history of trauma will demonstrate elevated levels of both trauma-related distress symptoms and levels of resilience. An anonymous survey will be administered to individuals 16 and older to measure each participant's exposure to family history of trauma through stories, frequency of hearing these stories, and self-reported emotional and physiological responses after hearing these stories on a Likert scale of 1-10. Participants will be categorized as those with a history of trauma versus those with no history of trauma, and their symptom scores will be grouped into a distress response and a resilience response score. T-tests will be used to compare average distress and resilience scores between groups, and a Pearson correlation will be used to test the strength of the relationship between frequency of exposure and distress and resilience scores. Future research will expand the study to compare different cultural, ethnic, and socioeconomic backgrounds to investigate the role of cultural norms.

Kinga Kozyra

The Effect of Environmental Conditions on Genetically Modified *Vibrio natriegens* to Degrade PET Plastics More Efficiently



Mentor:
Dr. Tianyu Li & Elizabeth Morgan
Crook Lab, NC State University

The global demand for plastic has increased due to its low price and versatility as a material, resulting in accumulations of polyethylene terephthalate (PET) in ecosystems that can take 450 years to degrade into microplastics. Microplastics then threaten the well-being of animals by blocking and damaging cells and essential body systems. *Ideonella sakaiensis* is a wastewater bacterium that naturally produces PET plastic-hydrolyzing enzymes (PHEs): PETase and MHETase; however, the organism and enzymes may be unable to function in saltwater environments. *Vibrio natriegens* (*Vn*) is a saltwater bacterium that has previously been genetically modified to produce PHEs; however, the process was time-consuming, and the optimal conditions for enzyme expression remained unclear. In this study, PETase and MHETase genes were introduced into *Vn* and tested at 30 °C and 37 ºC in pH levels of 6, 7.5, and 8, using MilliQ (deionized) water and exposure to BHET powder. BHET is the largest breakdown product of PET, which is metabolized into MHET and further into terephthalic acid and ethylene glycol. High-performance liquid chromatography was used to obtain the amount of proteins being produced in each environmental condition. *Vibrio natriegens* was found to favor a pH of 8 and 37 °C. Results suggest that alkaline conditions optimize degradation of BHET and, supporting future testing in authentic seawater with similar environments, to determine if PHE production and PET degradation are indeed possible as a potential solution to plastic pollution in water systems.

Kayli Kyu

Determining the Effects of DNA Methylation in Hepatocellular Carcinoma on Checkpoint Inhibitor Immunotherapy Outcomes



Hepatocellular carcinoma (HCC) is a common liver cancer with a primary malignant tumor and is the third leading cause of death in liver cancer patients. Checkpoint inhibitor immunotherapy is a treatment that revives T-cell response and immune activation and has been used to treat advanced-stage HCC because of its long-term efficacy. However, the immunosuppressive tumor microenvironment (TME) in HCC acts as a barrier to immunotherapy, as cancer cells are protected and metastasis can occur. Hypermethylation, the process of adding an abundance of methyl groups, causes changes in genes, resulting in the silencing of tumor suppressor genes in HCC. The purpose of this study was to determine whether DNA hypermethylation affected immunotherapy outcomes in patients with HCC through the downregulation of tumor suppressor genes. The methodology involved analyzing DNA methylation and gene expression data for tumor suppressor genes accessed from the open database OncoDB. Results showed a trend approaching significance, with methylation increasing in HCC patients compared to healthy controls ($p=0.092$). Additionally, the tumor suppressor genes BOLA2B, CDKN2A, FAM99B, HBB, LINC01093, PZP, TBX15, and THRSP were downregulated after methylation in HCC. A Pearson correlation analysis determined that there was a strong inverse linear relationship between methylation and expression ($r = -0.82$), indicating that as methylation increased in tumor suppressor genes, gene expression decreased. This decrease potentially silences gene function and may contribute to cancer progression. The implications of this study suggest that tumor suppressor genes may benefit from drug development targeting hypermethylation to increase gene expression and reduce cancer growth.

August Lipple Smetana

Investigating the Symptoms which Intravascular Ketamine Treats in Anorexia Nervosa Patients



Mentor:
Dr. Dora Kanellopoulos
Weill Cornell Medicine

Anorexia Nervosa (AN) is a distinct eating disorder defined by limited energy intake and self-inflicted malnourishment, leading to severe emaciation. As AN progresses, the limited caloric intake elicits neurobiological reactions, which evoke depressive symptoms such as anhedonia and dysmorphia: this commonly causes AN patients to be admitted into psychiatric care for depression. AN is also acknowledged as being recurrent and difficult to treat. Ketamine is a psychedelic drug frequently used in sub-anaesthetic doses to treat depressive disorders such as Major Depressive Disorder and Treatment Resistant Depression. Ketamine is promising as a treatment method for AN because of its unique method of working through the glutamatergic pathway. Ketamine acts as an NMDA Receptor antagonist, provoking the production and build up of glutamate in synapse, which thus stimulates the growth of new neurological pathways to reduce cognitive rigidity. Only in recent years has ketamine been used to target AN in a clinical setting, however literature on the treatment remains severely limited. The purpose of the study is to assess which symptoms ketamine addresses in AN in patients. It is hypothesized that the ketamine treatments will improve the cognitive rigidity of the patients and thus improve their appetite and caloric intake. The methodology will include accessing exclusive deidentified data of AN patients being treated inpatient with only intravascular ketamine through the New York Presbyterian Behavioral Health Center database. Timeline of symptom improvement, time of stay, weight gain, and caloric intake will be analyzed. It is expected that symptoms will improve greatly in the short-term, however after an extended period symptoms may begin to return to their original state and it will be necessary that ketamine is paired with other treatments such as psychotherapy to maintain improvement.

Marcus Lipton

Evaluating whether Cysteine Can Mitigate the Effects of Neuronal Ferroptosis in *Drosophila melanogaster* with an Overexpressed TFR1 Gene



Mentor:
Dr. Jeff Guptil
Argenx

Intracerebral hemorrhages (ICH) are a type of stroke involving the rupturing of blood vessels in the brain causing excess levels of iron in brain cells. This high level of iron content can increase reactive oxygen species (ROS) concentration due to the fenton reaction, ultimately leading to ferroptosis or iron-dependent cell death. When there are increased levels of ROS, higher amounts of reduced glutathione are used by the cell to eliminate the ROS, and reduced glutathione cannot be converted to oxidized glutathione to aid the performance of the glutathione peroxidase 4 (GPX4) enzyme and protect against oxidative stress. Cysteine, an amino acid that can help with antioxidant functions, is essential for glutathione synthesis and supports GPX4 activity. The purpose of this study is to evaluate whether or not cysteine can help mitigate the effects of ferroptosis. A dose response study will be conducted using D*rosophila melanogaster* that overexpress the transferrin receptor 1 (TFR1). An overexpression of the TFR1 protein leads to an influx of intracellular iron, likely inducing ferroptosis. Homemade cornmeal fly food will be supplemented with 0, 0.5, 10, 50, 100 mM of cysteine solutions, and locomotor ability of the fly stocks will be assessed using a negative geotaxis assay. This assay was chosen because ferroptosis results in neurodegeneration and muscular impairment, which should be reflected in the climbing ability of the flies. It is expected that as cysteine levels increase, locomotor ability of the flies will improve meaning that cysteine aided in reducing the harmful effects of ferroptosis.

Marissa Lusardi

The Decoy Effect: The Extent to Which A Stylized Format Influences Consumers' Likelihood of Choosing a Target Phone Product



Mentor:
Jack Kelly
Harvard University

The Decoy Effect is a widely known marketing phenomenon that influences consumer choice toward buying more expensive products by introducing a third option. The presentation of these products and their attributes—product qualities and descriptions—can dramatically alter consumer preferences. This study uses two different product presentation techniques, a natural condition and a stylized condition, to study the influences on the effectiveness of the Decoy Effect. The natural condition represents the objective characteristics of a product (e.g., "10-hour battery life"); the stylized condition is a subjective interpretation of information, such as customer ratings or proportions (e.g., "7/10 battery life"). A randomized controlled survey approach study was conducted by distributing four versions of a Google Form survey through Prolific. The surveys had either two or three phone choices in both the natural and stylized conditions, as well as decoy-present versus decoy-absent conditions. A chi-squared test showed that with the decoy present, there was no significant relationship between condition and phone chosen, χ^2 (1, N = 88) = 1.12, p = .290.; however, with the decoy absent, there was a significant relationship between condition and phone choice, χ^2 (1, N = 91) = 5.93, p = .015. This means that participants chose more expensive products in the stylized condition, but the Decoy Effect was not amplified by that condition. Implications include that the stylized condition may be more influential on a consumer's choice than whether or not a decoy is present.

Isabella Mariani

Altering The Reaction Between Aluminum and Water With Food Waste and Copper For Green Hydrogen Production



Aluminum is a reactive metal once its aluminum oxide barrier has been compromised. This allows the element to react with chemicals such as water, hydrochloric acid, and sodium hydroxide. In these reactions, green hydrogen is released, meaning that the hydrogen is produced without emitting carbon dioxide. The purpose of this study was to determine whether the components of a pellet made from materials commonly found in trash (aluminum from soda cans) and food waste (chicken bones to form hydroxyapatite) that was bounded together with polyvinyl alcohol (PVA), could be used to accelerate the reaction between aluminum in an electrolytic solution. Eight different compositions of pellets, involving aluminum, copper powder, hydroxyapatite, and PVA were mixed with water, hydrochloric acid (HCl), and sodium hydroxide (NaOH). The reaction time was measured in seconds. It was determined that copper powder significantly aided in catalyzing the reaction in both HCl *($p<.01$)* and NaOH *($p<0.001$)* when not in the presence of PVA. The hydroxyapatite sped up the reaction in the NaOH solution *($p<.01$)* but not in HCl. This is due to the hydroxyapatite forcing a more dispersed copper powder concentration across the aluminum that allows for an organized electrocatalytic effect allowing for easier water reduction to occur. However, in the HCl, the hydroxyapatite reacted with the acid, neutralizing the area around the aluminum, thus no longer abrasion the oxide barrier. These findings suggest an initial understanding of how pellets made from reusable resources can be utilized towards green hydrogen generation.

Kerilyn Marsh

Comparing the Performance of PFAS-Containing and PFAS-Free Cosmetics



Mentor:
Dr. Dejun Chen & Kelsey O'Malley
Georgetown University

Per- and polyfluoroalkyl substances (PFAS) are man-made substances that have long-lasting and water-resistant properties. PFAS is often referred to as a "forever chemical" because it can persist in the environment and the human body since its carbon-fluorine bonds are extremely resistant to being broken down. Many cosmetic manufacturers include PFAS within their products to provide long-lasting and water-resistant properties. Little research has directly compared the performance of cosmetics containing PFAS to those without. The purpose of this study is to investigate the extent to which cosmetics containing PFAS perform better than PFAS-free cosmetics when tested for waterproof properties, transfer resistance, and oxidation over time. The methodology will involve testing various cosmetics that have tested positive for PFAS in prior studies and cosmetics that have not using a gelatin skin model. Synthetic eyelashes attached to the model will be coated with products, and smudging, clumping, and product loss will be compared after water is applied. Lipstick samples will be applied to the model and left to dry for 10 minutes before a paper towel is pressed to measure product transfer. Foundation samples will be applied to the model and photographed every hour for a 4-hour period to observe changes in color and oxidation. It is expected that cosmetic products containing PFAS will outperform cosmetics not containing PFAS in terms of waterproof properties, transfer resistance, and less oxidation over a period of time. This is because PFAS contain strong carbon-fluorine bonds, increasing product durability and resistance to water.

Isani Mitra

Determining Whether Humidity During Heat Shock Elicits a Cardiovascular Response in *Lumbriculus variegatus*



Mentor:
Professor Matthias F. Schneider
TU Dortmund University

This study investigated whether changes in humidity during heat shock elicit a cardiovascular response in *Lumbriculus variegatus*, a question of increasing ecological importance with global climate change causing rises in temperature in humid tropical areas. Understanding how these combined stressors influence cardiovascular activity and stability in annelids can allow for better predictions about the resilience of complex species. To examine these effects, pulse propagation rate in the dorsal blood vessel was measured in 15 *L. variegatus* specimens exposed to controlled humidity environments (33%, 50%, 70% RH) at two temperatures (20°C and 28°C). Saturated salt solutions were used to generate humidities, and pulse propagation was measured beneath a dissection microscope after 10 minute adjustment periods. A two-way ANOVA tested for main and interaction effects and showed that temperature significantly increased pulse propagation across all humidity levels ($p < .001$), supporting the hypothesis that heat shock elevates cardiovascular activity. However, humidity alone did not produce a consistent or significant effect when temperature was held constant. A significant interaction between temperature and humidity was found ($F(2, 84) = 76.089$, $p < .001$) indicating that humidity affects the magnitude of heat-shock responses. These findings demonstrate that cardiovascular responses in *L. variegatus* are influenced not solely by temperature but by the combined effect of temperature and humidity, with high humidity and heat eliciting the strongest cardiovascular reaction. This interaction has ecological implications. As global warming increases high-temperature/humidity locations, annelids and similar organisms may experience heightened cardiovascular stress, which could affect ecosystem biodiversity and environmental stability.

Ines Monti Mihanovich

The Synthesis of Sodium Alginate Hydrogels with Optimal Crosslinking Density to Support Properties for Tissue Engineering and Repair



Mentor:
Dr. Tony Chen
Hospital for Special Surgery

Hydrogels are complex polymers that have the potential to be applied in biomedical fields. Hydrogels that have been structurally modified are able to mimic aspects of articular cartilage. Synthetic hydrogels such as PolyVinyl Alcohol (PVA) can mimic the mechanical properties of cartilage more effectively than naturally based hydrogels, but cannot integrate well with surrounding cartilage tissue. Naturally derived polymers such as Sodium Alginate (SA) lack mechanical properties to withstand force, but are biochemically similar to cartilage and support new cell deposition in the Extracellular Matrix (ECM), gradually encouraging cell growth and cartilage repair. This study aimed to produce a naturally based sodium alginate hydrogel with improved mechanical properties to extend its applications for cartilage repair implants. Hydrogels were modified using chemical and physical crosslinking methods, the addition of divalent cation solutions to hydrogel samples, and freeze-thaw cycles. Results showed that hydrogels with a high crosslinking density of Barium Chloride and Calcium Chloride showed significant differences in resistance to compressive forces than those of lower crosslinking densities. The results of an ANCOVA test for stress-strain values showed that crosslinking density in hydrogel samples had led to a significant difference in the elastic moduli of all testing groups ($p,0.0001$), and there was also a significant difference between the elastic moduli of PVA hydrogels and all SA hydrogels ($p<0.0001$). Findings indicate that low cross-linked alginate hydrogels were not mechanically stable under force, emphasizing the need for higher-density crosslinking strategies for hydrogels to be applied in biomedical implants.

Rihanna Mota-Sanchez

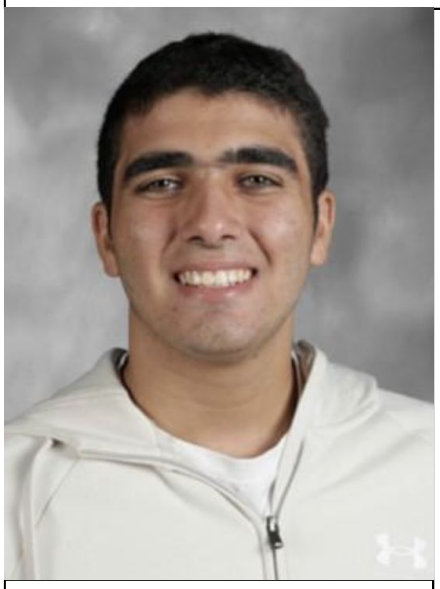
Assessing Whether Adolescent Apartment Dwellers Will Experience Less Sleep And Lower GPAs than Their Peers Who Live In Houses



The purpose of this study was to investigate whether living conditions, specifically living in a house or an apartment, affects the quality of sleep reported by adolescents and their academic performance. The methods entailed surveying 33 (apartments n =15, houses n=18) high school students who attend the same economically diverse high school in suburban, NY. The survey asked participants to state whether they lived in an apartment or house, report their affluence using the Family Affluence Scale, rate their sleepiness using the Cleveland Sleepiness Adolescent Questionnaire, and report their GPA. Results showed that the relationship between family affluence and structural residence approached significance ($p=0.057$) with higher family affluence associated with living in a house; and that students who lived in apartments reported lower GPAs but not significantly lower than those living in a house ($p=0.1066$). However, there was no significant difference between reported sleepiness and living in an apartment or house ($p>0.05$). This implies that structural residence alone cannot predict sleep and academic performance. Another surprising result was that as family affluence increased there was a decrease in reported GPA scores, although, there was no relationship between the number phones, computers and televisions and level of sleepiness or GPA ($p>0.05$). This implies that it is likely not the structural residence and specific resources that affect student sleep and academic performances but something else.

Yohanna Moussa Abdelsayed

Using Mathematical Modeling to Determine the Viability of Using Solar Fields to Overcome Pre Existing Energy Deficits in Developing Countries



Mentor:
Professor
Matt Aiello-Lammens
Pace University

Energy deserts are places where there is demand but limited supply of electricity. Many developing countries are energy deserts, including Pakistan. Limited access to electricity leads to people suffering from inhumane conditions. Blackouts occur daily which disrupts daily life, withholding manufacturing,and slowing down the economy. Solar energy may be able to be used to cover the energy deficit or fully replace non-renewable resources.This study will extrapolate from existing data of a high energy density city, a low energy density city, a suburban area, and a countryside to determine an energy deficit value per pixel in a geographic area on ESRI Land Cover Maps. Mathematical Models will be created to estimate the total energy deficit that currently exists in Pakistan using the number of pixels of each geographic area. Then, the amount of energy that can be produced and the total cost of a solar field will be calculated using a Jinko Solar Panel as a base unit. Different sizes of solar fields will be modeled to determine whether solar energy could be a reliable source of energy to fulfill the preexisting energy deficit or completely meet the energy needs of Pakistan. In the long term, having the majority of a country's electric supply coming from solar energy may be beneficial for the environment, but it may not be viable due to the immediate funding it would require and because of the significantly higher operating costs; however, transitioning to being fully solar dependent may be more useful over a longer period of time.

Sophie Olsey

Microplastic Release and Environmental Impact of Waste Plastics Incorporated into Asphalt Pavements



Mentor:
Professor Thomas Bennert
Rutgers University

Annually, 91% of plastic isn't recycled properly, contributing to 8.3 billion metric tons of plastics accumulated as landfill trash. This excessive amount of plastic piles up in the land, contaminating surrounding ecosystems. Asphalt, used to pave roads, is made with different mineral aggregates and bitumen which binds the aggregates together. Some plants are incorporating waste plastic into asphalt, partially replacing the bitumen binder. However, it is unclear if, as the roads become worn, plastics will be broken down and release microplastics into the environment, contaminating marine and terrestrial ecosystems. Therefore, this study will be to determine whether using waste plastic to replace a percentage of the asphalt bitumen composition would reduce the waste plastic in landfill, decrease the amount of bitumen in asphalt, and remain safe for the environment. Asphalt slabs measuring 50cm X 40cm X 5 cm will be produced with varying plastic percentages (0%, 3%, 6% of the total mass) of LDPE. Four different environmental simulations will be conducted to evaluate the microplastic release on the environment. 1. Water runoff will be collected off a solid slab and the change in microplastics released will be measured over time. 2. Water runoff will be collected off with a cracked slab with the inside exposed and the microplastics released over time will be assessed. Spectroscopy will also be used to determine the composition of the plastic particles. 3. Mechanical stress will be assessed by driving a vehicle over a slab, and crushing a cylinder in a compression machine. 4. Finally, a freeze-thaw test will assess the amount of microplastic particles after each freeze thaw cycle by filtering and using spectroscopy. Future research would entail incorporating plastic into a working roadway and measuring microplastic release from real world stressors.

Samuel Parsley

Assessing Changes in Locomotor Function Induced by Polyethylene Microplastic Ingestion and Rescue with Liposomal Glutathione Supplementation in Wild Type *Drosophila melanogaster*



Each week, the average person ingests about 5g of plastic. In humans, plastic accumulation can impair daily functions, causing respiratory and skin irritation, cognitive decline, and cellular damage that disrupts homeostasis. Liposomal glutathione is an antioxidant that protects cells by removing toxins like Bisphenol A and phthalates from microplastics (MPs) and other substances. Because it is food grade, it can potentially be ingested to combat the negative symptoms associated with MPs. This study aims to determine if liposomal glutathione can counteract the negative effects of polyethylene (PE) MPs on adult climbing in *Drosophila melanogaster.* The methodology involved raising Wild Type (WT) *Drosophila melanogaster* on 10 mg/mL and 25 mg/mL PE MP diets, and then transferring the adult flies to a liposomal glutathione diet for 48 hours. Contrary to the findings of Ranjan et al. (2024), results showed that the 25 mg/mL PE MP diet significantly increased the locomotor ability of the flies ($p<.0001$), and the 10 mg/mL diet showed a significant increase in flies >10 days old ($p<.05$). >10 day old flies fed liposomal glutathione performed similarly to the WT ($p>.05$). Even though flies on the PE MP diets performed better, it is possible that the hyperlocomotion observed was actually a sign of neurological distress. This is because PE MPs are known to cause a disruption in the circadian rhythm of model organisms which affects hyperactivity. Liposomal glutathione might have counteracted these effects.

Gabriela Perez Capcha

Using Bioinformatics to Determine Molecular Targets of the Enriched Pathways of Osteosarcoma



Mentor:
Dr. Gregory Hamilton
Icahn School of Medicine

Osteosarcoma is the most common type of bone cancer, prevalent in children and adolescents, characterized by tumor heterogeneity. It derives from malignant osteoid producing mesenchymal cells and has yet to have an identified cause. Non-metastatic chemotherapy has been successful, but metastatic cases have a survival rate of 20%, calling for greater treatment research. Targeted therapy, a growing therapy alternative, aims to use drugs to target proteins which progress cancer. Since osteosarcoma has high tumor heterogeneity, single protein targeted therapies are unlikely to be universally effective in osteosarcoma. To address this challenge, this study aims to identify molecular pathway drivers that consistently progress osteosarcoma progression with the goal of expanding the diversity of treatments. To perform this, RNA-sequencing data will be analyzed comparing osteosarcoma and normal bone tissue samples, using differentially expressed genes in combination with biological pathway enrichment to determine which signaling pathways are the most strongly and consistently enriched, narrowing down the focus of proteins. Preliminary pathway analysis highlights the Hippo Signaling Pathway, creating an investigation into the proteins involved in the nuclear activation of YAP and TAZ, as well as additional proteins that may more directly drive osteosarcoma progression specifically related to the bone.

Charlotte Reville

Examining Whether High MHC2 Expression in Tissue Corresponds to Response in LAG-3 Inhibitor Therapy in Patients Who Received Nivolumab and Relatlimab Combination Therapy



Mentor:
Dr. James Smithy
MSK Cancer Center

Melanoma is the most aggressive form of skin cancer. Treatment options include Immune Checkpoint Inhibitor (ICI) immunotherapies some of which are called Nivolumab and Relatlimab. Effectiveness is high yet there are varied responses to this treatment. LAG-3 Inhibitors (Relatlimab), a form of ICI, target the and block the LAG-3 checkpoint on T-cells preventing the immune evasion of cancer cells. MHC2 is a surface glycoprotein that helps mediate the T-cell antitumor behavior. MHC2 is also involved in promoting the same anti tumor T-cell behavior as the LAG-3 Inhibitor therapy. The purpose of this study will be to determine if high MHC2 expression in tissue will correspond to a response in LAG-3 Inhibitor therapy, in patients who received Nivolumab and Relatlimab combination therapy; this could be a first step towards personalized treatment plans for patients. This study will be conducted by working with Memorial Sloan Kettering Cancer Center (MSKCC) to build data sets from stains of biobanked melanoma from patients who received Nivolumab and Relatlimab combination therapy, to determine if high MHC2 corresponds to a response in LAG-3 Inhibitor therapy. It is expected that when there are high levels of MHC2 there will be an improved response to LAG-3 Inhibitor therapy in patients who received Nivolumab and Relatlimab combination therapy. As more MHC2 expressed will allow for a higher T-cell anti tumor response combined with LAG-3 helping facilitate cancer cells from immune evasion, leading to an effective treatment.

Emily Savocchi

The Extent To Which Eliciting Stress Alters Brain Waves in Convergent and Divergent Thinking Tasks



Convergent and divergent thinking represent two different types of cognitive processing approaches to problem-solving. Convergent thinking involves identifying a single correct solution and is associated with beta and gamma brainwaves, while divergent thinking involves generating a range of potential outcomes and solutions and is linked with alpha and theta waves. Research has shown that different brainwave frequencies are associated with different cognitive processes and can improve or impair them. While prior research has shown stress influences focus and creativity, less is known about whether stress alters brainwave activity associated with convergent and divergent thinking tasks differently. The purpose of this study is to determine the extent to which acute stress alters brainwave activity during convergent and divergent thinking tasks. The methodology will involve participants completing the Remote Associates Test (RAT) to measure convergent thinking and the Alternate Uses Task (AUT) to measure divergent thinking while wearing the Muse EEG device. Under a counterbalanced design to reduce order effects, participants will complete both tasks under stress and no stress conditions while EEG data is collected before and during all tasks. The stress condition involves time pressure, including a countdown timer with sound cues, and social-evaluation pressure by stating results will be scored and compared to other participants. Brainwave activity will be compared across task type and stress conditions. Stress is expected to alter brainwaves in both tasks, but have a greater negative impact on divergent thinking because it is likely to reduce alpha and theta brainwave activity, associated with creativity. This research can have important implications for educational and workplace settings.

Raito Sekine

Evaluating the Mediating Role of Cognitive Distortions in the Relationship between Musical Self-Efficacy and Musical Performance Anxiety



Anxious and depressive disorders such as stage fright are abnormally frequent in musicians, limiting and sometimes debilitating their career opportunities. Musical performance anxiety (MPA) is a disorder marked by persistent anxiety within performance situations. Self-efficacy is an individual's belief in their ability to perform a certain task. Cognitive distortions are irrational negative cognitions regarding the world. Existing literature has established the relationship between self-efficacy and MPA, but studies have not examined cognitive distortions in relation to either. Currently, limited understanding of cognitive processes in MPA makes development of treatment methods difficult. Research on how distortions affect MPA and efficacy could identify a specific mechanism by which MPA is induced and guide use of therapies such as CBT. The study determined if cognitive distortions mediated the relationship between self-efficacy and MPA. Relationships between variables and differences between demographic groups were also considered. Data was collected from 39 high-school musicians in a survey containing the following validated instruments: the MPAI-A, SEMP, and CDS. Major findings included that cognitive distortions did not mediate the relationship, as the indirect effect was not significant ($b = -.1330$, 95% CI: [-.435,.099]), although all three linear regressions between variables were significant ($p<.01$). Female musicians reported higher levels of MPA ($p = .006$). Instrumentalists reported higher distortions ($p = .047$). Findings were surprising and suggest development of a music-specific distortions inventory or studying alternate mediators such as perfectionism. Building self-efficacy should remain a focus in therapies and vulnerable groups such as female musicians should be prioritized.

Gabriella Smyth

Comparing Microbial Diversity and Concentrations on Surface Materials in Transportation Systems in Urban Environments



Mentor:
Dr. Alexander Lucaci
Weill Cornell

Transportations systems with an increasing global connection are posing higher risks for transmission of disease for passengers and workers. Although clean practices and sanitation are in place, it can only reduce the risk to an extent. It has been found that environmental parameters such as temperature, humidity, and PM levels affect the spread and growth of microbes. Micropores and moisture properties, found on porous materials, allow microbes to accumulate and survive within the material. As microorganisms are trapped, this may lead to a higher diversity of microbes. For this reason, the interest of this study is aimed to focus on the impact of surface materials in different transportation systems and how they interact with microbes. It is hypothesized that porous surface materials will support a greater diversity and concentration than non-porous materials. Additionally, the diversity is expected to vary across cities with higher variation in airports than subways and bus stations due to greater range of exposure. The methodology will involve systematically identifying samples of highly touched surfaces in airport, subway and bus stations from A global metagenomic map of urban microbiomes and antimicrobial resistance by Danko, Bezdan, et al. (Cell, 2021). Galaxy will be used for data analysis and Kraken will be used for DNA identification. Bray Curtis models will be created to quantify the difference in species composition between the different materials. In addition, microbial counts and types will be compared across locations. It is expected to see greater variation and concentration on porous materials, such as biological surfaces, with more diversity in airports. These findings may lead to improved material design and its role in limiting microbial transmission, as well as possibly sanitation precautions.

Rosa Strino

The Effect of L-Carnitine and Pantothenate Supplementation on UAS-ENOK Knockdown *Drosophila Melanogaster,* A Model for Kat6A

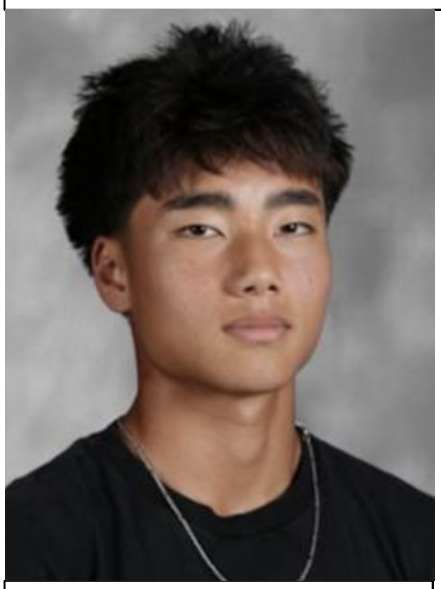


Mentor:
Dr. Paul Marcogliese
University of Manitoba

The KAT6A gene is mutated during pregnancy resulting in a rare genetic syndrome. There are only 500+ diagnosed cases worldwide but it is recognized by over 70 countries.. Despite this, there isn't an exact number due to potential misdiagnosis and undiagnosed cases. Symptoms of the syndrome include but are not limited to: autism, speech delays, heart defects, and abnormalities in bones. KAT6A is associated with lowered histone acetylation and results in changed gene expression patterns as well as low regulation in the important proteins used for cell metabolism. L-Carnitine, which is found in red meat, carries long-chain fats across the membrane so they can be burned for energy while additionally acting as a brake on enzymes which usually remove acetyl groups from histones. By blocking these enzymes, l-carnitine keeps the KAT6A gene "turned on." Pantothenate, also known as Vitamin B5, converts itself into coenzyme A which is a molecule that helps create Acetyl-CoEnzymeA providing energy through the Krebs Cycle. When combined, they may help with improving mitochondrial function, increasing histone acetylation, and correcting protein / transcriptomic expression patterns, potentially mitigating the effects of the syndrome. The purpose of this study was to determine whether L-Carnitine and Pantothenate, together would improve the climbing ability in *Drosophila melanogaster* which possesses the required gene, ENOK. The hypothesis was that combined supplements would improve the defects, even though it wouldn't reverse the mutation. To test, the method was to cross flies containing the UAS-ENOK and the ELAV-Gal4 which is a promoter that drives expression in neurons. Next, negative geotaxis assay was performed to determine the success of the diet. Preliminary results showed that the crossed flies have performed significantly better when the diet was supplemented with pantothenate ($p<.05$). It's expected that the flies on both supplements will perform even better.

Jun Tanaka

Using Binary Logit Regression to Predict How the Shape of A Cleat Stud Affects the Likelihood of Lower Extremity Injury



Mentor:
Professor Olu Owoeye
St. Louis University

As a competitive sport, many who participate in soccer suffer from injuries. Professional soccer players sustain 4 to 35 injuries per 1000 hours of exposure due to increase of speed and intensity by extreme competition. And in those injuries, lower extremity injuries are the most common. These lower extremity injuries will not only ruin their soccer careers but also will stop them from being mobile. Cleat studs provide essential traction, stability, and a grip on the surface to allow players to run with maximum speed, accelerate, decelerate and change directions without slipping. Sudden stops or change of direction will cause blood to pool in the lower extremities, increasing stress on joints and ligaments, or damaging nerves if nerves cannot tolerate the load The purpose of this study is to determine whether a clear relationship exists between the shape of the cleat studs and lower-extremity injuries. It is hypothesized that if the cleat stud is smaller and less sharp, players will have fewer chances of injuries and also maintain their performance because it creates less tension to the lower extremity and allows the players to maintain high running speed and sudden turns. A logistic regression will be run to determine the extent that the shape of the cleats influence the chance of getting a lower-extremity injury injury. Using different match-tracking websites and apps, such as Fotmob and PremierInjuries, up to 70 professional soccer players who injured their lower legs while playing in the Premier League were identified. The type of cleats they wore when they were injured was determined. When creating a logistic regression, the position on the field and BMI will be controlled. Implications include that manufacturers can produce cleats and cleat studs that would better protect players from lower extremity injuries and extend their careers

Lily Tse

Determining the Extent to Which The Amino Acid D-leucine Influences Resistance and Recovery Time of Seizures after Heat-induced Paralysis in para[ST76] Mutated *Drosophila melanogaster*



Dravet Syndrome is a severe, treatment-resistant genetic epilepsy caused by mutations in the SCN1A gene, which disrupt Nav1.1 sodium channel function, leading to hyperexcitable neural networks, temperature-sensitive seizures, and developmental complications. This study determined whether D-leucine rescued the effects of the para ST76 in Drosophila melanogaster by raising resistance time and lowering recovery time. Para ST76 mutant Drosophila, an ortholog model of human SCN1A mutations, were raised on diets containing 0 mM, 1 mM, 3 mM, 5 mM, or 10 mM D-leucine. Heat-induced seizures were simulated using a 40°C water bath, and resistance to paralysis and recovery times were recorded. Recovery was defined as the point at which 50% of flies regained posture and coordinated movement. An ANOVA showed that D-leucine significantly increased resistance to heat-induced paralysis and reduced recovery times compared to control diets, with all experimental groups performing better than the control. The 10 mM diet produced the greatest improvements ($p < 0.001$), with 95% confidence intervals of (-21.89 to -12.61) for resistance time and (25.70 to 35.30) for recovery time. Improvements were dose-dependent, as higher D-leucine concentrations corresponded with increased resistance and faster recovery. These results support the neuroprotective effects of D-leucine in mitigating seizure severity in para ST76 mutants. They suggest that more research is needed but D-leucine may rescue sodium-channel dysfunction caused by SCN1A/para mutations, stabilize neural excitability, and reduce seizure susceptibility, offering a promising amino acid-based therapeutic strategy for Dravet Syndrome. Using D-leucine could complement or provide a safer alternative to traditional antiseizure medications.

Jack Weinberg

The Effect of Lexile Level on High School Students' Answer Consistency and Accuracy in Personal Finance Decision-Making



Mentor:
Professor John Grable, PhD
University of Georgia

Financial illiteracy refers to the lack of knowledge and skills related to personal finance, including budgeting, saving, investing, managing debt, and understanding financial products and services. A lack of knowledge proved costly for Americans, upwards of an estimated $280 billion dollars in 2017 (NFEC, 2024). Despite growing awareness of this issue, many young adults still enter adulthood devoid of a foundational understanding of key financial concepts, leaving them vulnerable to poor personal-financial decision making throughout their lives. While prior research has shown that many teenagers lack financial literacy skills, there is a lack of knowledge regarding whether the wording of a personal finance question affects the accuracy and consistency of student responses. The purpose of this study is to examine whether the complexity of a question, as measured by Lexile level, affects the consistency and accuracy when high school students make personal financial decisions. It is hypothesized there will be a higher level of consistency and accuracy when items are written at a lower Lexile level compared to items written at a higher Lexile level for all types of financial decisions. The methodology will entail administering a survey targeting three types of financial literacy questions: interest, interest versus inflation, and diversification. Each section of the questionnaire will have a low, medium, and high level complexity question as measured by Lexile level. It is expected that questions with lower Lexile levels will be related to more consistent and accurate participant responses across decision types. Further research will investigate whether a similar trend is evident in different socioeconomic environments.

Sasha Weiner

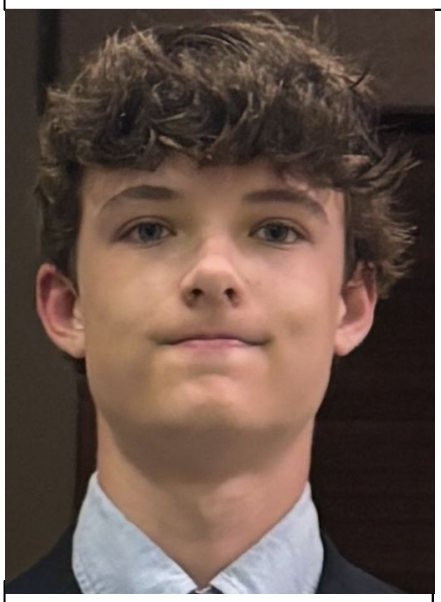
Determining if Parental Involvement Mediates the Relationship Between Exposure to Violence in the Media and an Adolescent's Mental Well Being (MWB)



Adolescents today have widespread access to newspapers, video games, social media, and television, increasing potential exposure to violence (EXV). Research suggests that EXV can negatively affect adolescents' mental well being (MWB), potentially leading to distress. Parents may play a critical role in mitigating these effects by monitoring media use and encouraging healthier choices. This study aimed to examine whether parental involvement (PI) mediates the relationship between EXV in the media and adolescent MWB. After IRB approval, a survey was distributed to the adolescents. Participants rated their EXV in media and PI using a Likert scale (1–5). MWB was assessed using the Warwick-Edinburgh Mental Well-Being Scale (WEMWBS). Demographic information was also collected. Linear regressions were conducted to analyze relationships among EXV, PI, and MWB. Results indicated no statistically significant relationships among the variables. PI did not predict mental well-being, EXV was not associated with PI, and EXV did not predict MWB. The extremely low R^2 values across all models suggested that the variables explained minimal variance in one another. As a result, PI was not supported as a mediator in this relationship. Although no significant effects were found, these results highlight the need for continued research on how parents can support adolescents in managing media related stress. Limitations such as small sample size and limited demographic diversity may have influenced the outcomes. Future research should examine larger and more diverse populations and consider cultural or socioeconomic factors that may shape adolescents' vulnerability or resilience to media violence.

Flynn Williams

Increased Drug Use as a Mediator Between Neighborhood Disorder and Juvenile Offending



Mentor:
Professor Matt Aiello-Lammens
Pace University

While juvenile crime has seen an overall decrease in the past decades, the frequency of violent offenses, particularly homicides, has increased in recent years. Moreover, there was an estimated total of 549,500 juvenile delinquency cases in 2022, and 84% of Juvenile Offenders reported ever using drugs, displaying dire need for policy action. Research has also explored neighborhood disorder, or low levels of social cohesion and increased disorganization within particular communities. Research finds a significantly positive relationship between neighborhood disorder and juvenile crime, as well as a significantly positive relationship between neighborhood disorder and alcohol and drug use. Thus, the purpose of this study will be to analyze the extent to which increased drug use acts as a mediator of the relationship between neighborhood disorder and juvenile offending. It was hypothesized that drug use will partially mediate the relationship between neighborhood disorder and juvenile offending, indicating that drug use, while not the sole or most important factor, acts as a method through which neighborhood disorder predicts juvenile offending. Data pertaining to juvenile offender's drug use and neighborhood conditions were collected from Mulvey *et al.'s* *Pathways to Desistance* study, which interviewed over 1,000 violent juvenile offenders from Pennsylvania and Arizona. In addition, data was statistically analyzed via a mediation analysis using IBM SPSS and PROCESS v.5.0 software. The results showed a significant and positive mediating effect, with drug use explaining about 19% of the reason neighborhood disorder predicts juvenile offending. These results carry many implications for future public policy, particularly the need to implement stringent drug use regulations, programs, and policies.

Sophie Wong

Designing a Montmorillonite-Potato Starch Nanocomposite for Increased Phosphorus Delivery to *Raphnus sativus*



Mentor:
Dr. Jason White
Connecticut Agricultural Experiment Station

Excessive phosphorus fertilizer usage has caused nutrient runoff and leaching that contributes to global eutrophication, and interestingly, only 10-20% of applied fertilizers are utilized by crops. Biopolymer nanocomposites derived from potato starches are structurally weak, but may be improved with nanoclay reinforcement. This study evaluated the ability of montmorillonite nanoclay to enhance the phosphorus delivery properties of potato starch nanocomposites, aiming to determine the specific percentage loading that maximizes phosphorus uptake in Raphanus sativus. Seeds were planted in soil with nanocomposites containing incremental montmorillonite percentage loadings (0, 5, 10 and 15 wt%) and fixed amounts of CaPO4. Post-germination, sprouts were grown for 34 days and measurements were taken for biomass, anthocyanin production, and elemental analysis to evaluate P, Ca, K, and Na uptake. Elemental analyses demonstrated that montmorillonite reduced phosphorus uptake, revealing decreasing trends: While the 10 wt% and 15 wt% loadings had significantly less phosphorus ($p<0.01$), the 5 wt% loading was most similar to the control. Similarly, interlayer cation absorption indicated decreasing trends pertaining to groups containing montmorillonite: The 5 wt% absorbed significantly higher amounts of Na ($p<0.01$) and the highest amount of Ca, while the 15 wt% consistently had reduced absorption of Na and a significantly reduced absorption of K ($p<0.01$). Despite elemental differences between groups, no significant differences in biomass and anthocyanin production were observed. Results show that increasing montmorillonite loadings create a more intercalated and tortuous structure that absorbs fewer cations, limiting the expansion of the clay layers, ultimately reducing phosphorus release. The findings highlight a tradeoff between structural reinforcement and release rates, indicating that lower nanoclay loadings may improve functional performance while higher loadings may improve long term nutrient release.

Fujiko Yamada

Determining the Effectiveness of Tannic Acid in Removing Microplastics from Sandy Soil Samples



Microplastics are tiny plastic particles that have been broken down from larger plastic items. Due to their size, they end up in various environments, such as soil. After contact with soil, microplastics pose a threat to its porosity, structure, and nutrient intake. While various methods have been attempted to remove microplastics from soil, many of them are expensive and/or time-consuming. Tannic acid (TA) is a common, naturally derived plant compound that is found in multiple sources, such as nutgalls, oak wood, and fruits. Oosthoek in 2023 found that 95.2% to 99.9% of microplastics were coagulated and removed from water through the application of TA. However, it is unclear whether TA can also remove microplastics from soil samples. The hypothesis is that higher concentrations of tannic acid will increase the removal efficiency of polyethylene microplastics from sandy soil samples through coagulation. The methodology will entail three experimental groups, in which the soil samples will receive different TA concentrations (0.05%, 0.1%, and 0.2%). After 24 hours of the TA application, an olive oil-based separation method will be used to extract microplastics from the samples. The microplastics were counted using a Sedgewick-Rafter cell under 10% magnification of a Wolfe light microscope, and the removal efficiency was determined. Preliminary results showed that after a 0.1% TA concentration was applied to a 0.1% PE aqueous solution, the microplastics showed signs of coagulation. Currently, TA is being applied to the soil samples. Further research will determine whether the addition of other coagulative materials, such as Chitosan, will increase the removal efficiency of microplastics from TA applied soil samples.

Bennett Yates

Using a Supervised Learning AI Model to Predict Concussive Impacts Based on the Speeds and Angle of Head-to-Head Player Collisions in the NFL



In the National Football League (NFL), over fifty percent of concussions go completely undetected, undiagnosed and without proper care. Player-to-player contact, more specifically helmet-to-helmet, is the leading cause of concussions, accounting for around 70% of all concussions. A concussion is a significant impact to the head that results in a mild traumatic brain injury (TBI), altering the brain's function. Artificial intelligence (AI) algorithms can analyze vast amounts of video data to identify patterns and insights that would be difficult for humans to detect, providing data-driven insights to make better decisions about when to implement medicinal measures. The purpose of this study will be to use an AI model that is capable of analyzing existing athletic video footage to identify concussive impacts based on the angle and speed of the players involved. Supervised learning will be implemented where the algorithm is given short video clips that are labeled as either concussive or non-concussive head impacts. The methodology consists of the use of MATLAB, a programming computing platform that generates embedded code, to train and create an AI model with past NFL video footage from multiple games in the past decade. Currently, based on an analysis of fifteen sets of data points from the impacts, the created AI model has an accuracy of 54.5%. However, it is expected that increasing the number of sets of data points (to fifty) will result in a model of higher accuracy. Future research would improve upon the AI model, allowing it to analyze live game footage and determine a risk for concussion in real time, effectively saving players from further injury. This could be accomplished through a combination with an in-real time monitor to determine the angle and speeds of collisions, such as the 'X-Patch sensor'.

Sydney Young

Determining the Extent to Which Social Stress, Physical Stress, and Cognitive Overload Impact Memory Encoding and Retrieval



Mentor:
Dr. Matt Nichols, PhD
Rivergreen Psychology

Many teenagers are exposed to stress during various experiences in their day-to-day lives. This stress can be social stress in response to social structures and interactions, physical stress in response to physical pain or discomfort, or cognitive overload stress due to exposure to excessive external stimuli. Stress activates the hypothalamic-pituitary-adrenal (HPA) axis, which results in secretion of the stress hormone cortisol. Cortisol increases heart rate and can attach to hippocampal receptors, impacting both memory encoding and retrieval. While previous research has explored the effects of stress on memory, a direct comparison of the impact of social, physical, and cognitive overload stress on both memory encoding and retrieval has not been fully studied. The purpose of this study is to determine the extent to which social, physical, and cognitive overload stress affects memory encoding and retrieval in teens. It is expected that cognitive overload will most drastically impact both memory encoding and retrieval. The methodology will involve two sessions over two separate days for each participant in which immediate recall will measure encoding and delayed recall will measure retrieval. In the control session, participants will undergo an adapted auditory verbal learning test with no stress. During the stressor session, participants will undergo a parallel auditory/verbal learning test while undergoing one of three stressors: cold pressor (CPT), social stress (TSST), or a cognitive overload simulation. Both sessions will have a 15-minute distractor period prior to delayed recall. Future research will identify ways to reduce the impact of stress on both memory encoding and retrieval, as well as examine gender differences in the impact of stress on memory.

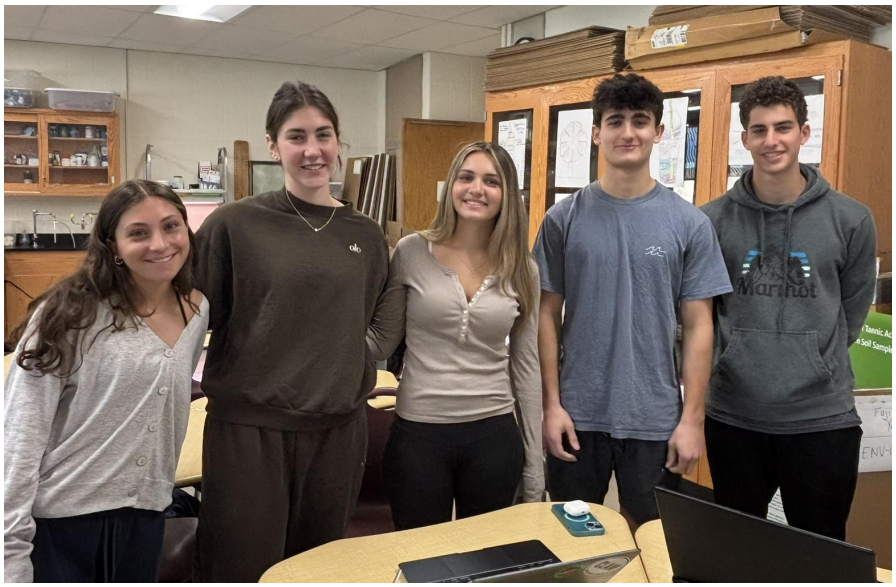






Science Research Sophomores





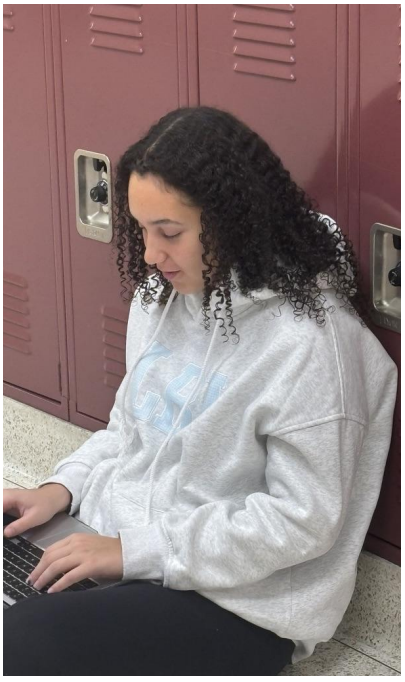












Antonio Albanese

Determining the Extent to Which Primary Sport Playing Surface Predicts Hip Mobility Measurements in Male High School Athletes



Femoral-acetabular Impingement (FAI) is a common hip condition among adolescent athletes where excess bone growths and lesions can cause pain, labral damage, and premature arthritis. This can lead to decreased hip mobility and range of motion (ROM). Repetitive stress on the capital femoral physis and triradiate cartilage during adolescence has been suggested to play a significant role in causing this hip abnormality. However, it is unclear whether the primary playing surface for young athletes is associated with differences in hip ROM. The purpose of this experiment is to determine the extent to which primary sporting surface predicts hip ROM measurements in male high school athletes. It is hypothesized that athletes who play on harder surfaces, such as concrete and hardwood, will show decreased ROM due to greater stress impact on the joints. The methodology will involve surveying current male high school athletes on their primary sport and playing surface, years spent playing, hours per week spent training and participating in mobility enhancing exercises, and injury history. Participants will then complete standardized hip mobility assessments, including the FADIR test and goniometric measurement of hip ROM. Multiple linear regression will be conducted to determine the extent to which primary playing surface is associated with hip ROM scores after controlling for years of participation, training and stretching frequency, and injury history. Future research can evaluate whether these findings differ in female high school athletes or athletes at the collegiate level.

Paige Bianchini

Determining the Effect of 5-Hydroxytryptophan on Repetitive Grooming Behavior in a *Drosophila melanogaster* Model for Compulsive Behavior



Body-focused repetitive behaviors (BFRBs) are compulsive self-grooming habits, including nail biting, skin picking, and trichotillomania. They can decrease quality of life through physical damage, emotional stress, and social stigma. Though not fully understood, BFRBs are believed to stem from genetic and environmental factors, namely lower serotonin levels. Current treatments like habit reversal training or antidepressants may be limited by access, adherence, and incomplete symptom reduction. Limited research has evaluated whether over-the-counter serotonin precursor supplementation can reduce repetitive behavior in a fly model. The purpose of this study is to determine the effect of different concentrations of the serotonin precursor 5-Hydroxytryptophan (5-HTP) on grooming behavior in an NF1 mutant Drosophila melanogaster model compared to wild-type flies. The methodology will involve feeding both fly types different concentrations of 5-HTP: 0mM, 1mM, 3mM, 5mM, 10mM, or 25mM. Grooming behavior will be measured using a dye-based assay: flies are coated with bright yellow powder and allowed to groom for 30 minutes. The remaining dye is dissolved into a solvent and quantified using spectrophotometry. A two-way ANOVA test and a Tukey's Post Hoc test will be used to compare results between the mutants and controls across doses. It is expected that moderate doses of 5-HTP decrease repetitive grooming behaviors most effectively in both fly models, but more pronounced results in the mutant line. Higher concentrations may lead to a plateau effect because of decreased locomotor activity from the natural sedative effect of 5-HTP. Future studies will determine how NF1 flies respond to dose-related 5-HTP concentrations under stress to see if environmental factors reduce its efficacy.

Gabriel Biggs

Effect of Gradual Temperature Change and Heat Waves on the Filtration Rates of Mercenaria mercenaria from the Long Island Sound



Current ocean temperatures are at their highest recorded in human history, and still increasing. Rising temperatures are affecting marine life through gradual temperature changes or heat waves where temperatures heavily increase over a short period of time. The LIS, a coastal estuary filled with diverse ecosystems, has experienced a significant decrease in biodiversity and species richness. Key organisms like *Mercenaria mercenaria* (Hard Clams), filter water, removing particles like algae, bacteria, and organic matter. They are located in estuaries where ocean saltwater mixes with freshwater. These filter feeders play an important role in regulating phytoplankton numbers and help transfer energy from tiny organisms to larger animals. Scientists have studied the effects of temperature stress on bivalves, as well as the filtration rates of clams. This study focuses on different patterns of temperature change, gradual increasing temperature versus abrupt thermal shocks, affecting the filtration rates of hard clams. Hard clams will be collected from the LIS and placed into controlled aquariums. Methods include increasing water temperature slowly to simulate climate change and increasing temperature rapidly to replicate a heat wave. Filtration rates will be measured by putting a fixed amount of particles in the water and measuring the change over time. It is expected that clams exposed to gradual temperature shifts will experience more stable filtration rates, while clams placed in temperature-shocked environments will have drastically affected filtration rates because the clams won't be able to adapt to their new environment. In a heat-shocked environment, clams may close their shells to avoid the heat, decreasing filtration. Future research could look into other stressors like salinity, acidification, or pollution, interacting with temperature stress to further affect filtration rates in hard clams.

Seraphina Blackman

Testing Speed and Accuracy of Triaging During Emergency Situations in EMTs of Varying Levels of Expertise to Train Novices



Mentor:
Professor Sarah Rossetti
Columbia University Irving Medical Center

After working for years, professional Emergency Medical Technicians (EMTs) gain expert intuition, where they recognize patterns and make rapid decisions, rather than relying on specific training they have completed. One situation where this is seen can be during triaging in mass casualties where patients are sorted into different groupings depending on the severity of their condition. This study will measure the speed and accuracy of triaging with EMTs of varying levels of expertise, and this information will be considered in the context of using it to train novice EMTs. It will be hypothesized that EMTS with more years of experience will be able to triage faster and more accurately. The methodology will involve providing EMTs with a questionnaire including questions about how long they have been working in the field, and how confident they are in their abilities. They will then be provided with an original virtual simulation in which they will receive patient symptoms and vital signs. They will be asked to triage a large number of patients in a short amount of time. The results will be analyzed to measure the correlation between EMT levels of expertise, and speed and accuracy of triaging. If shown to be a helpful tool, the simulation will be considered to later be employed with novice EMTs to help them train how to triage by utilizing their intuition. The expected outcome is that EMTs who have been working for longer will show greater speed and accuracy while triaging, due to the intuition they have acquired, allowing them to make rapid decisions. Future research in this topic could focus on novice EMTs who train using this simulation, and study how their intuition develops.

Jordan Blake

Evaluating AI Writing Detection Tool Bias Toward Formal Writing Among Non-Native English Speakers in Educational Settings



As AI advances and becomes increasingly difficult to distinguish from human work, writing detectors have become increasingly common in schools to prevent plagiarism. However, Stanford HAI (2023) found that AI detectors disproportionately flag writing by non-native English speakers as AI-generated. It is unclear whether formal academic writing increases that risk. The purpose of this study is to determine the extent to which AI writing detection tools assign higher AI probability scores to formal writing by non-native English speaking students and native English-speaking students compared to conversation writing among non-native and native English-speaking students. It is hypothesized that formal non-native writing receives the highest AI-probability scores and is disproportionately flagged across multiple detection platforms. The methodology will involve each participant providing two human-written samples (one conversational, one formal) in response to standardized prompts to ensure the topic does not affect results. These samples will be submitted to AI detectors such as GPTZero, Originality.ai, Copyleaks, & ZeroGPT, with AI probability scores compared using a two-way ANOVA. It is expected that formal writing and casual writing of native speakers receives lower AI-probability scores, casual writing of non-native speakers receives slightly higher scores, and formal writing of non-native speakers receives the highest scores. This might occur because detectors rely on measuring how predictable text is, which can mistake the academic language of non-native speakers for AI-generated text. Further research should conduct a test to see if this bias persists across specific proficiency levels, and if idiomatic expressions or mild grammatical errors lower AI scores for non-native formal writing.

Henrik Boman

Determining the Effect of Different Humectants on Water Retention and Swelling Ratios of Gelatin-Based Hydrogels for Osteoarthritis Repair



Mentor:
Dr. Marc Kowalsky, MD
ONS

Knee osteoarthritis is a condition in which the articular cartilage erodes over time, impacting nearly 654 million individuals worldwide. Articular cartilage degeneration leads to chronic pain, stiffness, and mobility challenges. Hydrogels are being tested as a non-invasive, injectable approach to providing an environment most similar to a lubricated joint, which in turn may improve symptoms. However, hydrogels must retain a specific level of moisture in order to function properly. If moisture level is too high or too scarce, mechanical properties will be impaired. Humectants are molecules with the capability to retain moisture effectively, however it remains unclear which humectant can most effectively balance water retention without causing excessive swelling. The purpose of this study will be to determine how three different humectants impact the water retention percentage and swelling ratio of a gelatin-based hydrogel. The methodology will include preparing gelatin discs of standardized size and mass with either glycerin, aloe vera, hyaluronic acid or no humectant. Samples will be weighed before and after a period of absorption to determine swelling ratio, and weighed again after a drying period to determine water retention. A one way ANOVA will be used to determine any significant differences between groups. It is expected that glycerin will produce the best balance between water retention and swelling ratios due to its efficient hydrophilic qualities while hyaluronic acid will produce the highest water retention and lead to negative swelling outcomes. Future studies could evaluate the impact of different humectants on elasticity and mechanical strength.

Emilia Borzellino

Determining Whether Frequency and Intensity of Physical Activity Has an Effect on Cognitive Function in Nf1 Mutant *Drosophila melanogaster*



NF1 is a genetic condition, affecting 1 in 3000 births where the NF1 gene, located on chromosome 17, encodes neurofibromin, causing tumors to grow on nerve tissue. Hau et. al (2025) found that NF1 is a condition where there are strong associations with elevated ADHD symptoms. There is no cure, so medication and therapy are the main treatments to help relieve symptoms. Carmen et. al (2025) found that physical activity can be an effective complementary intervention for reducing overall ADHD symptoms. Ontiveros et al (2025) found that frequency of physical activity can reduce the association between ADHD and emotional dysregulation, more than the intensity of physical activity. There is limited research on the connection between physical activity and ADHD in NF1. The purpose of this study will be to investigate whether having high intensity or frequency of physical activity can be used to improve cognitive ability in ADHD in NF1. It will be hypothesized that symptoms would be reduced most when there is a high frequency of physical activity. The methodology will involve the use of Nf1 *Drosophila melanogaster*. These flies have been used in previous studies to model multiple NF1 manifestations and to study ADHD because of their similar brain pathways and ease of genetic manipulation. A power tower will be used to simulate physical activity because it uses the flies' natural instinct to run upwards after being tapped down to the bottom of the tower. The cognitive function of the flies will be measured by an olfactory y-maze. It is expected that Nf1 mutants will have an increase in cognitive functioning when exposed to physical activity. Exercise increases brain derived neurotrophic factor (BDNF), causing cognitive improvement. Further research will investigate the effects of exercise on NF1 on more complex organisms.

Jack Bulfin

Evaluating the Use of a "Floating" Facemask Design on Mitigating Head Impacts



The design of football helmets has changed dramatically over the last decade. Helmets offer designs and technology that are specific to different positions. Despite the rapidly changing designs of helmets, the structure of facemasks on football helmets has not changed for the last decade. Arbogast *et al*. (2024) argues nearly a third of concussions in professional football have come from impacts to the facemask. It is difficult to find ways to mitigate impacts to the facemask because it has to be durable and strong enough to survive multiple hits and to protect the face of the person wearing it, while still absorbing impact on the other parts of the helmet like the sides and back. The purpose of this study will be to determine the effectiveness and limitations of using a "floating" facemask system that features springs, on football helmets. The hypothesis is that the improved facemask design will effectively absorb impact better than currently used helmets. The methodology will involve using the NOCSAE(National Operating Committee on Standards for Athletic Equipment) drop test to test both the helmet with the "floating" facemask and a standard helmet. A pasco pasport accelerometer will be used to track the data of the impact. It is expected that the new facemask design will absorb impact and surpass prior versions of facemasks, ultimately reducing concussions. Future research includes exploring how the facemask will perform under severe weather conditions.

Gabriella Catanzariti

Associations of Lifetime Cognitive Enrichment with Incident Alzheimer Disease Dementia, Cognitive Aging, and Cognitive Resilience in Diverse Populations



Mentor:
Dr. Andrea Zammit
Rush Alzheimer's Disease Center

In 2021, nearly 60 million individuals worldwide suffered from Alzheimer's disease and related dementias (ADRD). In 2019, this cost the US economy $1.3 trillion. Alzheimer's disease is a progressive neurodegenerative disorder which becomes more prevalent with age, and occurs due to a buildup of the protein beta-amyloid, which forms sticky clumps in the brain, as well as the misfolding of the tau protein which leads to neuron death. Symptoms include memory problems,confusion, trouble with everyday tasks, sudden or extreme changes in behavior, and changes in speech and language capabilities. Zammit *et al (202*6) found that participation in cognitively stimulating activities could decrease an individual's risk of developing ADRD by up to 38%, however, this study was done on a population which consisted almost wholly of white Americans, while the same results have not been studied in populations of color nor disabled populations. Thus, the purpose of this study will be to examine the effects of participation in cognitively stimulating activities on the chance an individual will develop ADRD, as well as on the severity of ADRD in a diverse population including white and nonwhite and able-bodied and disabled populations. The methodology will entail accessing deidentified patient data through the RADC Hub. The next step will be to look at diverse population data from cohorts including MAP, MARS, LATC, and PARDoS through the RADC and comparing white, nonwhite, disabled, and able-bodied populations' frequency of participation in cognitively stimulating activities to determine the results of such activities within a diverse populations. It is expected that a more diverse population will experience more drastic changes with participation in cognitively stimulating activities as a result of having less institutional access to such activities to begin with.

Amanda Dedvukaj

Comparing the Impact of Beverage Pigmentation and Acidity on the Optical Clarity and Mechanical Strength of Essix Retainers



Mentor:
Dr. Ilan Shamus, DDS
Ilan Shamus Orthodontics

Essix retainers are clear orthodontic appliances typically made of PETG, which is preferred for long term use due to its transparent appearance having fewer effects on aesthetics. Prior research has demonstrated that these retainers are susceptible to degradation and staining from acids and pigments found in beverages, potentially decreasing performance and longevity of these devices. However, it is unclear whether the acidity or the pigment of a beverage has a larger impact on the optical clarity and mechanical strength of PETG materials. The purpose of this study will be to evaluate whether pigmentation or acidity has a greater effect on the optical clarity and mechanical strength of PETG samples after repeated solution exposure. The methodology will involve soaking samples of PETG in neutral non-pigmented, acidic non-pigmented, neutral pigmented, or acidic pigmented solutions for 30 minutes at a time, 3 times per day, for 6 weeks. Between exposures samples will be covered with an artificial saliva and rinsed after the third exposure each day. At the end of 6 weeks, these samples will be examined under the microscope to assess visible for physical damage and discoloration before undergoing a three-point flexure test to determine bending resistance of the samples. It is expected that samples exposed to the acidic pigmented solutions will show the greatest amount of tears and decreases in mechanical performance and optical clarity. Future research could evaluate the impact of beverage pigmentation and acidity on the mechanical strength of elastomeric chains.

Angelica Escamilla Ancira

The Impact of Early Language Learning on Intercultural Traits in Sixth Grade Language Classes



Mentor:
Dr. Irina Tiurikova
University of Bergen, Norway

Five personality traits that have been shown to help with intercultural success are cultural empathy (empathizing with the feelings and behaviors of culturally diverse individuals), open mindedness (considering ideas that are different to your own), social initiative (actively approaching social situations), flexibility (interpreting new situations as a positive situation and adapting accordingly), and emotional stability (staying calm under new and and stressful conditions). As the world becomes more intertwined, fostering these traits becomes essential. Multilingualism can be defined as the acquisition or the learning of a second language (L2), or third (L3) etc. Previous studies have shown that multilingual identity (one's explicit self-identification as a multilingual) fosters these personality traits as the individual already feels part of the culture associated with the language. The purpose of this study will be to determine if starting the process of learning a new language is enough to foster these intercultural traits rather than explicitly needing a multilingual identity, especially in the US as it is geographically isolated so people often aren't as exposed to learning new languages and cultures. The methodology will entail a longitudinal survey of sixth grade year 1 language classes that will examine changes in intercultural traits using the Multicultural Personality Questionnaire (MPQ) at three intervals (baseline, three months and six months) over a six month period. It is expected that as the sixth graders advance throughout the time period with a consistent exposure to the new language, there will be an increase in the MPQ scores as the curiosity and discovery of the new language will develop the intercultural traits.

Graham Eskrett

Determining the Extent to Which Emotion Regulation and Motivation Predict Burnout in High School Athletes Who Play Individual Versus Team Sports

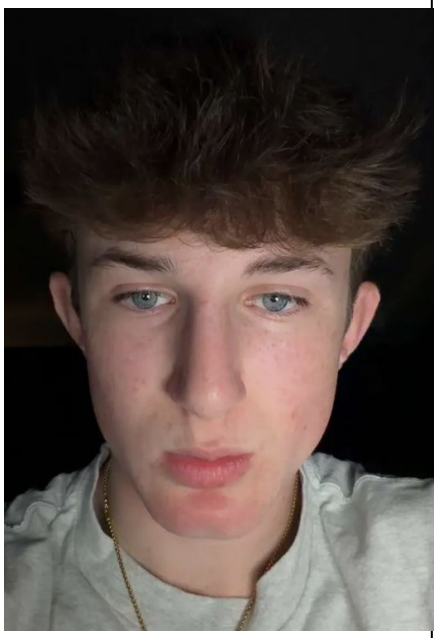


Mentor:
Professor Christine Habeeb
East Carolina University

Athlete burnout is an important issue in sports because it can lead to decreased performance, increased mental health symptoms, and sport dropout. Emotion regulation, the processes individuals use to manage emotions, and motivation, the factors that drive an individual to continue towards a goal, have both been shown to influence burnout. Athletes participating in individual sports often experience pressure that is highly self-directed, whereas athletes in team sports experience a more complex form of pressure due to the added responsibilities of collective team performance and potential teammate disappointment. Few known studies have looked at how emotion regulation and motivation jointly predict burnout among high school athletes, and whether this relationship differs by sport type. The purpose of this study is to determine the extent to which emotion regulation and motivation predict burnout among high school athletes, focusing on whether this relationship differs between those who play individual versus team sports. It is hypothesized that athletes who demonstrate stronger regulation and higher motivation will report lower levels of burnout, and that these effects will be greater among athletes who participate in individual sports. The methodology will involve administering a survey to high school athletes to gather information of their emotion regulation, motivation, burnout, and sport type. Correlation and multiple regression analyses will be conducted to examine whether emotion regulation and motivation predict burnout, and whether the strength of these relationships differs by sport type. Further research could investigate if these relationships differ in college athletes or if factors like family or peer relationships impact burnout.

Derek Graffeo

Examining Differences in the Relationship Between Career Goal Clarity, Academic Motivation, and Engagement Among Underclassmen and Upperclassmen



Many high school students experience career uncertainty when deciding their future career paths. According to OECD (2023), many adolescents lack career goal clarity, meaning they are unable to identify their plans post-high school or their intended profession. When students are unable to connect their future goals with their high school studies, they may experience lower levels of motivation and engagement in school. It is unclear whether a relationship between career goal clarity, academic motivation, and academic engagement differs depending on how far along a student is in high school. The purpose of this study is to assess whether career goal clarity is associated with high school students' academic motivation and engagement, and if this relationship differs between underclassmen and upperclassmen. The methodology will involve administering an anonymous survey to high school students, grouped as underclassmen (grades 9-10) and upperclassmen (grades 11-12). The survey will use Likert-scale statements to measure career goal clarity, academic motivation, and academic engagement. After composite scores are calculated for each variable, Pearson correlations will be used to evaluate relationships between the variables and t-tests will be used to compare scores for underclassmen and upperclassmen. It is expected that students who have greater career goal clarity will report higher levels of motivation and engagement in school, and this relationship will be stronger among upperclassmen, who are closer to making career decisions. Follow Up studies will look more closely at whether career exposure programs improve career goal clarity, motivation and engagement by increasing career awareness for high school students.

Devin Haarsgaard

Examining Whether Bipolar Subtype is Associated with Differences in Medication Treatment Profiles



Bipolar disorder is a mental illness that affects approximately 2.4%-4.4% of people worldwide and can significantly impact an individual's life. Bipolar 1 is a subtype that is characterized by periods of mania and depression, while bipolar 2 is characterized more often by periods of depression and hypomania. Primary treatments for bipolar disorder include antipsychotics, mood stabilizers, and antidepressants, or some combination of these medications. On average it takes 6 years after the onset of the disorder for a person to obtain adequate treatment, often depending on symptom presentation. While treatment is individualized, it's unclear whether real-world clinical approaches differ based on bipolar subtype. The purpose of this study is to examine whether bipolar subtype is associated with differences in medication treatment profiles of bipolar individuals. It is hypothesized that there will be differences in treatment regimens, with individuals with bipolar 1 being prescribed antipsychotics and mood stabilizers more often while individuals with bipolar 2 will more often have antidepressant prescriptions. The methodology will entail accessing de-identified data of bipolar patients from the FondaMental Advanced Center of Expertise-Bipolar Disorder (FACE-BD) study. Individuals that are not prescribed medication, have a dual diagnosis of schizophrenia or borderline personality disorder will be excluded. Participants will be grouped by subtype and treatment types will be categorized by antipsychotics, mood stabilizers, antidepressants, and each combination of medications. Chi-square tests will be used to evaluate whether medication class is significantly associated with subtype. Future research can evaluate whether bipolar subtype is associated with differences in long-term disorder progression.

Jon Hasanramaj

Comparing the Effectiveness of Machine-Learning and Human-Generated Forecasting Models in Reducing Restaurant Over Ordering, Food Waste, and Food-Loss Costs



Restaurants that serve perishable items must determine how much product to order without knowing exact customer demand each week. When restaurants order too much product, unused product leads to food waste and profit loss. Restaurant owners often forecast demand based on human judgment, past experience, and sales patterns related to day of the week, holidays, and season. Machine learning demand forecasting is increasingly used at larger organizations to help reduce loss and maximize profit. Less is known about the effectiveness of these models at reducing wastes and minimizing loss for a small restaurant with limited data. The purpose of this study will be to compare the effectiveness of a machine-learning demand forecast and a human-generated forecast in reducing over ordering, decreasing food waste and minimizing food loss costs for selected perishable items in a small restaurant. It is hypothesized that the machine-learning model will more accurately predict the amount of supply needed. The methodology will entail comparing the two forecasting methods for cod fish, ribeye, and lobster tail. Historical restaurant data will be collected, including amount of product purchased and cost, amount sold and price, amount discarded, starting and ending inventories, shelf life, and day of week. The current human-generated forecasts will be recorded weekly and GoogleColab will be used to train a Random Forest Regression model on the restaurant data to generate weekly predictions. Over the testing period, the cost of each item, amount sold, and amount lost will be used to measure levels of over ordering, waste, and food-loss cost. Further research could evaluate whether machine learning demand forecasting could be applied to other restaurant types.

Charlotte Hazelton

Determining Whether Knee Laxity can be Trained Through the Development of Lower Limb Muscle Mass



Mentor:
Professor Sandra Schultz
UNC Greensboro

The Anterior Cruciate Ligament or ACL, is found in the knee and is a band of fibrous tissue that assists with stability in the joint, extension, and flexion required for running and jumping. When the ACL is injured, it requires surgery to repair the tear. A recovery period is approximately a year to return to play for athletes. Female athletes are on average 5 times more likely to tear their ACL than male athletes. Anatomical differences in females such as the quadriceps angle and smaller femoral notches play a role in ACL injury. Females rely more on the quadriceps muscle which strains the ACL which can cause tears. Female athletes may need to focus on training the hamstring and glutes in order to relieve the stress put on the ACL. Shultz et al. (2016) have found a narrower ACL has greater knee laxity so by training the width of the ACL through lower extremity training of the hamstrings and glutes, the knee laxity should decrease. The purpose of the study will be to determine if training the width of the ACL appropriately (through optimization of lower extremity muscle mass development) would decrease knee laxity rate which would decrease risk of ACL tears in female athletes. The methodology will involve measuring knee laxity and muscle mass using a device called a Mobil-Aider which measures joint laxity by performing Lachman Tests. The study will use female athletes training 2-3 times a week over a 10 week period. Data collection of how much muscle mass is gained and laxity within the knee will occur biweekly. It is expected that the increase in muscle mass which would increase width of the ACL would decrease the amount of joint laxity within a knee lowering the amount of ACL tears. Future research will focus on developing training regimens for female athletes during different phases of the menstrual cycle because of the fluctuation of knee laxity throughout the cycle.

Jennifer Honorio

Determining whether the Consumption of Cacao Decreases Inflammation and Improves Locomotor Performance In *Drosophila melanogaster* with Green Fluorescent Protein



Oxidative stress and inflammation contribute to a decrease in physical performance in organisms. One potential solution is the intake of antioxidant rich foods such as dark chocolate. Antioxidants are supplements that reduce damage caused by reactive oxygen species (ROS), which are harmful molecules that can weaken the overall cell function. Cacao is the main ingredient in dark chocolate and contains flavonoids, an anti-inflammatory compound. Several studies suggest that foods containing cacao may improve physical performance, but it is unclear whether the mechanism is by decreasing inflammation. This study will analyze the effects of cacao on inflammation, and locomotor ability. The hypothesis will be that the higher concentration of cacao, the less inflammation, which will result in improved performance. The mutant *Drosophila melanogaster* that expresses Green Fluorescent Protein (GFP) in the presence of inflammation will be used. A dose response study will be conducted where the Drosophila will be fed 0 grams, 3 grams, and 5 grams of cacao for every 100 mL of cornmeal fly food. Flies raised on the different concentrations will undergo two hours of continuous exercise in a power tower assay to exercise the flies for an extended period of time. The NIGHTSEA fluorescence adaptation to a Zeiss 305 stereo microscope will be used to view GFP expression in the flies, which will then be quantified using IMAGEJ. A negative geotaxis assay will be conducted before and after the power tower to determine change in performance. It is expected that the flies receiving the higher dose of cacao will have a decrease in inflammation and an improvement in climbing ability compared to the control group. Future research will use a luminescence kit to test for improved mitochondrial functioning and will look at if the same results with the *Drosophila melanogaster* apply to more complex organisms.

Kevin Iwanski

How Message Source Affects Public Perception of Controlling Huanglongbing Disease in Florida Using Spinach-Defensin Transgenic GMO in Citrus



Mentors:
Professors Shelli Rampold & Jamie Greig,
University of Tennessee

In the past two decades, Huanglongbing Disease or Citrus Greening Disease has spread in millions of acres of orange farms in Florida causing orange production to decrease by 92.5%. However, GM technologies provide potential solutions to citrus greening, one of which is the Spinach-Defensin GMO. The Spinach-Defensin GMOs are plant-incorporated protectants (PIPs) which are implemented into other plants to produce proteins that combat pathogens. Despite this, GM food, while well understood by science, is not widely understood by the public, leading to skepticism about its safety, and many holding the sentiment that they are generally unsafe. The purpose of this study will be to determine how the message source affects public perception of the use of the Spinach-Defensin GMO in citrus in order to control the Huanglongbing disease problem in Florida. It will demonstrate how the actor from which we receive our information influences people's opinions towards specific recent phenomena. A randomized controlled study will be conducted to determine whether changing the message source that people get their information from will impact how they perceive new GMO technology within the specific context of Florida's citrus crisis. Participants will be obtained through Prolific, a high quality online platform that connects researchers and participants. It is expected that because this is a mostly non-partisan issue that the source credibility will not influence perception of the GMO. However, perception will be influenced by a politician as it makes the issue more partisan and encourages a stronger stance.

Dylan Jonisch

Comparing Airport Wheelchair Options to Improve Air Accessibility



This project will investigate the ways that air travel can be improved for people with locomotor disabilities by measuring wheelchair accessibility and mobility needs in airports. There are many wheelchair users that will face challenges during air travel, including crowded terminals and the risk of damage to personal mobility equipment. The study will begin with a preliminary survey comparing the experiences of bringing a personal wheelchair to the airport or using a wheelchair provided by the airport. The survey will measure which option will better support convenience and overall independence for wheelchair users. It will be hypothesized that personal wheelchairs will provide more comfort and independence, while airport wheelchairs will only offer advantages such as eliminating the risk of damage to personal wheelchairs, and reducing the burden of transporting personal mobility equipment during travel. To collect data, wheelchair users will be surveyed about their airport experiences and preferences. The results will be analyzed to determine the major factors that influence the quality of wheelchair users' travel experiences. Using the findings from this preliminary research, a compact wheelchair will be developed, with the goal of fitting in an airplane overhead compartment while still remaining functional, safe, and comfortable for users. By combining survey research with engineering design, this project will aim to identify a practical solution that could improve airport and airline experiences for individuals with locomotor disabilities.

Neil Kaji

Determining the Effect on Accuracy by Using Zero Nose Extrapolation and Dynamic Decoupling in Bernstein-Vazirani Quantum Circuits



Mentor:
Professor Ning Bao
Northeastern University

Classical computers lack the capabilities of quantum computers. Quantum computers use quantum bits, called qubits, that operate in superposition to represent 0 and 1 simultaneously, enabling more complex computations. However, they experience interference, or noise, that reduces the accuracy of their calculations. Several techniques exist to mitigate this, including Zero Noise Extrapolation (ZNE) and Dynamic Decoupling (DD). ZNE artificially adds noise to measure how accuracy changes, then extrapolates backwards to predict results at zero noise. DD reduces decoherence (a qubit drifting from its original state) by inserting carefully timed pulses. Bernstein-Vazirani is a quantum circuit that finds a hidden binary string in a single query, where a classical computer would require one query per bit. Real quantum hardware is hard to access and can instead be run on a simulator, software provided by companies such as IBM or Google that simulates quantum calculations under easily adjustable conditions. ZNE and DD are widely researched individually, but a gap exists in which both are deployed together. This study will determine the effectiveness of noise mitigation when both ZNE and DD are utilized together. Using the Qiskit Aer simulator, the Bernstein-Vazirani circuit will be run at three different circuit depths: 2, 4, and 6 precision qubits, with noise having a greater effect at higher depths. Each depth will be tested in 4 configurations: no mitigations, DD only, ZNE only, and DD+ZNE. The Bhattacharyya distance and Shannon entropy will measure the accuracy of each configuration's output against the noiseless result. The expected outcome is that DD+ZNE together will outperform either technique alone. Future work involves testing on real quantum hardware.

Mikayla Kalaau

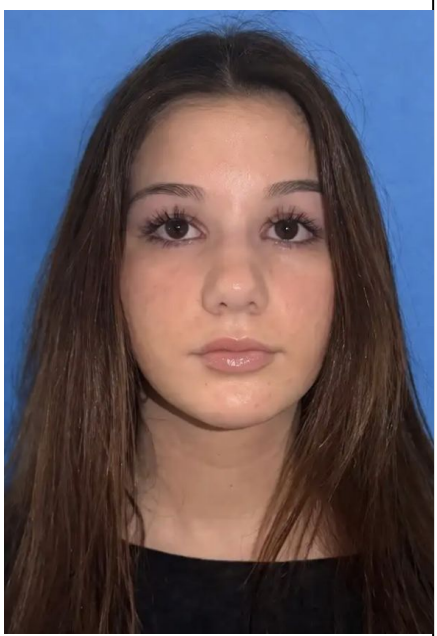
Evaluating Curcumin Paste as a Potential Alternative to Oxybenzone in Sunscreen Formulations



Marine ecosystems are exposed to about 14,000 tons of sunscreen annually. Oxybenzone, a synthetic UVA/UVB filtering chemical, alters coral DNA leading to coral bleaching and affects the health of other marine life. Damaging effects of oxybenzone occur on marine life in concentrations as low as 62 parts per trillion. Thus, scientists are researching potential ingredient replacements that can be biodegraded easier and don't pose danger threats. Curcumin paste is a natural plant pigment obtained from the rhizome of turmeric spice that effectively filters UVA and UVB. The purpose of this study will be to determine the UV absorption capability and the impact of the curcumin paste on ecosystem health. The methodology will include coating photochromic paper with curcumin paste and exposing it to UV light. UV absorption will be assessed every minute for the first 10 minutes, and then every 10 minutes for two hours. In addition, samples of protozoa will be exposed to 0.5%, 1%, 1.5%, 2% concentrations of curcumin and competition, diversity, and population changes will be assessed over a four week period. It is predicted curcumin paste will have similar UV absorption capabilities to oxybenzone, and will have little effect on the competition, diversity, and populations of protozoa making it a better alternative.

Rajna Kalamishi

Determining Whether Sleep Duration Mediates the Relationship Between Social Jetlag and Perceived Stress in High School Students with Significant Time Demands



Approximately 7 in 10 high school students fail to meet their sleep recommendations. Social jetlag, the difference in sleep timing on school nights versus weekends, can contribute to lack of sleep and poor sleep quality. Insufficient sleep has been linked to higher perceived levels of stress and various health issues. Academic workload and athletic commitments could further contribute to these problems by decreasing the time students have available for sleep. While prior research has established social jetlag is associated with higher perceived stress levels among adolescents, it is unclear whether sleep duration explains this relationship or whether it differs among groups with greater time demands. The purpose of this study is to determine whether sleep duration mediates the relationship between social jetlag and perceived stress levels among high school students and whether academic load and athletic status moderate this mediation effect. An anonymous survey will be administered to students grades 9-12 to gather information on average sleep duration, school night and weekend sleep timing, perceived stress levels, academic workload, and athletic status. A mediation analysis will be conducted to determine whether sleep duration explains the relationship between social jetlag and perceived stress. Academic workload and athletic status will be analyzed as potential moderators. It is expected that greater social jetlag will be associated with decreased sleep duration and higher perceived stress, particularly among students with academic or sport related time demands. Further studies could evaluate whether schedule-based interventions or stress management education can reduce the impact of these effects.

James Kaye

Evaluating the Accuracy of a Single-Camera Computer-Vision System for Tracking Repetitions, Sets, and Active-Use Time on Resistance Training Exercises



Accurate workout tracking is an important part of strength training, yet many gym users still rely on manual logging or fitness apps that do not fully capture resistance-training exercises. While computer-vision systems have shown promise in exercise recognition and repetition counting, fewer studies have examined whether a low-cost, single-camera system can reliably track workouts performed on different resistance-training exercises in a realistic gym setting. The purpose of this study will be to evaluate how accurately a single-camera computer-vision system can identify repetitions, segment sets, and measure active-use time across different resistance-training exercises compared with manual video annotation. It will be hypothesized that the system will achieve high accuracy in repetition counting, but slightly lower accuracy in detecting exact set boundaries and active-use time because of pauses, inconsistent pacing, and transitions between sets. The methodology will involve collecting video recordings of participants performing different resistance-training exercises under realistic gym conditions. A single-camera computer-vision system will then analyze the footage to estimate repetition counts, set boundaries, and active-use time. These outputs will be compared with manually annotated video data, which will serve as the reference standard. Accuracy will be assessed by comparing the system's results with human-reviewed counts and timings across multiple exercises. It is expected that the system will perform best on exercises with clear and repetitive movement patterns, while showing reduced accuracy on exercises with more subtle or irregular motion. Further research may investigate how this type of system could be improved to work across a wider range of exercises and gym conditions.

Erin Koyama

Quantifying Stellar Activity in JWST Spectra and Evaluating Small Wavelength Observations for Differentiation



Mentor:
Professor Luis Wellbanks, Arizona State University

The James Webb Space Telescope (JWST) has analyzed the atmospheric compositions of numerous exoplanets using transmission spectroscopy, detecting gaseous molecules such as carbon dioxide, methane, and water vapor, allowing scientists to search for complex life outside of the solar system. Faculae consist of high temperatures while spots consist of cooler temperatures. Both types of stellar contamination can distort the transmission spectra, ultimately leading to inaccurate exoplanet atmosphere characterization. This study will evaluate how much a certain temperature difference between the star and a faculae/spot will alter the spectra of the star, and test whether this will fall in the JWST threshold of 50 ppm. The study will also investigate how smaller wavelength observations will exaggerate the contrast between the transit depth of the star and the stellar activity. The hypothesis is that as the temperature difference between the star and the stellar contamination increases, it will have a more significant effect on the spectra, exceeding the 50 ppm error bar, making it difficult to distinguish stellar contamination. However, by observing this in smaller wavelengths, the activity will be highly detectable, providing a baseline for correcting stellar contamination. The methodology will involve using the PHOENIX simulated data and the Rackham (2018) equation for modeling stellar contamination spectra in terms of transit depth to determine how the temperature of stellar activity affects the spectrum and if the contamination noise will exceed the 50 ppm threshold. This will ensure that the signal is from the planet's atmosphere, not the star's activity. The data of stellar activity will then be observed through NIRISS which can view wavelengths less than 1 micrometers. It is expected that by viewing simulated data through smaller wavelengths, stellar contamination can be filtered and corrected. Future research will investigate more on the need for UV capabilities in the Habitable Worlds Observatory.

Isis Leite

How Cultural Values Influence Attitudes Towards Mental Health and Help-Seeking Behavior



People in different cultures may express distress differently. For example, some cultures have been found to emphasize physical symptoms over mental ones, which can lead to a "category fallacy", where ethnic minorities avoid seeking help for their mental health. These have created gaps in prevalence rates for common mental disorders (CMDs) in ethnic minorities. The purpose of this study is to determine if there is a relationship between cultural values and ethnic groups' attitude towards mental health and how this affects how likely they would be to report emotional symptoms for CMDs. After IRB is obtained, the methodology would include conducting a survey on different ethnic groups to determine how much they prioritize certain cultural values using the Schwartz Cultural Values Scale, and how their cultural values influence their willingness to seek help for mental health symptoms It is expected that ethnic minorities will have a less perceived care for mental health and are less likely to report CMD symptoms.

Michaela Lopane

Evaluating the Extent to Which a Brief Sports Nutrition Intervention Improves the Short-Term Knowledge Retention and Self-Reported Habits of High School Athletes



Mentor:
Jill Gulotta, MS, RDN, LMHC
Jill Gulotta Nutrition

High school athletes frequently demonstrate minimal understanding of sports nutrition, which can negatively affect their athletic performance, recovery, mood, and overall health. Current high school health programs focus on broad nutritional needs as one small component of the curriculum and do not educate student athletes on how their nutritional needs may differ. Although nutrition education has been well studied in athletes, few known studies have assessed whether a brief nutrition intervention can positively impact the nutritional knowledge and fueling habits of high school athletes short-term. The purpose of this study will be to determine the extent to which a brief sports nutrition intervention will improve the short-term nutritional knowledge retention and self-reported habits among high school athletes. The methodology will consist of an initial survey assessing student athletes' demographics, initial nutrition knowledge and current dietary habits. Participants in the experimental group will then attend a sports nutrition intervention providing education on fuel timing before workouts, hydration tips, and the role of key dietary factors, followed immediately by a post-test. The control group will not receive the intervention. One week later, all participants will fill out a follow-up survey to evaluate knowledge retention and self-reported changes in dietary behavior. It is expected that athletes who participate in the intervention will have greater short-term retention and report more positive changes in their dietary habits one week later. Future research will investigate differences in retention and application of knowledge between endurance and strength training athletes, as well as if effects last long-term.

Emanuelli Mata da Silva

Determining Whether Chronic Stress-Related Neurobiological Pathways Associated With PTSD Influence the Production and Accumulation of Amyloid-Beta Plaques



Mentor:
Professor Licia P. Luna
Johns Hopkins Hospital

Post-Traumatic stress disorder (PTSD) is a chronic psychiatric disease that a person can develop after exposure to trauma; this condition can persist for months and even years. Evidence suggests that PTSD may present long-term neurological changes such as amyloid deposition. This is the accumulation of amyloid-beta proteins in the brain, and is strongly associated with Alzheimer's disease. The purpose of this study will be to determine to which extent chronic stress mechanisms observed in PTSD contribute to the increase of amyloid beta production. It will be hypothesized that individuals with PTSD that show hyperactivation in the amygdala and prefrontal cortex will show abnormal cortisol levels, leading to increased amyloid beta production. The methodology will involve using Python to analyze amyloid deposition patterns in pre-existing fMRI imaging data of PTSD patients found in the database, OpenNeuro. It is expected that results will show a direct correlation between PTSD related pathway activity and abnormal amyloid beta accumulation. Future research will involve examining symptom severity and determining whether these symptoms are correlated with amyloid deposition. Understanding this relationship could contribute to identifying early biomarkers and improving diagnosis.

Mira McKell

Developing Sustainable Mycelium-Based Textiles: Evaluating Cross-Linking Agents for Polyester-like Fabric Performance



Mentor:
Dr. Julian Silverman
FIT

The global textile industry generates approximately 92 million tons of waste annually, with nearly 87% of discarded materials ending up in landfills or incinerators and less than 1% being recycled into new garments. In addition, the fashion industry contributes to global carbon emissions, estimated between 2% and 5%. To address this issue, several bio-based textile alternatives have been developed; however, research suggests that these materials do not consistently achieve full biodegradation under natural environmental conditions, indicating that more effective sustainable textiles are still needed. Mycelium-based materials have been studied as a potential sustainable alternative because they can be grown from agricultural waste and processed into biodegradable, leather-like textiles. However, research shows that their mechanical strength and durability are inconsistent, limiting practical use. In other studies, cross-linking agents have been used in bioplastics to enhance properties such as mechanical strength, stability, and water resistance. The purpose of this study will be to determine if cross-linking agents can be used to develop an improved mycelium-based fabric with polyester-like properties. The methodology will involve testing two cross-linking agents--citric acid and tannic acid--at high and low concentrations. The success of each material will be determined by examining surface morphology using a stereo microscope, measuring water absorption, testing mechanical strength and flexibility, assessing thermal and insulative properties, and evaluating biodegradability in soil and water environments. Future research will focus on testing combinations of cross-linking agents to optimize the mechanical, insulative, and biodegradable properties of mycelium-based fabrics, aiming to develop a sustainable material that closely mimics the performance and qualities of polyester textiles.

Henry Murphy

Creating Affordable Hydroponics Systems: Examining the Capability of a Low-Cost Soilless Production Platform Built from Recycled Materials for Deployment in Food-Scarce Communities



Hydroponics is a form of soilless food production that can supply high yields while requiring low maintenance. It consumes only a fraction of the land and less than 10% of the water, compared to traditional soil-based agriculture. This means that the technology is environmentally beneficial due to lower resource consumption, with the possibility of improving global environmental conditions if deployed on a large scale. However, due to high front-end financial burdens, these systems remain largely inaccessible to food-scarce communities, which would greatly benefit from the supplementation of increased food production. The purpose of this study will be to determine the feasibility and potential impact of using recycled components in the development of a hydroponics system, specifically whether hydroponics is a suitable medium for food production while remaining sustainable and low-cost. The methodology will involve utilizing various recycled and affordable materials to develop system components, including a water pump and filter. The system monitoring will be performed through an IoT sensor system connected to an Arduino relayed to a Raspberry Pi for data uploading, to determine the system's ability to maintain suitable conditions for lettuce growing and the yield of the lettuce. The yield and maintenance of the environmental conditions of the recycled hydroponics system will be compared to existing systems. Performance-to-environmental impact ratios will be evaluated. Future work will involve adding solar panels to improve sustainability through the use of a green energy source. The ultimate design will run off a sustainable source of electricity while also being affordable, addressing sustainability, and accessibility.

Eric Myung

Modeling the Impact of a Housing First Reform Approach on Emergency Department Usage



Emergency department usages in homeless populations cost over $9.9 billion dollars annually, which can be reduced by nearly 50% with supportive housing, with the average individual visiting five times a year for an average of three nights each. The purpose of this study will be to model the impact of a Housing First reform approach on emergency department usages for influenza and other viral diseases in unhoused populations and how that would impact homeless spending. This will be accomplished by comparing data from data.gov websites on influenza and Covid related illness (CRI) emergency department (ED) visits in cities with large homeless populations against cities with smaller homeless populations, and additionally comparing the ED visits in cities with Housing First programs as opposed to those without. It is expected that ED visits will be reduced by Housing First programs, and likely, those will reduce homeless spending in cities.

Giuliana Palmisano

Determining the Influence of State-Controlled Media Narratives on AI Model Outputs



Mentor:
Dr. Meg Young
Data & Society

State-run media allows governments to control narratives and disseminate viewpoints in order to promote state agendas, limiting freedom of the press. One example of this is in Bulgaria, where press freedom is fragile and unstable, and people's individual media rights are being restricted. Additionally, Bulgaria is implementing the “Concept for the Development of Artificial Intelligence in Bulgaria until 2030,” to drive economic growth, modernize public services, and align with EU digital transformation goals. However, if these models are trained on government-controlled data, then there is a high risk of the models lacking diverse perspectives. The purpose of this study will be to investigate whether artificial intelligence models will provide varied viewpoints on Bulgarian news, where media rights are limited, compared to the US, where press freedom is greater. The methodology will entail asking different AI models generalized prompts about political issues in both countries and analyzing any signs of bias. It is expected that the models will lack diverse perspectives and rely more on government narratives when discussing Bulgarian news than US news. Further research will investigate whether the language in which the AI models are prompted (Bulgarian or English) will change the descriptions of the media.

Gabrielle Pasquale

Identifying the Effect of Cordial Approaches to Politics in Politically Diverse Households on Fostering Open Mindedness in Children



Mentor:
Mr. Jack Kelly
Harvard University

Household interactions shape children's personality, mentality, and outlook on life. Political conversation in the home has shown to benefit cognitive development in children as it exposes them to nuanced and complex ideas. Research suggests that diverse political affiliations in parents that represent different sides of an issue can positively affect child development and impact open mindedness. Open mindedness can be quantified by thoughtful consideration for diverse views or opinions, openness to new ideas and willingness to participate and new experiences. The purpose of this study is to determine whether growing up in “politically diverse households” can foster open mindedness in children or youth. The study would compare how hostile versus cordial behavior between parents on opposing political views can impact “Open mindedness”. A multiple regression analysis will be performed to determine whether cordiality in parental conversations is a significant predictor of open-mindedness in their adolescent children.. After IRB approval, and participant consent is obtained, surveys will be distributed to adolescents who will be asked to rate how similar their parents’ political views are to each other, and how cordially their parents’ approach political conversations. Then, the adolescent will take the Stanovich and West AOT scale to determine their level of open mindedness. The study will match adolescents from politically similar households to those from politically diverse households with similar characteristics of household life and socioeconomic status. It is expected that children with parents of diverging political affiliation approached cordially will exhibit more open mindedness than those with parents of agreeing political parties or hostile approaches. Implications include that parenting styles and approaches to complex conversations can shape adolescent’s open mindedness which fosters empathy for others/ different viewpoints; both essential traits for establishing political stances.

Gia Pinilla

Analyzing Differential Gene Expression of Apoptosis and Neuroinflammation-Related Genes for Rats Exposed to Sevoflurane



POCD (Post-operative cognitive dysfunction) is when a patient shows a decline in memory, attention, and executive function that persists for weeks or months post-operation. Sevoflurane, a commonly used anesthetic, has been connected to decreased neurogenesis and increased apoptosis and neurotoxicity. Because the hippocampus plays a role in memory and learning, changes in gene expression in this brain region may help explain how molecular pathways contribute to these symptoms. However, it is unclear which specific genes related to neuroinflammation, oxidative stress, and apoptosis may be affected. The purpose of this study is to determine if sevoflurane exposure is associated with differences in gene expression of neuroinflammation, oxidative stress, and apoptosis-related genes in rat hippocampal tissue. It will be hypothesized that selected neuroinflammation, oxidative stress, and apoptosis-related genes will be upregulated in the sevoflurane exposed tissue compared to controls. Public transcriptomic datasets from the NCBI Gene Expression Omnibus (GEO) will be analyzed to compare control and sevoflurane-exposed rat hippocampal tissue. Differential gene expression will be determined using GEO2R based on log fold change and adjusted p-values. Genes will then be categorized using gene-function databases. Differences could provide insight into how sevoflurane activates molecular pathways that lead to neuronal stress and damage. Future studies could test whether these differences in gene expression lead to measurable memory differences in animal models.

Madelyn Polenberg

Comparing the Epigenetic Effects of PTSD from World Trade Center First Responders to Survivors of Other Types of Trauma



Post Traumatic Stress Disorder (PTSD) is a chronic mental disorder that can be found as a response in victims of traumatic events. With symptoms that can impact the daily life of those who have it, this is a very significant disorder that affects 7-8% of the population in the US. Gene expression patterns in the blood are consistent with those in the brain and may provide biomarkers for PTSD. Kuan et al (2019) found that four kinds of immune cells (CD4T, CD8T, B cells, and monocytes) had distinct gene expression patterns with World Trade Center survivors with PTSD compared to non-PTSD. Studying genetic alterations in isolated immune cell subsets may provide a clearer understanding of the link between PTSD and immune functioning. However, it is unclear if these biomarkers are unique to those who survived the WTC attacks or if they are universal for PTSD survivors. The methodology will include comparing data of these biomarkers in WTC survivors to other PTSD survivors from different events. With further research, there could be similarities seen which could lead to a deeper understanding of PTSD and biomarkers.

Mentor:
Professor Sean Clouston
Stony Brook Medicine

Joseph Portocarrero

Determining Whether Microplastics Affect the Bioaccumulation of a Hydrophobic Contaminant Surrogate in *Enchytraeus albidus* Under Terrestrial Soil Conditions



Microplastics are tiny plastic particles that range in size from 1 μm to 5 mm. Most microplastic research focuses on the marine ecosystems, with a considerable lack of research on terrestrial ecosystems. Experts estimate that there are 4-23 times as many microplastics in terrestrial ecosystems than in marine ones. Therefore, it is key to understand how microplastics can affect contaminant movement between terrestrial soil and decomposers. The organism *Enchytraeus albidus* (white pot-worm) is an appropriate model organism, as it is an established decomposer in terrestrial soil and has a translucent body that supports analysis of the uptake of fluorescent substances. Hydrophobic organic contaminants (HOCs) are known to be toxic, and since they can adhere to microplastics, can more easily translocate into organisms. Therefore, this study will be conducted to determine whether microplastics affect the accumulation of curcumin, a safe HOC surrogate, in *E. albidus* under terrestrial soil conditions. The hypothesis is that when microplastics and curcumin are co-exposed, there will be an increase in uptake from the soil to the worms, compared to curcumin alone. The methodology will involve exposing *E. albidus* to either control soil, soil with only polystyrene (PS) microspheres, soil with only curcumin, and soil with curcumin-coated PS microspheres for 28 days. Following exposure, each group's worms will be removed, washed, and left for 48 hours to allow for gut clearing. Worms will be viewed under a UV lamp, and ImageJ will be used to quantify levels of PS microsphere and curcumin accumulation. Future research could incorporate plants and other decomposers into the microcosm to obtain results under more realistic ecosystem conditions.

Polina Rakita

Genetic Characterization of the Autonomic Heart–Brain Axis in Neurodegenerative Diseases



Mentor:
Dr Natalia S Ogonowski
The University of Queensland

Neurodegenerative disorders are conditions that progress slowly over time damaging the brain. Cardiovascular disease is a group of diseases affecting heart and blood vessels. It is estimated that 7 million adults are diagnosed with a neurodegenerative disorder while almost half of the adults in the U.S. have some form of heart disease. These numbers are expected to increase in the future due to the aging population. Neither condition is curable, however measures can be taken to reduce their risk and impact. The heart and the brain are tightly connected through the autonomic nervous system which is a series of nerves that runs through the body, controlling unconscious actions. Previous studies have demonstrated connections between cardiac structure and brain traits however specific mechanisms linking the two together, especially the genetic underpinnings of the brain-heart axis are not completely understood. The purpose of this study will be to characterize the genetic architecture of the autonomic brain-heart axis while focusing on the relationship between central brain regions, cardiac electrical activity, and left ventricular function. The methodology will consist using the Genome Wide Association Study (GWAS), to determine which part of the genome is associated with each condition, and to determine if there is overlap. It is expected that this study will result in identifying the link between autonomic brain regions and cardiac traits, in addition to evidence connecting the brain-heart axis to disease-related traits.

Jack Salemo

How Sensory Processing and Executive Functioning Differ Between Adolescents and Young Adults with ADHD Traits



Mentor:
Dr. Marcel Schulze
University Hospital
Bonn, Germany

Attention Deficit Hyperactivity Disorder (ADHD) is a common neurodevelopmental disorder. Symptoms include difficulty with executive functioning skills including staying focused, disorganization, chronic procrastination, and restlessness. Sensory processing is how the nervous system receives and organizes information and how it responds to sensory input from the environment. In children with ADHD sensory processing is delayed. Given that sensory association areas of the brain have extensive connections with the prefrontal cortex, it is possible that executive functioning is also delayed. It is unclear if executive functioning will improve as sensory processing develops in individuals with ADHD. The purpose of this study will be to understand how sensory processing and executive functioning affects high school aged students (14-17 year olds) versus young adults (20 -22 year olds) in individuals exhibiting ADHD traits. It is hypothesized that Sensory Processing and Executive functioning will have a more profound effect at age 14-17 because sensory processing is the basis of cognitive functioning, and sensory processing is delayed in individuals with ADHD. The methods will involve surveying adolescents and young adults. ADHD traits will be accessed using ADHD Rating Scale 5, Conners 4. Sensory processing will be accessed using the Adolescent/Adult Sensory Profile (AASP), executive functioning will be assessed by using BRIEF-2 and the strengths and Difficulties Questionnaire (SDQ) will assess behavior. It is expected that the older individuals will exhibit better executive functioning skills because they will have time to overcome sensory processing delays.

Julian Satate

Determining the Extent to which Resilience Predicts Pride Among Minority-Minority Multiracials



Mentor:
Dr. Mark Cleveland
The University
of Western Ontario

A race is a group of people who share characteristics physically, such as facial features, or the color of their skin. Mixed-race is a category of people who have parents that are of two different races. Among this group, there are minority-minority individuals ('double minorities') who have ancestry from multiple racial groups that are not in the majority. Identity-based challenges may affect mixed-race individuals' distress levels. One such factor relates to the notion of Racial Imposter Syndrome. This is when people feel fraudulent about their racial identity based on external perceptions. Resilience among mixed-race individuals is defined as persevering through challenges associated with being mixed race such as identity, culture, and social aspects. Pride is having satisfaction about being mixed race. Within the mixed-race category, double minorities may feel marginalized, and so they'd have more to overcome feeling fraudulent about their racial identity, leading to more pride being developed. The purpose of this study will be to determine the extent to which resilience predicts pride among minority-minority multiracials. A sample will be recruited from Prolific, in order to obtain a cross-section of individuals from various combinations of minority-minority mixed races. The MCRS (Multiracial Challenges and Resilience Scale) will be used to assess factors such as multiracial pride, challenges with racial identity, appreciation of diversity in humans, family acceptance, and discrimination. All of these factors will be used to determine resilience. Then, the pride section of Mark Cleveland's MRI Scale will be used to assess the individuals' pride. A linear regression will be conducted to measure how strongly resilience associates with pride and an ANCOVA will be used to compare differences between different minority-minority multiracial groups . Future research will compare the cultural distance between the parents of minority-minority children to determine how it affects the child's resilience.

Nico Siega

Determining Whether Nighttime Screen Use Moderates the Relationship Between Insomnia Symptoms and Wellbeing in High School Students



Over 70% of U.S. high school students do not get the recommended 8-10 hours of sleep, which can contribute to declines in well being. Insomnia symptoms include difficulty falling asleep or staying asleep and wellbeing is one's state of mental and social wellness. Prior studies have found that increased insomnia symptoms are associated with decreased wellbeing levels and that increased screen use before bed is associated with increased levels of insomnia symptoms and lower wellbeing. However, it is unclear if nighttime screen use before bed strengthens the relationship between insomnia symptoms and wellbeing in teenagers. The purpose of this study will be to determine if night time screen use before bed moderates the relationship between insomnia symptoms and wellbeing. It is hypothesized that the relationship between insomnia symptoms and wellbeing will be stronger among teens with higher levels of nighttime screen use. The methodology is an anonymous survey administered to high school students measuring night time screen time use, sleep quality and well being. Screen time levels will be measured using the Adolescent Sleep Hygiene Scale, insomnia will be measured using the Insomnia Severity Index, and wellbeing will be measured using the WHO-5 Well-Being Index. A moderation analysis will be conducted to evaluate whether the relationship between insomnia and wellbeing is stronger among students with greater levels of nighttime screen use. Further research could investigate mechanisms that explain the relationships between the variables.

Zoe Singer

Determining Whether Sleep Deprivation Contributes to Locomotor Deficits in Aβ-42 Transgenic *Drosophila melanogaster*



Mentor:
Professor Paul J. Shaw
Washington University in St. Louis

Approximately 30% of adults suffer from sleep deprivation, with 10% experiencing chronic insomnia. Insomnia is a common sleep disorder characterized by persistent difficulty falling asleep, staying asleep, or periodically waking up throughout the night. Sleep deprivation is detrimental because during the sleep cycle, the brain removes toxins which include amyloid-beta plaques and Tau proteins which are associated with Alzheimer's disease. The purpose of this study will be to determine if sleep deprivation in Aβ-42 transgenic *Drosophila melanogaster* can increase the risk of developing Alzheimer-like symptoms in a shorter period of time than non-sleep deprived mutants. This gene expresses the human amyloid-beta peptide in the flies, which significantly reduces cognitive function and motor activity. It will be hypothesized that the sleep deprived *Drosophila melanogaster* stock will develop locomotor deficits in a shorter period of time than the non-sleep deprived stock. Methods will entail sleep depriving Aβ-42 mutant flies by continuously stimulating them using an adapted version of Tinkerhess's power tower, and comparing their locomotor performance in a negative geotaxis assay at days 1, 5, 10, 15, and 20 days of life. Further research will use immunohistochemistry to track amyloid-beta plaques in sleep deprived Aβ-42 transgenic *Drosophila melanogaster* brains to see if sleep deprivation increases the deposition of these plaques over time.

Shaili Singh

Determining Differentially Expressed Genes Associated with Hydroxyurea Response in Beta-Hemoglobinopathies



Beta-hemoglobinopathies are a group of blood disorders that arise from mutations affecting the beta subunit of adult hemoglobin. Because fetal hemoglobin (HbF) lacks a beta subunit, inducing production of HbF in adult erythrocytes reduces symptoms of beta-hemoglobinopathies. Hydroxyurea (HU) is one of the most widely used agents for pharmacologically inducing HbF production in beta-hemoglobinopathy patients. However, patient response to HU varies considerably and the broader gene pattern that distinguishes responders of HU from nonresponders remains inadequately understood. The purpose of this study will be to determine differentially expressed genes between HU responders and nonresponders among patients with beta-hemoglobinopathies. It is hypothesized that responders will show lower expression of BCL11A, a repressor of HBG, compared to nonresponders, and that additional differentially expressed genes will be identified. The methodology will entail utilizing publicly available transcriptomic datasets to compare adult erythroid cell gene expression between HU responders (patients with HbF levels at or above 20% 180 days after drug administration) and nonresponders (patients with HbF levels below 20% 180 days after drug administration). The transcriptomes of these groups will be analyzed using transcriptomics to identify genes that are consistently and significantly upregulated or downregulated. It is expected that BCL11A will be differentially expressed with higher levels of its mRNA in nonresponders and lower levels of BCL11A mRNA in responders. Findings could reveal genes that are downregulated or upregulated by HU, contributing to our understanding of the mechanism by which HU induces HbF. Future research could validate identified genes using wet-lab techniques and explore these genes as therapeutic targets for improved HbF inducing treatments.

Cooper Steinberg

Improving Cardiac Emergency Response Through GIS Mapping and Accessibility of Automated External Defibrillators (AEDs)



Mentor:
Ms. Ana Hiraldo-Gomez
Westchester County Department of Information Technology

Sudden cardiac arrest (SCA) is one of the major causes of death worldwide, and survival rates statistically decrease when the use of a defibrillator is delayed. Automated External Defibrillators (AEDs) are important in increasing the rates of survival; however, their accessibility and public awareness are limitations to their success. Failure to locate or properly use an AED can increase the delays that occur in sudden cardiac arrest situations, which could potentially be life-threatening as seconds go by. The purpose of this study will be to investigate how Geographic Information Systems (GIS) can be utilized to improve the accessibility and visibility of AED locations to the public within a suburban, New York community. The hypothesis will be that mapping AED locations will improve emergency response times and reveal locations where AEDs are not so easily accessible. The methodology will include collecting data on the locations of AEDs within a town and then inserting this data into the GIS platform, which will create a visual, comprehensive map. The study will then investigate the potential to integrate the GIS data into a working mobile app which will be able to provide directions to the nearest AED to your location as well as instructions on how to use it. This research can be crucial to improving public safety by helping individuals locate AEDs in emergency situations and providing an evidence-based framework for refined AED placement and increasing awareness of AEDs.

Daniela Udell

Evaluating *Neurospora intermedia* Fermentation as a Method for Converting Local Food Waste into Protein-Rich Biomass



Mentor:
Andrew Luzmore
Blue Hill at Stone Barns

About 37% of food is wasted post-harvest annually in Sub-Saharan Africa due to inefficient supply chains, lack of infrastructure to prevent spoilage, and poor handling. Simultaneously, around 20% of citizens experience a protein deficit as they rely heavily on starch-based crops such as fruits, vegetables, cereals, grains, and maize. *Neurospora intermedia* is a filamentous fungus that thrives on food remnants and improves nutritional value by digesting complex polysaccharides, forming hyphae that are protein-rich. It is unclear how effective *N. intermedia* fermentation is at enhancing the protein content of starch-heavy food wastes common to Sub-Saharan Africa. The purpose of this study will be to determine whether *N. intermedia* fermentation is an effective method for enhancing the protein content of common food waste streams in Sub-Saharan Africa. The methodology will involve the cultivation of *N. intermedia* on local starch-based food waste such as maize, sorghum, banana, and cassava. Substrates will be sterilized and inoculated with *N. intermedia* and protein content will be measured using the Bradford assay once the fungus has grown on the substrate for 6 days. Additionally, a cost-benefit analysis will be conducted to determine if this method is an economically viable solution compared to current methods for protein supplementation. It is expected that fermented maize will yield the highest protein content as it is highest in starch, which would support fermentation, and has a moderate protein content originally. Future research can evaluate the safety and the shelf-life of *N. intermedia* biomass.

Daniel Wellisch

The Impact of Ambient AI on Clinical Documentation and Physician Burnout



Physicians working in the United States typically work about fifty hours per week. Many doctors exceed that with some exceeding sixty weekly. In addition to direct patient care, doctors spend around 13 hours weekly to document interactions with patients and enter orders into electronic health records (EHRs)(American Medical Association [AMA], 2024). Consequently, many doctors complete clinical notes at home or post hours which creates less time for families and personal life. The AMA (2024) reports more than forty-three percent of doctors in the U.S. experience burnout. MGMA (2024) found twenty-seven percent of medical groups experienced loss of at least one doctor from early retirement due to burnout. The Association of American Medical Colleges estimates a shortage of eighty-six thousand physicians by 2036, and burnout related attrition will contribute significantly to this deficit. Ambient Artificial Intelligence (AI) utilizing Automatic Speech Recognition (ASR) and Natural Language Processing (NLP) to record doctor/patient conversations and create clinical notes within EHR systems is emerging as a possible solution. This study will investigate the impact of Ambient AI on physician burnout, documentation time, workflow efficiency, and job satisfaction with local outpatient clinicians. It is expected that physicians that utilize Ambient AI tools demonstrate reduced burnout, lower documentation burden, and improved work/life balance. Methodology will include conducting a survey of physicians on their experience before and after using ambient AI in patient encounters. The survey will measure burnout via the Maslach Burnout Inventory (MBI), fulfillment via the Stanford Professional Fulfillment Index (SPFI), distress via the Well-Being Index (WBI), and sleep quality via the Epworth Sleepiness Scale (ESS), in addition to self-reporting documentation times. It is anticipated that physicians utilizing Ambient AI will exhibit quantifiable reductions in burnout and documentation times. Future studies will investigate long term implications of these tools on physician well-being.

Liam Wellisch

Assessing Population-Level Genetic Resilience to Climate Change Using Protective Allele Frequencies



Mentor:
Dr. Matthew Hansen
University of Pennsylvania
Perelman School of Medicine

By 2100, the global temperatures are expected to rise by 3°C or higher due to global warming. The purpose of this study is to assess the future risk of populations based on their genetic vulnerabilities as global temperatures rise. For example, the gene TRPV1 rs8065080 is associated with variations in sensitivity to hot and cold pain, and so, individuals homozygous for the allele also show remarkable sensitivity to heat. Existing catalogs, such as PHEWAS and GWAS, will be used to find genes associated with temperature sensitivities. Ensembl will be used to access gene frequencies of global populations for the selected genes. Gene frequency spreadsheets will be sorted from lowest to highest based on the population's odds ratio. A polygenic risk score (PRS) will be calculated for all populations to assess overall risk throughout all the genes. A PRS of >0 means a population is at elevated risk compared to the global average. Carbon Brief will be used to determine the amount of warming since the 1800s and the high, low, and average temperature change predictions by 2100 for the locations of the nearest cities to each population. A histogram will be constructed to visualize the average temperature projection by 2100 for the global populations. Any city projected to have an average temperature in the top third will be considered at high risk. If a population is below the global average for the majority of the genes and also temperature-wise, it is at risk. An extension to this study would be to assess the same populations' future risk for other conditions, such as UV, by looking at frequency data for relevant genes (using PHEWAS and GWAS to aid selection).

Madelyn Wiesner

Evaluating Protective Matrices for Enhancing the Stability and Color-Sensing Response of Anthocyanin-Based pH Indicator Strips



Mentor:
Professor Ken Suslick, PhD
University of Illinois

In low-resource communities, many schools and farmers do not have the necessary materials to conduct classroom or soil pH testing. The expense and limited availability of commercial pH indicators contribute to this problem. Low-cost natural indicators exist, but their instability limits practical use. Anthocyanins are natural purple pigments found in fruits, vegetables, and other plants. Previous studies have shown that these pigments change color based on acidity and alkalinity, allowing them to act as natural pH indicators. While anthocyanin dyes are widely available, inexpensive, and biodegradable, they are highly susceptible to degradation by light and air. It remains unclear whether a protective matrix could improve stability while maintaining pH response accuracy. The purpose of this study is to evaluate which matrix best protects anthocyanin dyes from light and air degradation while maintaining accuracy in response to pH solutions. The hypothesis is that beeswax would provide the most effective protection because of its hydrophobic properties. However, more protection may negatively affect pH response and weaken the color change. The methodology will involve extracting anthocyanin dye from red cabbage and absorbing it into paper strips. Gelatin, cornstarch, and beeswax will be used to coat the strips, with an uncoated strip as a control. All strips will be exposed to air and light over a one month period and tested at weekly intervals with acidic and basic solutions. A standardized visual scale and a reference color chart will be used to measure pH response accuracy and color stability. A two way ANOVA will be used to compare coating types and exposure time of both pH and color stability responses. Further research will investigate the use of protective matrices in water to evaluate if strips maintain accuracy when used in real water samples.

Adriano Yarasca

Determining the Extent to Which Human-Canine Bond Quality Predicts Learning Rate, Response Latency, and Success Rate of a Novel Training Task in Household Dogs

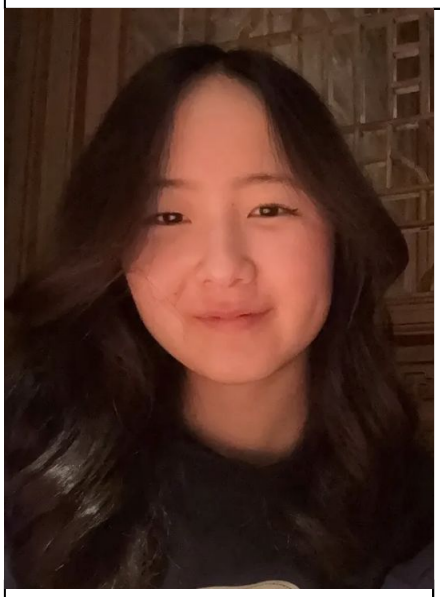


Mentor:
Sky Sobol
Boise State University

Research on canine thought processes and learning highlights substantial variation in how domestic dogs acquire new behaviors, even when consistent training techniques are applied. Although genetic and environmental factors have been identified as influential factors for learning, less is known about whether relationship quality between dog-owner pairs predicts learning outcomes in at-home training environments. The purpose of this study is to determine the extent to which human-canine bond quality predicts learning rate, response latency, and success rate during a novel training task in household dogs. It is hypothesized that high-quality bond pairs will display higher learning rates, lower average response latency, and higher Level 3 success rates compared to low-moderate-quality bond pairs. The methodology will consist of 20 owners and their dogs, older than 12 months, completing the Monash Dog Owner Relationship Scale(MDORS) to categorize bond strength between pairs. Owners will then implement a standardized seven-day training procedure with their dog for the novel task of "Box Stay" using materials provided. Progress will be recorded for 3 levels of achievement: Level 1 (nose contact with the box and sniffing), Level 2 (one paw entry), and level 3 (2 paws in box for 2 seconds). Data will be collected for 10 daily trials, with response latency, success rate, and learning rate (number of trials to reach Level 3) recorded for each. Learning rate, average response latency, and Level 3 success rate will be compared between high-bond and low-moderate bond pairs. Future studies could test a larger sample and explore whether differences in dog breeds, genders, or age predicts training success.

Olive Yoo

Determining the Effect of Petunidin on Locomotor Ability and Lifespan in Dystrophin *Drosophila melanogaster* Mutants



Mentor:
Professor Laura Johnston
Columbia University

Muscular Dystrophy (MD) is a genetic disorder that causes progressive muscle weakness, wasting, and degeneration. This is caused by a mutation in the human Dystrophin gene (DMD). In normal functioning, the DMD gene produces the protein dystrophin, which provides stability to muscle cell membranes during contractions. A damaged DMD gene will produce little to no dystrophin, which removes the physical support provided to the cells, causing deterioration of the muscles. *Drosophila melanogaster* is a valid model for studying MD. Anthocyanidins, natural plant pigments, have shown to improve muscle health by lowering inflammation and oxidative stress. However, it is unclear if petunidin, a type of stable anthocyanidin with high antioxidant levels, can improve muscle dystrophy symptoms. The purpose of this study will be to determine if petunidin can restore muscle function in *Drosophila melanogaster*. It is hypothesized that the lifespan of *Drosophila* will increase and performance in the negative geotaxis will improve. The methodology will involve a mutated UAS-RNAi-Dys mutant being crossed with a muscle GAL4 to produce flies that don't create enough dystrophin. After being separated into male and female groups, the flies will be fed dosages of blackberry powder, as it has a high petunidin concentration. The tested 0, 12.5, 25, and 50 µg/mL will be incorporated into homemade cornmeal fly food (BDSC). The flies will be subjected to a negative geotaxis test where their performance will be analyzed, Kaplan-Meier curves will be constructed to predict survivability rates. It is expected that the petunidin will rescue the effects of MD, with implications of the study helping to understand the cellular mechanisms by which anthocyanidins decrease oxidative stress.

Alicia Zihenni

Examining the Relationship Between Interpersonal Racism and Education Status, with Food Insecurity and Residence in a Food Desert



Mentor:
Dr. Nekabari Sigalo
University of Maryland

In 2024, 13.7% of U.S households were food insecure and 17.4% of the U.S population lived in food deserts. The rates of food insecurity for black and latinx households was nearly double the rate of White, non-latinx households. Furthermore, food deserts, geographical areas in which communities experience difficulty accessing supermarkets that sell healthy foods, are predominantly located in black and brown communities. Food insecurity, as defined by The U.S. Department of Agriculture (USDA), can be subdivided into low-food security and very low food security and it is a condition where the access to nutritious food is limited or uncertain. The purpose of this study is to determine the link between education status and interpersonal racism, a type of racism where individuals from minority groups are harmed or diminished by socially and politically dominant racial groups, with living in a food desert and/or experiencing food insecurity. Essentially, this study's main function is to dictate some of the various reasons why black and brown communities are disproportionately impacted by food insecurity and living in food deserts.The methodology will involve analyzing pre existing datasets that include variables such as experiences of discrimination, food insecurity status, education status and geographic information (e.g., latitude and longitude) to determine food desert status. Correlational analyses will then be conducted to examine the relationships between these variables while controlling for other factors such as gender, age, and more. Future studies can evaluate if there are gender disparities and/or mental health disparities among people who are food insecure and/or living in a food desert.





HARRISON HIGH SCHOOL
SCIENCE SYMPOSIUM

Some questions to ask students as you visit their posters:

1. **How did you get your idea? Why were you interested?**
2. **Did you work with a mentor?**
3. **What was the most rewarding part of your research?**
4. **What was the most challenging part of your research?**
5. **What are your next steps?**

Special Thanks:

The students and faculty of the Harrison Science Research program thank you for coming to this year's Symposium.

We hope you enjoyed the night as much as we enjoyed sharing our work with you!

Questions:

If you have any questions about the Research Program and/or tonight's event, please contact:
Ms. Allison Blunt at: blunta@harrisoncsd.org
Ms. Mary Blount at: blountm@harrisoncsd.org